Three Essays in Banking:

Corporate Governance and Corporate Finance

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To my inspiring mother,

For her sacrifice and courage

"Strive for progress, not perfection"

Abstract

This thesis contains three empirical studies in banking: corporate governance and corporate finance. Specifically, I develop three independent yet related research questions to address the criticism over high Chief Executive Officers (CEOs) compensation, understand how executive compensation and financing decisions in the banking sector work under various exogenous shocks and whether banks manage to maintain their current favourable ratings through financing decisions.

The first empirical study (Chapter 3) examines the determinants and consequences of U.S. bank CEOs forgoing bonus during the 2007 - 2009 financial crisis. We find that CEOs are more likely to forgo bonus if their banks are larger and better governed, consistent with political cost and corporate information environment hypotheses. Subsequent to bonus forgoing, these CEOs total compensation are not negatively affected, they are less likely to depart, and their bank performance is not economically improved. The results shed light to the debate on CEO compensation and support compensation "shareholder value view", suggesting that forgoing bonus is a temporary decision and has little economic impact on bank's performance.

The second empirical chapter (Chapter 4) uses a unique dataset of mortgage origination at loan level in the bank holding companies (BHC) operating in the USA, this study examine how incentive mechanisms embedded in CEO cash bonuses influenced the origination of risky mortgages prior to the housing market collapse of 2008–2009. We find that banks were more likely to deny risky mortgages when CEOs' cash bonus represented a higher proportion of total compensation. The findings are robust to exogenous shocks such as proximity to terrorist attacks and the adoption of FAS 123R. By identifying changes in cash bonus instigated by these shocks we show that banks located near the attacks preferred cash bonus over other forms of compensation, and that cash bonuses increased following the change of accounting policy. Taken together, these findings suggest that cash bonus mitigated the origination of risky mortgages, consistent with theories and empirical studies that predict that the incentive to take risks reduces when cash bonus forms a higher proportion of pay, and that levels of bank CEO cash bonus did not contribute to the 2008/9 financial crisis.

Finally, the third empirical study (Chapter 5) explores the impact of bank holding company (BHC) credit rating changes on the supply of local bank mortgage lending to

address the question whether banks manage to maintain their current favourable ratings. We find evidence that BHC credit rating upgrades contribute to a tightening in the supply of mortgage credit in the markets served by the BHC's bank(s). Additionally, the results show no association between credit rating downgrades and mortgage lending at the loan level, unless they heavily rely on non-core finance, in which case they deny more risky loan applications. Further, we also find that reductions in the supply of credit after a BHC rating upgrade are most pronounced for riskier loans and in markets with less competition. Recognizing potential market-based endogeneity, we examine the results for loans originated outside of the BHC's state of domicile and find similar results. Finally, we do not find evidence that the banks held by upgraded BHCs are moving into other types of loans after the upgrade. Collectively, the results suggest that BHCs move to protect their improved rating after the upgrade at the expense of the supply of local credit.

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Author’s declaration

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

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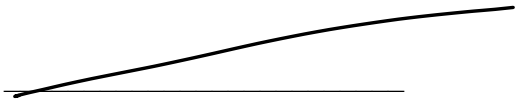
Signature: 

Abbreviation

BHC	Bank holding company
CARs	Cumulative abnormal returns
CEO	Chief Executive Officer
CRA	Credit Rating Agency
CRSP	Center for Research in Security Prices
DiD	Difference-in-Differences
FDIC	Federal Deposit Insurance Corporation
FEs	Fixed Effects
GDP	Gross Domestic Product
IBBEA	Riegle-Neal Interstate Banking and Branching Efficiency Act
NRSRO	Nationally Recognized Statistical Rating Organizations
OBS	Off-balance Sheet
OLS	Ordinary Least Squares
PSM	Propensity Score Matching
ROA	Return on Asset
ROE	Return on Equity
SEC	The U.S. Securities and Exchange Commission
SIC	Standard Industrial Classification
TARP	Troubled Assets Relief Program
U.S.	United States of America

Chapter 1

Chapter 1: Introduction

1.1 Introduction

The purpose of this thesis is to provide a better understanding of the debate over Chief Executive Officers (CEOs) compensation and financing decision making in the banking sector under different exogenous shocks. This chapter is organised as follows. Section 1.2 discusses and motivates the research problems on the controversies over the high executive compensation, bank financing decisions, and whether banks manage to maintain their current highly favourable ratings. Section 1.3 provides the core and related sub research questions. Next, section 1.4 presents the data sources and methodologies which have been applied in the three empirical studies of this thesis. Then, section 1.5 presents the main findings of empirical studies and section 1.6 provides the overall structure of this thesis.

1.2 Motivation

The vital theoretical frameworks on executive compensation are "shareholder value" and "rent extraction". The modern "shareholder value" view rooted in optimal contracting theory presents CEO compensation setting better. Specifically, CEO compensation is positively correlated with the CEO talent and firm size (Dow & Raposo, 2005; Gabaix & Landier, 2009; Edmans, Gabaix, & Landier, 2009; Gabaix, Landier, & Sauvagnat, 2014). Besides, the predictions have remained consistent with the observed practice, suggesting that CEO compensation is led by the competitive labour market forces. In the same vein, Edmans (2016) suggests that CEO compensation should be decided by the shareholders rather than public or government. Gabaix and Landier (2009) show that CEO compensation increase is in line with the increase of their firm market capitalisation during 1980-2003, and Kaplan and Rauh (2010) find out that compensation of CEOs was comparable to that of other talented groups since 1994 and that was likely driven by technology and scale. Additionally, there is evidence showing that CEOs have been indeed paid for their performance and penalised when their firms are underperformed, and boards do play roles in monitoring CEOs (Kaplan, 2013).

In contrast, the traditional "rent extraction" view suggests that executive compensation contract is designed to maximise own executive rents instead of being set out by boards. This view stems from poorly designed contracts that are not in the best interests of the shareholders; specifically, the CEOs assert their influential power over their boards and committees, resulting in pay that is too high and not tied to their performance (Bertrand and Mullainathan, 2001; Bebchuk and Fried, 2003; Bebchuk and Fried, 2004). That leads to the major changes of compensation legislation in the U.S. such as the SEC requirements of disclosure of compensation in 2006 and "Say-on-pay" as a part of "Dodd-Frank Act in 2010. However, the involvement of government in reducing compensation may backfire, and that leads to unintended consequences such as the increase of inequality (Murphy, 2013; Edmans, 2016).

Academic research has documented that high CEO pay is justifiable. However, in line with the "rent extraction" view, politicians and public still make it a political issue while arguing that CEOs are overpaid, their compensation keeps going up, and the government has tried to cap the executive compensation. For instance, in light of the U.S. financial crisis of 2008, excessive compensation of financial institutions' executives has been criticised as it is considered to have contributed to the financial crisis due to weak corporate governance. Even in the case of bank failures and government bailout, banks paid their executives exorbitant compensation, which enraged the public[1]. Firms those received the government bailout were capped executive total compensation at $500,000 (Bayazitova and Shivdasani, 2012).

Thus, the first empirical study in Chapter 3 addresses the debate from a different angle. We noticed that a number of bank CEOs forwent their bonuses during the crisis, for example, James Cayne of Bear Stearns (19-Dec-2007), Lloyd Blankfein of Goldman Sachs (16-Nov-2008), John Thain of Merrill Lynch (08-Dec-2008), Vikram Pandit of Citigroup (31-Dec-2008), among many others. Despite the high visibility of this phenomenon in the banking sector during the recent financial crisis, little research exists

[1] In 2007 alone, top executives at banks that have received government bailout were compensated nearly $1.6 billion (Associated Press, 2009). For example, Goldman Sachs was bailed out with $10 billion on October 2008, while its CEO, Lloyd Blankfein, received compensation of approximately $54 million in 2007 (see Frank Bass and Rita Beamish, "Study: $1.6B of Bailout Funds Given to Bank Execs," Finalcallnews.com, January 5, 2009 http://www.finalcall.com/artman/publish/Business_amp_Money_12/Study_1_6B_of_bailout_funds_given_to_bank_execs_5524.shtml, last accessed March 29, 2018).
- According to Execucomp, the seven troubled financial firms awarded their top executives a total compensation (bonus) of over $700 million ($92 million), while reporting losses of around $107 billion during 2007-2009 (Morgenson, 2009). The seven troubled companies are the American International Group, Bear Stearns, Citigroup, Countrywide Financial, Lehman Brothers, Merrill Lynch and Washington Mutual. https://www.nytimes.com/2009/02/22/business/22pay.html
- Noticeably, a considerable proportion of executive compensation is bonus, with the average amount of bonus paid to the CEOs of 95 U.S. bank holding companies and investment banks amounts to roughly a third of CEOs' total pay in 2006 (Fahlenbrach & Stulz, 2011).

on whether CEOs did that due to the government or public pressure and critics on reducing CEO's compensation in the long run. Unlike the popular media, which often focuses on individual cases, this study attempts to answer this question by a holistic perspective on the industry[2]. We hypothesise that they do this under external and internal pressure. However, we do not find that the bonus forgoing has an impact on these CEOs' long term pay, and the market does not value it as positive news.

Keep going on executive compensation, the second study in Chapter 4 is motivated given by the following reasons. Executive compensation at financial firms has received considerable attention since the financial crisis because compensation contracts incentivized managers at those firms to undertake excessive risks during the financial crisis (Bebchuk & Spamann, 2010; Gande & Kalpathy, 2017). Politicians and public continually bring up CEO compensation in stock options as a political issue, and are supported by some literature finding that stock options increase the sensitivity of executive compensation to the firm's risk and encourage bank managers to engage in more risky banking activities (Deyoung, Peng, & Yan, 2013; Mehran & Rosenberg, 2007). As a result, the Securities and Exchange Commission (SEC) adopted more stringent requirements on stock options as part of CEO compensation.

However, there is an argument against the effectiveness of these policy changes because firms respond to them by increasing the CEO's cash bonus while meeting the requirement on stock options, leaving the overall CEO compensation unchanged. While it is legitimate to keep CEOs' total compensation at a competitive level, since recent research suggests that the level of CEO pay is led by competitive labour market forces and reflects CEO talent and firm size (Dow and Raposo, 2005; Gabaix and Landier, 2009; Edmans et al., 2009; Gabaix et al., 2014; Edmans, 2016), to replace a significant portion of CEOs' stock options with cash bonus may have significant implications for firms. CEOs aiming to maximize cash bonus are more likely to avoid risk as they do not face pressure from either ownership and compensation incentives or active monitoring (Berger, Ofek, & Yermack, 1997). However, the risk-reducing effect of cash bonuses disappears as banks move closer to the point of default and the financially distressed banks seek to maximize the value of the financial safety net. In addition, some suggest that bonus contracts are designed to encourage short-term behaviour because they are contingent on annual performance goals. What the effects on bank risk-taking are, where

[2] To our knowledge, two other academic studies have examined related but different questions, both of which examine the determinants and consequences of $1 CEO salaries (instead of bonus) for all industries (rather than focusing on the banking industry) (Hamm, Jung, and Wang 2015; Loureiro, Makhija, and Zhang 2020).

cash bonus is a significant part of CEO total compensation, thus remains an empirical question.

The second study (Chapter 4), therefore, investigates the relationship between cash bonus as a portion of CEO total compensation and bank mortgage lending decisions using the U.S. data from 2003-2008. The challenge in making a causal claim is the difficulty of isolating mortgage lending decisions independent of the structure of CEO compensation and other bank characteristics. First, in any cross-section of mortgage loans, some unobservable bank characteristics may have driving effects on both the CEO compensation structure and the mortgage denial rates. Second, an aggressive or conservative mortgage lending strategy may induce a similar strategy on how to pay CEO, i.e., reverse causality. Finally, any fixed effects model which focusing on time-series variations in lending decisions, may ignore macroeconomic factors and policy initiatives that may be independent of the structure of CEO compensation and yet may induce compositional differences in mortgage borrowers over time.

We overcome these challenges by exploiting two plausible shocks outside the banking markets that induce exogenous variation in the likelihood of banks increasing cash bonus as a proportion of the CEO's total compensation compared to those banks with similar observable characteristics.

First, we pin down the causal impact of a terrorist attack as exogenous shocks to CEO bonus, which may affect bank mortgage lending activity. In particular, we examine whether or not CEOs prefer cash bonus over other forms of compensation following the terrorist attacks because of uncertainty and avoid adverse impacts on stock or option payments, consistent with prior studies (Dai, Rau, Stouraitis, & Tan, 2020). We employ the difference-in-differences (DiD) method and define the treated group including banks whose headquarters locate within 100 miles of the attack, and no other attack occurred within 100 miles of the same bank over the prior three years, and control group includes banks of the treatment group before the attack and for all remaining banks (Dai et al., 2020). Thus, the banks in the control group are not likely affected by the terrorist attacks. In line with our expectation, we find that CEO cash bonus is increased in overall after the terrorist attacks, and the treated banks, compared to the control banks, are more likely to deny risky mortgage applications, indicating that the treated banks are more risk-averse after the shocks and those findings are consistent with the OLS results. These results

imply that endogeneity between CEO cash bonus and mortgage risk-taking is less likely a concern.

Second, following Hayes, Lemmon and Qiu (2012) and Mao and Zhang (2018), we also use the change in the accounting treatment FAS 123R named Share-Based Payment as an exogenous shock. This accounting treatment was issued by the Financial Accounting Standard Board (FASB) and took effect in December 2005. Prior to the implementation of FAS 123R, firms were allowed to expense stock option at their intrinsic value of the stock option which equals to the difference between the exercise price and the underlying stock price on the measurement date. Thus, firms can take advantage of this recognition method by issuing the stock options with exercise price as same as underlying stock prices. The implementation of FAS 123R removes the favourable accounting treatment for stock options by requiring firms to expense stock options at fair value. Such change of accounting treatment can serve as an exogenous shock to executive compensations as will adjust the structure of executive compensation after the FAS 123R by reducing stock options and increasing other components of total pay. We find the FAS 123R speeds up the increase of cash bonus proportion to total CEO pay then translates to the likelihood of mortgage denial.

Move to the third empirical study (Chapter 5), yet, little is known about the implications of credit rating management on bank financing decision. Do bank managers manage to maintain the current credit ratings? This study attempts to address this question in the context of bank mortgage lending supply. If managers care about maintaining better ratings, they seek to keep the higher ratings to protect their bank reputation and direct their bank(s) to constrain lending to all but the safest of borrowers (but not necessarily after a downgrade). Credit ratings are used to access the creditworthiness of an entity, e.g. a bank or a firm, so they reflect the quality of the organization: the higher credit rating levels, the more benefits to a bank. Prior literature provides evidence of the effects of credit ratings, not only the cost of borrowing and funding (Katz, 1974; Grier and Katz, 1976; Hand et al., 1992; Wansley, Glascock, and Clauretie, 1992; Hite and Warga, 1997; Durand, 2011; and Watkins, 2012, among others), but also capital market reactions on the stock and bond valuations (Holthausen and Leftwich, 1986; Ederington, Yawitz, and Roberts, 1987; Hand, Holthausen, and Leftwich, 1992; Ederington and Goh, 1998; Dichev and Piotroski, 2001; Purda, 2007). Thus, the rating changes would lead to the discrete changes in bank investment and financial decisions and create strong motivations for managers of the issuers to take actions to maintain their current credit ratings when

credit ratings change favourably. We, therefore, hypothesize that when a bank is upgraded, the bank likely to reduce the mortgage lending supply.

However, it is unclear, a priori, if, and how, a BHC level credit rating change will affect bank lending behaviour. For instance, a credit rating downgrade may affect the BHC's, cost of funding. Consistent with Durand (2011) and Watkins (2012), if the BHC faces the increased costs of funding, the BHC may respond by directing its bank(s) to move further out on the risk curve making loans to less-qualified mortgages in an attempt to chase higher yields in order to offset its increased costs. Conversely, the downgrade may induce a move to conservativism as the BHC moves to repair the damage to its reputation, thus restricting lending by its bank(s). Likewise, with a rating upgrade, a BHC may face reductions in its costs of funding, thus enabling the BHC to direct its bank(s) to increase its lending. The effects of credit rating changes at the BHC level on bank lending is, therefore, an empirical matter.

Moreover, changes at the bank holding company (BHC) level, exogenous to bank financial health or local economic conditions, can engender real impacts on the local economy. Ashcraft (2005) documents significant and lasting effects to local economies subsequent to failure of two, otherwise, "healthy" banks. Ashcraft's study highlights both the specialness of banks in the intermediation process and identifies an external factor that can affect the efficacy of the intermediation process, i.e., changes emanating from the BHC. Taking together, to fill the void in the literature, we examine whether credit rating adjustments at the BHC level change bank mortgage lending supply.

1.3 Research questions

Given the motivation identified in the above section, I design the three central empirical studies to address the following core and sub research questions:

Empirical study one:

1. *Why did bank CEOs forgo their bonus during the recent financial crisis?*
    a. *What were the determinants of the bonus-forgoing decision during the recent financial crisis?*
    b. *What were the consequences of the bonus-forgoing decision?*

Empirical study two:

2. *How did cash bonus influence the supply of risky mortgages?*
    a. *Did cash bonus reduce the supply of new risky mortgages?*
    b. *Was cash bonus a factor contributing to the housing market collapse 2008-2009?*

Empirical study three:

3. *How did changes in external bank credit rating affect the supply of new local mortgage loans?*
    a. *Did changes in external bank credit rating promote or mitigate the supply of new local mortgage loans?*
    b. *How were the relationships after controlling for bank competition?*
    c. *Were the effects qualitatively similar across all bank ratings?*
    d. *What were the subsequent changes in lending activities followed by the credit rating changes?*

1.4 Data sources and methodology

1.4.1 Data sources

I collect data from a diverse source of information for the leading essays in this thesis, where there are some sources of data shared across the empirical studies.

In the first empirical study, follow Fahlenbrach & Stulz (2011), I collect compensation data from Execucomp, focusing on financial firms (SIC code between 6000 and 6300) but excluding businesses of non-traditional banking, e.g., firms in Investment Advice (SIC code 6282), Financial Services (SIC code 6199), and Security Brokers and Dealers such as pure brokerage houses (SIC code 6211). This filter leaves an initial sample of 98 U.S. banks. Next, I determine whether a CEO gave up bonus during the financial crisis by reading and coding information from the bank proxy statements, and when available, supplemented by searching business press online such as Financial Times, Reuters, the Wall Street Journal. Next, I merge data from three sources: (i) CEO background information from BoardEx, (ii) financial data from COMPUSTAT, and (iii) stock market data from CRSP. I collect TARP details from the TARP Investment Program Transaction Report issued by the U.S. Treasury on 29 September 2010.

With respect to the second essay, to build the data set, I begin with all financial firms (SIC code between 6000 and 6999) from the Execucomp to obtain the managerial cash incentives of their CEOs. I also collect equity incentives (Delta and Vega) from Lalitha Naveen's Web site[3]. Next, I merge these financial firms with CRSP to obtain their PERMCO which are used to link to the RSSDID in the linkage file of Federal Reserve Bank of New York. The RSSDID is the unique identifier to merge with the Call Report for bank financial data.

To measure lending activity, I use detailed mortgage data collected from a comprehensive sample reported annually to the Federal Reserve under provisions of the Home Mortgage Disclosure Act (HMDA) Loan Application Registry passed into law in 1975 and expanded in 1988 informs the public whether a financial institution serves local credit demand adequately and identify discriminatory lending[4]. The HMDA data covers approximately 90% of mortgage lending in the United States. The data allows me to determine not only the lenders but also the loan location based on the location (county) of the property securing the mortgage (Duchin & Sosyura, 2014) (Gilje, Loutskina, & Strahan, 2016). Additionally, each observation is a mortgage application which contains information of borrowers (e.g. income, gender, race), loan requested (e.g. amount of loan, type of loan, purpose of loan), bank decision on loan (e.g. approved, denied, or withdrawn). We apply some filter rules to compile our final sample. After removing the invalid loan records, each application for each year has been aggregated at the bank holding company level and then merged with the bank financial data from Call Report at the fourth quarter of the year prior to the mortgage application using bank identifiers in HMDA files which matches to bank identifiers in Call Report (RSSD ID). To be specific, RSSD9055 with agency code 1 is used for banks those report to Office of the Comptroller of the Currency (OCC), RSSD9001 with agency code 2 for banks those report to Federal Reserve, and RSSD9050 with agency code 3 for banks those report to the Federal Deposit Insurance Corporation (FDIC). We aggregate financial institutions at the BHC level and merge them with the incentive data of our sample banks.

In the third essay, the data of credit ratings is from Bloomberg Data Services (Bloomberg). Bloomberg maintains data on long-term foreign currency issuer credit

[3] http://sites.temple.edu/lnaveen/data/

[4] A financial institution is required to report HMDA data if it has any branches in any metropolitan statistical area and meets the minimum threshold of asset size, which was equal to $37 million in book assets as of 2008.

rating changes. I use Bloomberg's data to identify all Standard and Poor's long-term issuer credit rating changes over the period January 1st, 1990 through December 31st, 2010. We map the Bloomberg rating data into a numeric scale by converting the alphanumeric data to 22 numerical categories where 22 is the highest rating equivalent to AAA, and 1 is the lowest equivalent to default. For mortgage lending data, I keep using the data from the Home Mortgage Disclosure Act (HMDA) Loan Application Register.

Conclusively, apart from the specific different data for each essay, the first and the second empirical study share the similar core data of compensation data from Execucomp while the second and the third empirical study make use of the data of the Home Mortgage Disclosure Act (HMDA) Loan Application Registry data and linkage file of Federal Reserve Bank of New York to merge PERMCO with RSSDID.

1.4.2 Methodology

This thesis employs various research methodologies to conduct the empirical studies, including univariate statistical tests (univariate tests) for the mean and the median, the Ordinary Least Square (OLS) regressions, the non-linear regressions, i.e. logistics/probit, propensity score matching (PSM) methods, difference-in-differences (DiD) analysis and standard event study.

To be specific, in the first empirical study (Chapter 3), I use the univariate tests for the differences in mean and median of the characteristics of banks and CEOs between the two groups, then estimate a series of binary logistic regressions. For the subsequent tests on CEOs' compensation and bank performance, I apply PSM methods to form the treatment groups and the control groups, i.e. CEOs who forwent their bonus (treatment group) versus CEOs who did not forgo their bonus (control group), and banks with their CEOs forgoing their bonus (treatment group) versus banks without their CEOs forgoing their bonus (control groups). By doing this, I could ensure that the treatment groups and the control groups likely share similar characteristics to mitigate the concern of fundamental differences between them, then we apply the difference-in-differences analysis to test the subsequent CEO compensation and bank performance and risk-taking. I also use the standard event study with the Cross-Sectional Analysis by Eventus to measure market reaction to the announcement of forgoing decision.

The second study (Chapter 4) is done using series of Ordinary Least Squares (OLS) regressions and constructing heteroskedasticity - robust standard errors clustered at the bank-county level to allow for within bank-county correlation of residuals in loan denials. I choose a linear rather than nonlinear regressions to study on data of loan denials given that nonlinear specifications are likely to generate biased estimates with specifications including short time series and involving many fixed effects, resulting in incidental parameter problem and delivering inconsistent estimates (Duchin & Sosyura, 2014; and Puri, Rocholl, & Steffen, 2011). Moreover, the nonlinear fixed effects models may also produce biased estimates for interaction terms which is one of the main coefficient estimates of interest (Ai and Norton, 2003). As a result, the linear models appear to be better fit than the nonlinear models. In this study, I also apply the PSM methods to form the treatment groups and control groups, then perform the univariate tests for the mean of bank characteristics between the treatment groups and the control groups to ensure that they are likely fundamentally similar, and then use the difference-in-differences analysis based on the two exogenous shocks, i.e. the terrorist attacks and the accounting policy change (FAS 123R) to reduce the concern of endogeneity.

Finally, in the third study (Chapter 5), it shares similar main research methods with the second study when I conduct a series of ordinary least squares (OLS) regressions rather than non-linear regressions, i.e. probit regressions given by the two reasons. First, non-linear fixed effects regressions tend to produce biases estimates for interaction terms, i.e. Risky loan and its interactions with rating changes. Second, non-linear models also generate biases estimates with many fixed effects, i.e. bank FEs, county FEs, year FEs, bank*county FEs, county*year FEs (Ai and Norton, 2003). I, therefore, follow the recent literature on loan approvals and recommendation from econometrics literature to use linear models for these regressions (Duchin and Sosyura, 2014; Chu, Ma, and Zhao, 2019). For robustness tests, I also report the results with the probit regressions in the appendix 5D of Chapter 5. In addition, a critique to face in examining changes in loan denial subsequent to a BHC credit rating upgrade is that of a pre-selection issue, so I follow Roberts and Whited (2013) and Chu, Ma, and Zhao (2019) to conduct diagnostic checks of the pre-trend in mortgage denial rate to investigate the trends in loan denial rates pre-upgrade for the credit rating upgrade BHCs in the sample relative to a propensity matched control group to ensure that the differences-in-differences analysis is valid.

1.5 Main findings

In this thesis, I conduct the three empirical studies to have a better understanding of the debate over Chief Executive Officers (CEOs) compensation and financing decision making in banking sector under different exogenous shocks in Chapter 3, 4 and 5. The main findings, therefore, are summarised by each study as follows:

For the first study in Chapter 3, we start to investigate the determinants and consequences of CEO bonus forgoing decision by considering three plausible but mutually non-exclusive explanations which focus on both costs of non-forgoing and cost of forgoing. In particular, the cost of non-forgoing derives from either internal or external pressure from three sources: regulation, corporate governance, and loyalty even though these three sources of pressure are practically intertwined in forcing CEOs to forgo bonus. In addition to the "pressure" explanation, we also focus on the lower cost of *not* forgoing bonus which is considered as the "opportunism" channel given that CEOs are likely not to receive any rewards if their banks fail to achieve their performance target. Conclusively, we find supportive evidence for the cost of non-forgoing, but not for the cost of forgoing explanation. To be specific, the likelihood of forgoing increases in bank size, the intensity of internal monitoring (as measured by audit committee size), and if the bank has received funds from the government's Troubled Assets Relief Program (TARP). We also find that internally promoted CEOs are more likely than externally promoted CEOs to give up their bonus and CEOs who forgo their bonus less likely to quit their jobs, consistent with their willingness to signal their commitment to their banks.

We then perform several subsequent tests to examine the change in total compensation, market reactions to the announcement of bonus forgoing decision and subsequent bank performance and risk-taking. First, we examine how bank CEOs' decision to forgo bonus relates to their total compensation, and whether the decision results in a temporary or a long-term effect. We find that CEOs who forwent their bonus are less likely to leave their job, nor were their subsequent total compensation negatively affected. These results suggest that it is unlikely the banks' long-term decision to reduce CEOs' total compensation, which may negatively affect CEOs' subsequent compensation and their incentives to move. These results are consistent with CEOs' actions to forgo bonus during the financial crisis being temporary actions.

Additionally, we test whether CEOs' forgoing decision is to send a signal to the market that the management team has a strong commitment to shareholders and demonstrates their benefits to be aligned with shareholder interests during the downturn period. In the presence of asymmetric information between managers and investors, forgoing CEOs can signal to investors by distinguishing themselves from those who do not forgo their bonus. We compare the accounting and market performance of banks whose CEOs forwent bonus with those whose CEOs did not forgo bonus. The results suggest that there are no statistically significant differences in the changes in bank performance between the two groups after the forgoing year when controlling for their fixed effects.

Next, to provide further evidence of self-sacrificial leadership theory, we test whether the market reacts to the bonus-forgoing decision, and whether the decision is short-term. If stock markets react positively to bonus-forgoing action, suggesting that investors view this behaviour as symbolic management. However, if this action during the financial crisis is a temporary action, we expect the market does not respond to the CEO-forwent-bonus news positively. The results show that the market does not react to banks' announcements of their CEOs' forgoing decisions, indicating that the market does not consider it as symbolic, and this is a temporary behaviour, consistent with radical self-sacrificial leadership theory.

Taken together, CEOs are more likely to forgo bonus if their banks are larger, better governed, or receivers of the Troubled Asset Relief Program (TARP) by the U.S. government. Subsequent to bonus forgoing, these CEOs total compensation are not negatively affected, they are less likely to depart, and their bank performance is not economically improved. In addition, the markets do not respond to the bonus forgone news positively. The results shed light to the debate on CEO compensation and support that CEO pay is justifiable, and any pressure that forces CEO pay to deviate from their equilibrium level will be temporary and has a little economic impact on firms and the general public.

In the second research, we examine to extent cash incentives embedded in executive compensation contracts affect the risky mortgage supply while cash bonus is widely believed to mitigate risk-taking in the prior literature (Smith & Stulz, 1985; Leone, Wu, & Zimmermanb, 2006; Fahlenbrach & Stulz, 2011; Indjejikian, Mateˇjka, Merchant, & Van Der Stede, 2014; Vallascas & Hagendorff, 2013) and whether it is a factor to worsen

the recent financial crisis. We primarily use the mortgage lending data from the Home Mortgage Disclosure Act (HMDA) Loan Application Register, which reports data on mortgage applications, not just mortgage approvals, thus allowing us to control for changes in demand. We find that cash bonus incentives are both positively linked to mortgage denial and risky mortgage denial. These findings suggest that the incentives embedded in cash bonus do not encourage the origination of risky mortgages and cash bonus is not an element contributing to the financial crisis.

One caveat is that CEO cash bonus is likely to be endogenous with mortgage lending supply and may be associated with unobservable bank effects. To mitigate this concern, we conduct several analyses. First, we absorb by bank*county fixed effects in the more-fully specified because it is possible that some banks are always likely to reject the mortgage lending than others within the same county. Additionally, we include county-year fixed effects to sweep out potential confounding factors from demand side related to housing demand, industry composition, business cycle, and idiosyncratic economy shocks, etc. in a given county-year. The results after including the bank-county fixed effects and the county-year fixed effects remain unchanged, suggesting that the findings are not driven by the association between cash bonus incentives and bank characteristics as well as county characteristics.

Second, to further address to the endogeneity concern, our empirical analysis exploits the terrorist attacks and the accounting policy change, i.e. FAS 123R as exogenous shocks to CEO bonus, which may affect mortgage lending supply. In particular, the results suggest that CEOs prefer cash bonus over other forms of compensation following the terrorist attacks because of uncertainty and avoid adverse impacts on stock or option payments, consistent with prior studies (Dai et al. 2020), and the switch to expense option costs in income statement is related to changes in components of CEO compensation, i.e. banks switch to other forms of compensation, e.g. cash bonus from options following the adoption of options expensing rule. The DID results show that the treated banks, compared to the control banks, are more likely to reduce the mortgage supply, indicating that the treated banks are more risk-averse after the shocks and those findings are consistent with the baseline OLS results and imply that endogeneity between CEO cash bonus and mortgage risk-taking is less likely a concern.

Third, localized effects may be endogenous to CEO cash bonus; however, the locations of our bank sample are well diversified to lessen this concern. For instance, the

closure of one branch of Bank of America in New York unlikely influences Bank of America at the BHC level. However, to address this issue, we perform a series of regressions, similar to our main analysis, but on a limited sample where we exclude the mortgages located within the same state as the bank headquarters. The results remain unchanged in these tests, and are more pronounced for risky mortgages, suggesting that endogeneity is not a concern.

With respects to the third empirical study, we quantify the impact of BHC level credit rating changes on bank lending behaviour by studying the changes in mortgage lending for banks whose BHC experiences a credit rating change relative to those whose BHCs do not. Mortgage lending is our primary area of focus as the Home Mortgage Disclosure Act (HMDA) Loan Application Register, our primary data source, reports data on mortgage applications, not simply mortgage approvals, thus allowing us to control for changes in demand. We examine the changes in mortgage lending behaviour subsequent to both credit rating downgrades and credit rating upgrades. Overall, we find evidence that BHC credit rating upgrades more likely to deny the mortgage applications in the markets served by the BHC's bank(s). Mortgage loan denial at the bank increases in the year subsequent to a credit rating upgrade by the bank's holding company. We interpret this as evidence consistent with a BHC moving to protect or invest in, its recently improved reputation. To further explore the BHC's reputational considerations, we find that banks are more likely to deny riskier mortgage loans subsequent to a credit rating upgrade by its BHC. In addition, we do not find evidence that BHC level credit rating downgrades lead to changes in loan-bank-level, mortgage loan denial subsequent to the downgrade, on average, unless they heavily rely on non-core finance, in which case they deny more risky loan applications. We then examine competition as a mitigating factor of our main results. We find that mortgage denials increase subsequent to a credit rating upgrade, on average, but less so for banks operating in a competitive market. Conclusively, this result as evidence consistent with the notion that BHCs seek to protect their improved reputation subsequent to a credit rating upgrade. When pressured by competitive forces to a lesser degree, BHCs are free to actively invest in reputational considerations.

The challenge in our identification strategy is disentangling the endogeneity that exists between bank performance and the credit rating of the bank's holding company. For example, when the financial health of a BHC's bank is improving as the result of robust local economic growth, it is more likely, *ceteris paribus*, that the BHC will

experience a credit rating upgrade. To address this concern, we reperform our analysis over a sample where we drop mortgage loan applications originating in the BHC's state of domicile. Our findings hold over this restricted sample. Mortgage loan denial rates increase for banks in the year following a credit rating upgrade for the bank's holding company. Overall, this result is most pronounced for risky loans. Additionally, we find no effects on loan denial subsequent to a credit rating downgrade.

To better understand changes in the lending behaviour of banks subsequent to BHC level credit rating changes, we examine the effects of the ratings change on the loan composition of the bank. For example, it could be the case that mortgage denial subsequent to a credit rating upgrade increase as the bank finds it more advantageous to pursue other lending opportunities, e.g., if a bank's cost of funding is reduced subsequent to an upgrade, then it may be in the bank's interest to pursue loan opportunities in other loan classes. We explore this possibility by studying changes in bank balance sheets subsequent to the holding company level ratings change. Two important results emerge: 1) generally, we do not find significant changes in asset composition subsequent to a credit rating change (upgrade or downgrade); and, 2) we find evidence that banks increase mortgage lending to conforming loans and decrease lending to non-conforming loans subsequent to a credit rating upgrade at the holding company level. The lack of movement to other asset classes and the increased focus on conforming loans is consistent with the notion of BHCs moving to protect their improved rating.

Next, we explore the impact of credit rating changes on a bank's cost of funding by conditioning our results on the composition of liabilities for the banks in our sample. If credit rating changes impact a bank's cost of funding, then the impact should be most pronounced for banks more reliant on non-core liabilities. Overall, we show that mortgage loan denial increase following a holding company level upgrade and that this result is consistent regardless of the originating bank's reliance on non-core funding. However, subsequent to a BHC level credit rating downgrade, we do find that loan denial increases for banks that are more reliant on non-core funding. Collectively, these results suggest that BHCs and their banks focus on reputational considerations when cost-effective (i.e., after an upgrade) and cost considerations when mandated (i.e., after a downgrade when the bank is relatively more reliant on non-core funding).

Finally, we investigate the extent to which the marginal benefits to reputation protection differ for BHCs depending on their credit rating level after the rating upgrade.

For example, a BHC moving from a rating of AA to AA+ may not see the need to invest as heavily in protecting its improved reputation as a BHC moving from a rating of BB- to BB. If the marginal benefits to additional investments in reputational protection diminish as a function of the BHCs rating level (consistent with prior literature), then we would expect to smaller increases in loan denial for banks held by BHCs with higher post-upgrade ratings. Consistent with this conjecture and with our prior results, we find that the impact of a credit rating change on loan denial to be less pronounced for BHCs with higher post-upgrade ratings if the rating upgrade is exogenous to the increase of mortgage denial activities. We do not find a significant association between credit rating downgrades and loan denial on average, or when conditioned on the post-downgrade rating level. Conclusively, the results would be due to the fact that the marginal benefit of a credit rating upgrade is reduced for BHCs with a high initial rating.

1.6 Structure of the thesis

The thesis is organised by the six chapters in total with the chapter of introduction, the background of study and theoretical framework, three main empirical studies and one chapter for the conclusion. The remaining chapters are presented in detail as follow. Chapter 2 reviews the background of the study and provides the core theoretical frameworks which have been used to develop the main hypotheses in chapter 3, 4 and 5. Chapter 3 presents the first empirical study "Why Do Bank CEOs Forgo Their Bonus During the Financial Crisis?", chapter 4 devotes to the second empirical study "Cash Bonus and Mortgage Risk-Taking", and chapter 5 covers the third empirical study "Bank Holding Company Credit Rating Changes and the Supply of Local Credit". In general, the three empirical chapters share a similar structure. They start with the introduction to discuss the research problems and underlying motivation, then followed by the review of related literature and hypotheses development, data and sample selection, descriptive summary statistics, empirical results for pre-stated hypotheses together with discussion and additionally related robustness tests. Finally, chapter 6 provides the conclusion for the whole thesis by briefing the key findings and contributions of the research as well as research limitation and suggest some potential avenue for future research.

Chapter 2

Chapter 2: Background of study and theoretical framework

2.1. Introduction

This chapter provides the background of study in this thesis and theoretical framework which is grounded in related literature and hypotheses development in the three main empirical studies of Chapter 3, 4 and 5. Section 2.2 reviews the general background of structure of executive compensation, institutional features of the U.S. context, and overview of corporate credit ratings. Next, Section 2.3 provides the grounded theories, including the configuration perspective on the CEO, executive compensation theories in line with three specific views, i.e. agency theory, rent extraction theory and legal and institutional view, financial intermediation theory, and leadership theory. Section 2.4 concludes the chapter.

2.2. Background of study

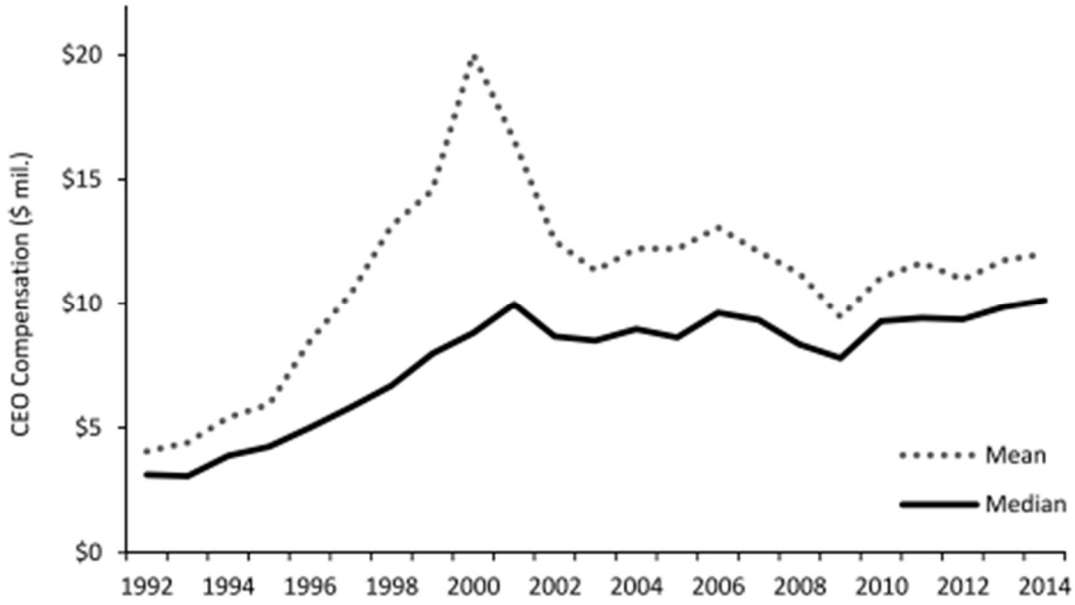
This section provides the background of the study which covers executive compensation and corporate credit ratings in the U.S. context. To be specific, section 2.2.1 presents the structure of executive compensation, followed by the institutional features regards to executive compensation in the section 2.2.2, and finally the overview of corporate credit ratings in the section 2.2.3.

2.2.1. Structure of executive compensation

Even though there are substantial heterogeneity in executive compensation policy across firms, overall, there are five major common components of executive compensations, namely salary, bonus, pay-outs from long term incentive plans (LTIPs), option grants, and restricted stock grants and other forms of compensation such as *"perquisites and other personal benefits, above market earnings on restricted stock, options/SARs or deferred compensation paid during the year but deferred by the officer, earnings on long-term incentive plan compensation paid during the year but deferred at*

the election of the officer, tax reimbursements, the dollar value of difference between the price paid by the officer for company stock and the actual market price of the stock under a stock purchase plan that is not generally available to shareholders or employees of the company[5]*, termination or change-in-control payments, contributions to defined contribution plans (e.g. 401K plans), life insurance premiums, gross-ups and other tax reimbursements, discounted share purchases etc."* (Execucomp). In this section, we summarize the major trend of main components of executive pays which is heavily drawn from Frydman and Jenter (2010) and Edmans, Gabaix, and Jenter (2017).

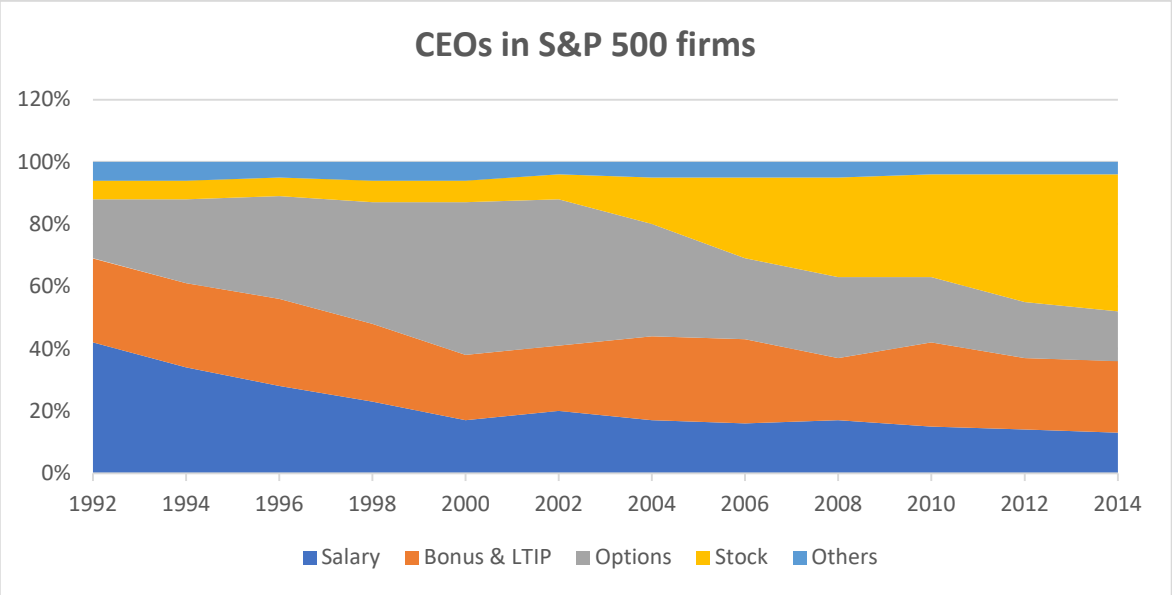
Figure 2.1: CEO compensation in the S&P 500 firms during 1992 – 2014



Notes: This figure illustrates the mean and median of total compensation of executives in the S&P 500 firms during 1992-2014 period. The key five components of compensation are salaries, bonuses and payouts from long-term incentive plans (LTIPs), the grant-date values of options calculated by using Black-Scholes, the grant-date values of restricted stocks, and other compensations. All values are adjusted for inflation in 2014 millions of dollars. The data is extracted from ExecuComp. Adapted from Edmans, Gabaix, and Jenter (2017).

[5] Exclusive of value realized from exercising stock options

Figure 2.2: The structure of executive compensation in the S&P 500 firms during 1992 – 2014



Notes: This figure presents the average composition of executive compensation in the S&P 500 firms during 1992-2014 period. The key five components of compensation are salaries, bonuses and payouts from long-term incentive plans (LTIPs), the grant-date values of options calculated by using Black-Scholes, the grant-date values of restricted stocks, and other compensations. The data is extracted from ExecuComp. Adapted from Edmans, Gabaix, and Jenter (2017).

Overall, CEO compensation and its major components have changes through the time which can be grouped into the three noticeable periods. In the 1930s, at the beginning, total compensation basically includes salaries and annual bonus which tied to firm accounting performance and then paid out in form of either cash or share. The bonus plans for multi-year performance (LTIPs) started to increase the importance from 1960s, it has been paid in form of either cash or share as planned for several years. Secondly, in the years 1950s, firms began to reward executives in form of options grant but until the 1980s and 1990s, option grants have been surged as the largest component of total pay, i.e. 32% and 37%, respectively, especially 49% in 2000. However, the increase of options was not at the expense of other components of compensation, i.e. salaries remained at constant and bonuses increase over the same period (Frydman and Jenter, 2010).

Thirdly, the relatively large shift in the compensation structure was remarked at the end of the 1990s when stock-market collapse together with and recession was in 2000-01 and technology boom. Option grants sharply dropped in both relative and absolute value, i.e. 16% of total pay in 2014, and replaced by the increase of performance-based restricted stock grants which were vested relied on performance indicators, i.e. 44% of total pay in

2014. This is shown in Figure 2-1 and Figure 2-2. This shift in compensation structure is still an open question which a number of studies have been attempting to investigate (Edmans, Gabaix, and Jenter, 2017).

Conclusively, the structure of executive compensation has changed over time which can be observed through the three periods. Salaries and bonuses dominated the total compensation in the early stage, then the composition shifted to the option grants during the 1980s and the 1990s and shifted again from option grants to performance-based restricted stock grants until recently.

2.2.2. Institutional features of the U.S. context

This section provides overview of the most important institutional features which impact on executive compensation practice in the U.S. in the view for economists. The main legislation and requirements of disclosure are presented heavily based on Edmans, Gabaix, and Jenter (2017) and we mainly focus on executive bonus as below:

Legislation

"Regulation S-K of the Securities Act of 1933 ("Regulation S-K") lays out reporting requirements for various SEC filings issued by public firms.

The Securities Exchange Act of 1934 ("1934 Act") created the SEC to enforce U.S. federal securities laws. Section 14(a) of the 1934 Act requires a firm to file a proxy statement when soliciting shareholder votes, e.g., for the annual shareholders' meeting. SEC regulation §240.14a-101 Schedule 14A stipulates the information required in a proxy statement; as a result, a proxy statement is often referred to as a Schedule 14A, and a definitive proxy statement is filed using SEC Form 14A. This information includes disclosure of executive compensation as required by certain items of Regulation S-K. The SEC subsequently made major amendments to its disclosure rules in 1978, 1992, and 2006, and minor amendments in other years (such as 2002 and 2009).

– Note that Section 14(a) of the 1934 Act is different from Section 14A of the same act, which was newly added by Dodd–Frank and concerns shareholder approval of executive compensation.

The Sarbanes–Oxley Act of 2002 ("Sarbanes–Oxley"), effective from July 30, 2002, was primarily focused on accounting reform, but contained some legislation relevant to executive compensation.

• In August 2002 and October 2002, the NYSE and Nasdaq respectively proposed changes to their listing rules to the SEC, to strengthen corporate governance standards for listed companies. These rules were approved in November 2003.

• The Dodd–Frank Wall Street Reform and Consumer Protection Act of 2010 ("Dodd–Frank") was primarily focused on Wall Street reform and consumer protection, but most of its executive compensation rules applied to all listed firms. The executive compensation items involved several additions to the 1934 Act, e.g., of Section 10C ("compensation committees") and of Section 14A ("shareholder approval"). In turn, many of these additions required the SEC to increase listing and disclosure requirements.

• Accounting standards were initially set by the Accounting Principles Board ("APB"), which was replaced in 1973 by the FASB. The FASB issues Financial Accounting Standards ("FAS") for public and private companies and non-profit organizations. Effective from July 1, 2009, the FASB established Accounting Standards Codification ("ASC"), which integrated the hundreds of existing accounting standards under 90 broad topics; thus, one new ASC typically integrates several FASs. The relevant ASCs for executive compensation are given in Figure 2-3:

Figure 2.3: Accounting standard codification reference.

FAS	***ASC Topic***
FAS 43	*ASC 710 Compensation General*
FAS 112	*ASC 712 Compensation – Nonretirement Postemployment Benefits*
FAS 87; 88; 106; 112; 132(R); 158	*ASC 715 Compensation – Retirement Benefits*
FAS 123 (R)	*ASC 718 Compensation – Stock Compensation*

Note: Adapted from Edmans, Gabaix, and Jenter (2017, p.129)

• The Internal Revenue Code ("IRC") is the domestic portion of federal tax law" (Edmans, Gabaix, and Jenter, 2017, p. 128-129)

Disclosure

"– From 1934 to 1978, the SEC required publicly-listed firms to disclose the compensation (including salaries, bonuses, stock, and options) of the three highest paid executives in the annual proxy statement.79 Starting in 1942, the SEC required companies to disclose some executive pay data in a table, rather than just in narrative form, and expanded the tabular disclosure in 1952. Proxy statements for firms with December year ends are typically issued in March or April, giving rise to "Shareholder Springs" where shareholders sometimes voice their opposition to compensation.

– The 1978 Disclosure Rules extended individual pay disclosure from the top three executives to the top-five (typically the CEO plus four other highest-paid executives) and expanded the information in the Summary Compensation Table ("SCT").

– The 1992 Disclosure Rules required an even more detailed SCT, summarizing the major components of pay received by the CEO, CFO and other top-three executives over the past three years. Separate tables are required for the number of awarded options and stock appreciation rights ("SARs"),80 for exercises and end-of-year holdings of options and SARs, and for long-term incentive plans ("LTIPs").

∗ Previously, compensation was disclosed mainly through narrative descriptions, with only limited information in the SCT; the 1992 rules mandated much more extensive tabular disclosure for clarity. Standardization of the tables aimed to promote comparability between years and across firms.

∗ However, the value of options granted did not need to be disclosed, so there was no total compensation number.

– The 2006 Disclosure Rules required:

∗ The SCT to contain the value of new option grants (plus changes in pension value and any above-market interest or preferential dividends on nonqualified deferred compensation81), thus leading to a total compensation number for the first time.

∗ A new Compensation Discussion and Analysis section, describing the firm's overall compensation policy and objectives.

∗ A new Pension Benefits Table containing the present value of accumulated pension benefit, plus payments during the current year.

∗ A new Nonqualified Deferred Compensation Table containing the value of accumulated deferred compensation, plus contributions, earnings, and withdrawals during the current year.

∗ A new Director Compensation Table, similar in format to the SCT but for directors.

– Prior to 2006, firms separately reported "annual bonuses" and "pay-outs from long-term performance plans". Under the 2006 rules, both annual cash bonuses from short-term incentive plans and long-term performance bonuses are considered "non-equity incentive compensation" if they are based on pre-established performance targets. If they are not based on pre-established targets, they are considered "discretionary bonuses".

– The main effects of Dodd–Frank, passed in 2010, on disclosure requirements were:

∗ Section 953(a) added Section 14(i) to the 1934 Act, which mandates the SEC to adopt rules requiring disclosure of the link between realized pay and financial performance, including stock price performance. To implement it, the SEC proposed the addition of Item 402(v) to Regulation S-K on April 29, 2015. This rule has not yet been adopted.

∗ Section 953(b) led to the SEC adding Item 402(u) to Regulation S-K on August 5, 2015. This rule requires firms to disclose the ratio of the CEO's total pay to the median total pay for all other employees. It was due to be implemented for fiscal years beginning on or after January 1, 2017 but is currently being reconsidered.

∗ Section 955 added Section 14(j) to the 1934 Act, which mandates the SEC to adopt rules requiring the disclosure of whether company policies allow directors and employees to hedge any fall in the stock price. To implement it, the SEC proposed the amendment of Item 402(b) and the addition of Item 407(i) to Regulation S-K, on February 9, 2015. This rule has not yet been adopted." (Edmans, Gabaix, and Jenter, 2017, p.129-131)

Clawbacks provision

"• Legislation and disclosure:

– Section 304 of Sarbanes–Oxley requires firms, in the event of a financial restatement due to misconduct, to claw back CEOs' and CFOs' bonuses, equity-based pay and profits on stock sales over the last twelve months.

– Section 954 of Dodd–Frank added Section 10D to the 1934 Act. To implement it, the SEC proposed Rule 10D-1 on July 1, 2015, which forces national securities exchanges and associations to establish listing standards that require listed companies to adopt, disclose, and implement a clawback policy. The proposed rule broadens clawback policies to all executives and stipulates the terms and amount of clawbacks. Upon a financial restatement due to a material error, an executive must repay that portion of any incentive compensation received during the three prior years that would not have been received based on the restated accounts. The clawback is to be "no fault", i.e., apply regardless of whether the executive was responsible for the restatement, and even if there is no misconduct." (Edmans, Gabaix, and Jenter, 2017, p.139)

2.2.3. Overview of corporate credit ratings

With an aim to provide the key background of credit rating in our third empirical study, this section is presented to comprehend business of credit rating agencies, rating scales, and rating philosophy.

Business of CRAs

In general, credit rating refers to "*an opinion regarding the creditworthiness of an entity, a debt or financial obligation, debt security, preferred share or other financial instrument, or of an issuer of such a debt or financial obligation, debt security, preferred share or other financial instrument, issued using an established and defined ranking system of rating categories*" (De Haan and Amtenbrink , 2011, p.3), and CRAs are professional rating agencies responsible for evaluating the creditworthiness of an entity (issuers), e.g. financial and non-financial institutions (De Haan and Amtenbrink, 2011). For instance, in the U.S., these agencies obtain the approval as nationally recognized statistical rating organizations (NRSRO) from the securities and exchange commission (SEC) to provide services such as financial institutions, insurance firms, corporate issuers, asset-backed securities and government securities (SEC, 2012).

Historically, Mercantile Agency, the very first agency, started to offer rating services based on the supply and demand of the railroad bond market in 1841 by Lewis Tappan (Deb, Manning, Murphy, Penalver, & Toth, 2011). Through a hundred years, nowadays, there have been around 150 local and international CRAs worldwide (De Haan and Amtenbrink, 2011). In the U.S., the Big Three credit rating agencies are Standard &

Poor's Ratings Services (S&P), Moody's Investors Service (Moody's), and Fitch Ratings (Fitch). They have dominated the market by leading approximately 95 percent of total market shares and S&P constitutes for 42 percent out of the total market (Véron, 2011). Overall, these CRAs can offer a substantial heterogeneity in categories of rating products based on different standard criteria, i.e. issuer vs issue, long-term vs short-term, confidential vs published ratings, and solicited vs unsolicited ratings, local vs foreign currency ratings.

Rating scales

Rating scales are described in form of alphabetic identifiers and varied from different agencies. For instance, the range of rating scale is categorised in the order of lowering of creditworthiness, from highest ratings to lowest ratings. S&P and Fitch use plus and minus signs to combine with letters (e.g., A+ and A-) while Moody's uses numbers to combine with letters (e.g. A1 and A3) (see Figure 2-4). The rating scales are grouped into two grading categories, i.e. investment-grade and speculative grade. To be specific, scales of BBB- or Baa3 and above are grouped into investment-grade long-term credit risk, whereas BB+ or Ba1 and below belong to "speculative" long-term credit risk (IMF, 2010). The differentiation of investment and speculative grade is important given by several reasons. First, the borrowing costs and opportunities of assessment to capital market are based on whether investment or speculative grade. Second, from regulatory view, there are stricter requirements for issuers of speculative grade bonds. Finally, that ratings fall below the investment grade sends a signal to institutional investors in due course of action (Gras, 2003).

Rating philosophy

To judge the behaviour of ratings and CRAs, it is important to understand the rating philosophy. In other words, when CRAs assign ratings, they evaluate time horizon to decide to choose whether short-term or medium and long-term perspectives to assess the solvency of institutions. That is so called 'Point-in-time' versus 'through-the-cycle' rating methodology (Muñoz, Pastor, and de Guevara, 2011). In general, ratings assigned by CRAs are based on 'through-the-cycle' instead of 'point-in-time' information, and apply the smoothing rules for rating changes which incur only if (i) the changes are likely persistent, and/or (ii) the changes are more than one notch (Cantor and Mann, 2007). In this sense, Altman and Rijken (2004 and 2006) find that the rating agencies focus on the

long-term in form of ‘through-the-cycle’ to achieve a certain stability. Cantor (2001), Fons, Cantor, & Mahoney (2002), Cantor and Mann (2003), Amato and Furfine (2004) and Bangia, Diebold, & Schuermann (2002), among others share the same views whilst Cantor (2001), Fons et al. (2002), and Cantor and Mann (2003) find that the agencies only adjust the ratings when permanent changes in solvency happen. In somehow contradictory, Alsakka and ap Gwilym (2012) find that among rating agencies, whereas S&P focus on the short-term accuracy, others pay attention to the long-term stability.

Figure 2.4: Rating scales

Rating			Numeric	
Moody's	S&P	Fitch	equivalent	Appraisal
Aaa	AAA	AAA	20	highest quality, smallest risk
Aa1	AA+	AA+	19	high quality, very low credit
Aa2	AA	AA	18	
Aa3	AA-	AA-	17	
A1	A+	A+	16	upper-medium grade, low credit risk
A2	A	A	15	
A3	A-	A-	14	
Baa1	BBB+	BBB+	13	moderate credit risk
Baa2	BBB	BBB	12	
Baa3	BBB-	BBB-	11	
Ba1	BB+	BB+	10	questionable credit quality
Ba2	BB	BB	9	
Ba3	BB-	BB-	8	
B1	B+	B+	7	high credit risk, generally poor credit quality
B2	B	B	6	
B3	B-	B-	5	
Caa1	CCC+	CCC	4	very high credit risk, extremely poor credit quality
Caa2	CCC	CCC	3	
Caa3	CCC-	CCC	2	
Ca	CC	CCC	1	highly speculative, potential recovery value low
D	D		0	

Notes: This figure shows the ratings scale of the Big Three credit rating agencies Adapted from Alsakka and ap Gwilym (2011).

2.3. Theoretical framework

This section provides the theoretical framework of the thesis which are grounded for my three empirical studies in chapter 3, 4 and 5. To be specific, section 2.3.1 reviews the configurational perspective on the chief executive officer (CEO), followed by the key theories in executive compensation in section 2.3.2, the financial intermediation theory in the section 2.3.3, and the self-sacrifice leadership theory in the section 2.3.4.

2.3.1. Configurational perspective on the chief executive officer (CEO)

The configurational perspective on the CEO framework is the recent comprehensive theory on management studies (Busenbark, Krause, Boivie, & Graffin, 2016)[6]. From this view, CEO decision is made based on the comprehensive perspectives which consist of the person, the position, and the environment (See Figure 2-5). This framework allows to study CEO-related phenomena from inter-relationships of theories from three comprehensive dimensions rather than just one dimension. Bonus-forgoing decision of CEOs in the first empirical study, therefore, has been examined based on this framework.

With regards to the position, this domain focuses on the corporate governance mechanisms related to the CEO, the strategic decision maker role of the CEO, and selection of the CEO. This one mostly concentrates on the agency theory (Fama & Jensen, 1983) because even though there are several theories such as stewardship theory, they tend to be as foils for agency theory (Boyd, 1995). This domain, therefore, presents the primary mechanisms to deal with principal-agent issue, namely incentives and monitoring (Jensen & Meckling, 1976; Tosi & Gomez-Mejia, 1994; and Boyd, 1994). Particularly, the monitoring function is the common duty of the entire board and its committees. Kesner (1988) finds that most key decisions originated from board-level committees, such as audit, executive, compensation, and nomination committees, which have crucial impact on firm activities (Vance, 1983). Researchers try to draw a full picture of CEO's structural position in the board management and the independence of the board from the CEO. However, there is no obvious evidence on the impact of either CEO chairman position or percentage of independent directors on the systematic performance (Dalton, Daily, Ellstrand, & Johnson, 1998; Krause, Semadeni, & Cannella; Tuggle, Sirmon,

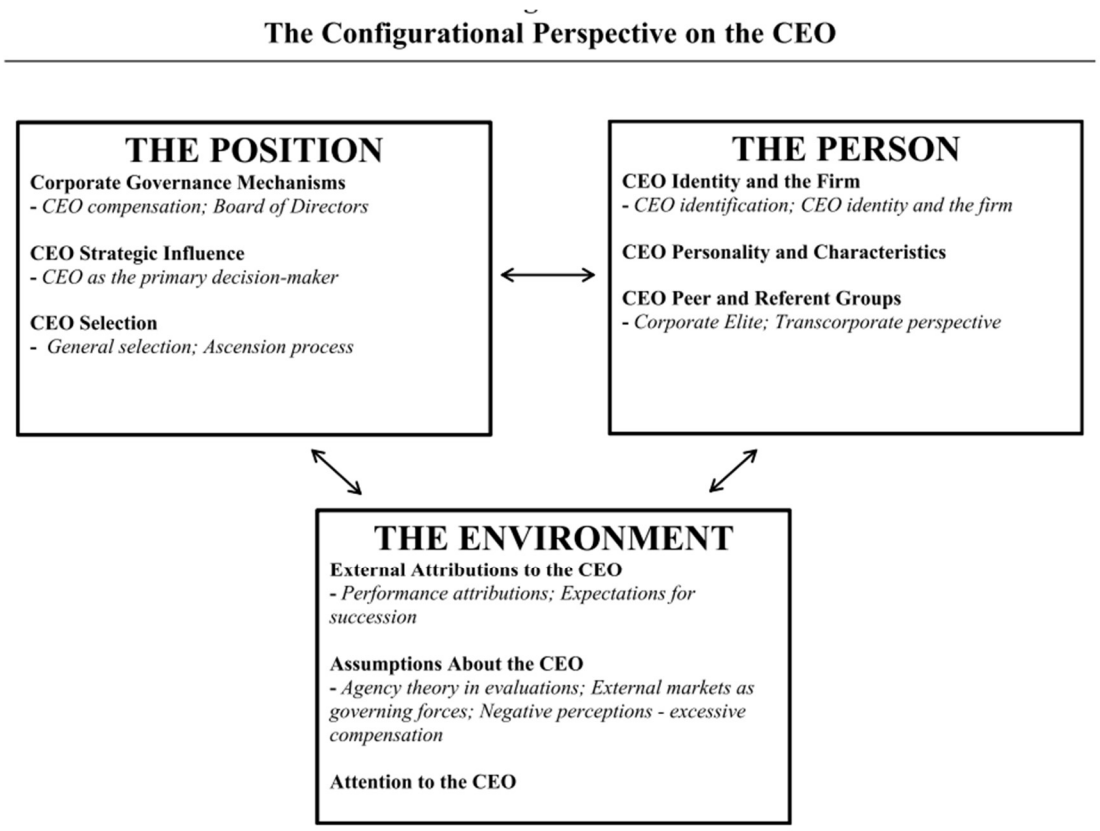
[6] See Busenbark, Krause, Boivie, & Graffin (2016) for extensive details of the framework.

Reutzel, & Bierman, 2010). In recent years, the demographics of corporate boards has changed with the higher proportion of outside directors and more slightly diversified in gender and ethnic (Finkelstein et al., 2009; Zhu, Shen, & Hillman, 2014). Boards appear to be more independent as a part of regulatory changes, i.e. Sarbanes-Oxley Act. However, that leads to the circumstance that there may be only CEOs who are the inside directors on boards, as a result, they may receive less vigilant monitoring given that these CEOs are the only source of firm-specific information on the board (Joseph, Ocasio, & McDonnell, 2014). Regards to executive compensation, which is discussed further in the next section, researchers attempt to understand the determinants of CEO compensation.

Additionally, a central role of CEO is given by the primary strategic decision maker for firms and literature provides mixed evidence on their impact on firm performance while there are some studies show that 20% to 40% of variation in firm performance can be explained by the CEOs (Crossland & Hambrick, 2011; Fitza, 2014; Quigley & Hambrick, 2015). The other studies suggest that the impact is limited (Fitza, 2014). To be reconciled, CEO experience and skills that are in line with firms' needs should be included (Gamache, McNamara, Mannor, & Johnson, 2015), or when they are put under specific conditions such as their functional experience and firm competitive strategies are consistent (Beal & Yasai-Ardekani, 2000).

Another aspect of position domain is CEO selection and the ascension process. In general, there are some important factors that sends to the position of CEOs, in particular, human capital is positively associated with being selected as the CEO (Brady, Fulmer, & Helmich, 1982; Daily, Certo, & Dalton, 2000, among others), person with experience matching with firm strategy (Datta & Guthrie, 1994; Daily, Certo, & Dalton, 2000), or a member of top management team under a celebrity CEO (Graffin, Wade, Porac, & McNamee, 2008). With respect of the ascension process, the tournament theory which refers to how individuals develop and hold the CEO position in the firm focus on the incentives and internal competition of one executive to become CEO (Connelly, Tihanyi, Crook, and Gangloff, 2014), and explain the reasons why CEOs are rewarded more than the others within the firm (Connelly et al., 2014; Conyon, Peck, & Sadler, 2001; Ridge, Aime, & White, 2015).

Figure 2.5: The configuration Perspective on the CEO



Notes: This figure provides the summary of the configurational perspective on the CEO. Adapted from Busenbark, Krause, Boivie, & Graffin (2016)

Related to the person, this domain focuses on CEOs' self-perceptions and characteristics of CEOs. The debate continues about whether CEO individual personality and their characteristics matters for firm outcomes (Herrmann & Nadkarni, 2014; Peterson, Walumbwa, Byron, & Myrowitz, 2009, among others). The neoclassical economics infers that individuals are homogenous, so it helps to explain the reason why different individuals make the same choice, but not why different individuals make different decisions. According to management literature, the upper echelon theory postulates that individual differences among CEOs would be important, especially in the more complex decision–making environment as in the banking business. The idiosyncratic experiences of executives significantly impact on the way they interpret the situations and make strategic decisions, and in due course influence on firm behaviour and performance (Hambrick & Mason's, 1984; Hambrick, 2007).

In the sense of identification and identities of CEOs with their firms, CEOs are quick to develop a sense of identity and connection with their firms compared to the regular employee, deriving a greater sense of efficacy, belonging, self-esteem and general

purpose in life. The CEOs who identify themselves with their firms are likely to put them into positions as the representatives for their firms and find themselves reflected through firm performance. There is evidence showing that CEO identity are reflected on firm's image (Briscoe, Chin, & Hambrick, 2014; Chin, Hambrick, & Treviño, 2013, among others). For example, a narcissistic CEO tend to be involved in corporate social responsibility (CSR) activities to satisfy their own need for attention (Petrenko, Aime, Ridge, & Hill, 2016). Political ideology may also influence on firm behaviour, for example, liberal-leaning CEOs were found to be more likely to engage in CSR activities (Chin, Hambrick, & Treviño, 2013) or conservative CEOs tended to have a lower likelihood of engaging in tax avoidance behaviours compared to those run by more liberal CEOs (Christensen, Dhaliwal, Boivie, & Graffin, 2015). Additionally, CEOs tend to choose board members who share demographically similar to themselves or have experience working with demographically similar members (Cannella, Jones, & Withers, 2015; Zhu & Westphal, 2014). Moreover, CEOs who are in the *corporate elite*[7] may behave differently among the other CEOs (Jensen & Zajac, 2004; McDonald & Westphal, 2011; Useem, 1984).

Finally, in term of the 'environment' dimension of the configurational perspective on the CEO framework, the environment in which CEOs work obviously perceives the CEOs. It consists of not only the traditional environment, such as country (Crossland & Hambrick, 2011) and industry (Hambrick & Quigley, 2013) which is identical for all CEOs but also the environmental factors that may be distinctive to each CEO (Busenbark et al., 2016). The literature provides evidence on the attribution of firm performance to the CEO, assumptions about the CEO and attention to the CEO. Particularly, research has demonstrated that CEO are often held accountable for the outcomes of the firm, when the firm runs well, the status of the CEO is often held in prestige from external parties (Khurana, 2002; Wade, Porac, Pollock & Graffin, 2006). Whereas, when the firm runs poorly, the CEO is considered as the instigator of this outcome and is often dismissed (Crossland & Chen, 2013). In addition, external markets and stakeholders can be functioned as CEO governing forces (Agle, Mitchell, & Sonnenfeld, 1999; Schepker & Oh, 2013) which include institutional activism, general investors (Grossman & Cannella, 2006; Zhang & Wiersema, 2009), security analysts (Wiersema & Zhang, 2011), peers (Bednar, Love, & Kraatz, 2015), and the media (Bednar, 2012; Bednar, Boivie, & Prince,

[7] *Corporate elite* is used to mention to those at the top of the firm in both case of a single firm and of all the elites (Jensen & Zajac, 2004; McDonald & Westphal, 2011; Useem, 1984)

2013; Gomulya & Boeker, 2014, among others). Moreover, there is evidence showing that CEO compensation is not aligned with the interests of shareholders (Dalton, Hitt, Certo, & Dalton, 2007; Tosi, Werner, Katz, & Gomez- Mejia, 2000), CEO try to maintain the high compensation packages (Davis, Yoo & Baker, 2003) or CEOs are perceived as celebrities, so they get high compensation package (Wade et al., 2006), thus, that raises the concern of excessive compensation for CEO (Kaplan, 2008). However, it is also likely that the high compensation is deserved for the CEO for their responsibility for firm performances which is recognised by the other parties (Quigley & Hambrick, 2015).

2.3.2. Executive compensation theories

This section provides the overview of traditional and modern theories of executive compensation which is summarised heavily based on Edman & Gabaix (2016). From the traditional theories, the view from "rent extraction" suggests that executive compensation contract is designed to maximize executive own rents instead of being set out by boards, so it is difficult to explain the data. This view stems from poorly designed contracts that are not in the best interests of the shareholders, specifically the CEOs assert their influential power over their boards and committees, resulting in pay that is too high and not tied to their performance (Bertrand and Mullainathan, 2001; Bebchuk and Fried, 2003, 2004; Conyon, 2014). As a result, that received a lot of attention from both scholars and policy maker and then there were major changes of compensation legislations in the U.S., i.e. the SEC requirements of disclosure of compensation in 2006 and "Say-on-pay" as a part of "Dodd–Frank Act in 2010 as mentioned in the above section.

In contrast, the modern theories based on "shareholder value" view are believed to present CEO compensation setting better and the predictions have remained homogenous with the observed practice. This view is from an economic or market-based perspective, suggesting that CEO compensation is led by the competitive labour market forces. CEOs compensation, therefore, is positively correlated with their talent and firm size, and contracting costs are minimised even though the contracts may not be perfect (Dow and Raposo, 2005; Edmans et al., 2009; Conyon, 2014). This view is also known as "optimal contract" view which typically concentrate on the details of contracts. However, it is widely considered as "shareholder holder" value view given by several reasons. First, even in case boards have more concerns about shareholder value than rent extraction, they unable to set out the perfectly optimal contracts because optimal contracts have been highly nonlinear in theory and less likely to be observed in practice. Second, it is so called

"bounded rationality" when boards may miss of certain performance measures which are potentially unobvious to set out the contracts.

Conclusively, these points of view are grounded for the first empirical study which we examine the reasons behind bonus-forgoing decision of the CEOs in the financial crisis in Chapter 3.

2.3.3. Financial intermediation theory

Overall, the theories of financial intermediation are classified into two groups, i.e. conventional and new concepts (Schmidt, Hackethal, & Tyrell, 1999). The traditional theories are formed on transaction costs and asymmetric information (Allen and Santomero, 2001). From the view of conventional theory, Gurley and Shaw (1955) prevail the reasons why banks exist. Typically, banks serve as a financial intermediary between surplus and deficit agents. For instance, banks connect savers and borrowers by taking deposits from savers and then transform those funds into loans to provide to borrowers in the economy (Sharpe, 1990; James, 1987; Fama, 1985; Allen and Santomero, 2001). As a result, they perform their roles more efficiently by transforming the capital and promoting the social value of capital. However, from the view of Gurley and Shaw (1955), banks and nonbank financial intermediaries were not differentiated.

Given the importance of banks in the financial intermediation process, it is tantamount that bankers, regulators, and societies at large better understand the factors, internal and external, that affect the efficacy of banks in the intermediation process. Numerous studies have explored and debated the "specialness" of banks[8]. In the model of Diamond and Dybvig (1983), banks have abilities to transform "illiquid assets into liquid liabilities" that makes them unique. Banks offer an efficient means of intermediating between the suppliers of capital and the users of capital enabling real economic growth.

In the same vein, changes at the bank holding company (BHC) level, exogenous to bank financial health or local economic conditions, can engender real consequences for the local economy. Ashcraft (2005) highlights both the specialness of banks in the

[8] See, for example, Boyd and Gertler (1994), Stein (1998), Allen and Santomero (1998, 2001), Kayshap, Benston (2004), among others.

intermediation process and identifies an external factor that can affect the efficacy of the intermediation process, i.e., changes emanating from the bank holding company.

However, in recent decades, there are substantial changes in the modern financial market that challenges the traditional view of intermediation and creates new concepts in financial intermediation theory. Allen and Santomero (2001) paint a compelling picture that the traditional banking business of accepting deposits and making loans is in decline. Commercial banks, the authors argue, have been able to maintain relevance in the financial intermediation process by innovating and switching from their traditional business to fee-producing activities. Boyd and Gertler (1994) provide evidence supporting the notion that traditional banking is changing, though not necessarily in decline. For example, the authors show that the share of financial intermediation conducted by commercial banks is declining relative other financial intermediaries, but that the ratio of bank assets to GDP is actually increasing. Boyd and Gertler argue that banks are simply changing. For example, the authors show 1) that non-interest income as a percentage of bank assets increased roughly 167% in the industry from the late 70s to 1992; and, 2) that the use of off-balance sheet derivative instruments as a means to hedge and to generate non-interest income has "exploded" over recent years.

The financial intermediation landscape for BHCs and their banks is changing, markedly so for the largest BHCs. As the industry shifts from its traditional business of decentralized deposit-taking and loan-making to one of more-centralized non-interest income and off-balance sheet activities, it is of utmost importance that bankers, regulators, and societies at large understand how the change affects the strategic mission of BHCs and, ultimately, how this shift impacts local economies. Taken together, both traditional and new theories are considered to examine the financial intermediation role of banks as in Chapter 4 and 5.

2.3.4. Self-sacrifice leadership theory

According to Yorges, Weiss, & Strickland (1999, p.428), self-sacrifice demonstrates a person who is willing ''to suffer the loss of types of things to maintain personal beliefs and values'' and this behaviour has been observed among the great leaders (Burns, 1978; Conger & Kanungo, 1987). There has been a growing body of literature on self-sacrificial leadership. This thesis focuses on this concept in the

distribution of rewards in the context of "organisational setting"[9]. Leader self-sacrifice has been in forms of either partial or total and either temporary in one point in time (radical) or continuous repeatedly (incremental) (Choi & Mai-Dalton, 1998), and it has been examined to serve as an effective mean of leadership (Choi & Mai-Dalton, 1999; De Cremer & Van Knippenberg, 2004; Van Knippenberg & Van Knippenberg, 2005; Yorges, et al., 1999). There have been evidences showing that leader self-sacrifice encourages trust and cooperation, as well as boosts performance among their followers (De Cremer, 2006; Van Knippenberg & Van Knippenberg, 2005) because those leaders sacrifice their personal self-interests, and switch personal costs to contribute to the pursuit of organizational interests (Conger & Kanungo, 1987; Shamir, House, & Arthur, 1993). In particular, followers of self-sacrifice leaders were keen on reciprocating their leaders' behaviour (Choi and Mai-Dalton, 1999). In the same vein, compared to self-benefiting leaders, self-sacrifice ones are believed to be more effective in promoting cooperation in a public good dilemma (De Cremer, 2002).

With regards to the behaviour temporarily exhibited, radical self-sacrifice has been described as "temporary postponement of personal interests in the distribution of rewards" (Choi & Mai-Dalton, 1998, p.479) with the purpose to change the attitudes of the members, build trust, and demonstrate loyalty and dedication to the organization (Conger, 1989; House & Shamir, 1993; Yukl, 1994). Moreover, leaders who sacrifice during times of crisis are perceived better (Halverson, Holladay, Kazama, & Quinones, 2004). In our first empirical study, from this point of view, CEOs' action of forgoing bonus is, therefore, viewed as radical self-sacrifice by employees that is investigated further in Chapter 3.

2.4. Conclusion

This chapter has presented a comprehensive review of background of the study and related theoretical framework for the main essays. In particular, the background of this thesis is given by the structure of executive compensation and institutional features regarding to executive compensation in the U.S. context and the overview of corporate credit ratings. With respects to theoretical framework, we apply the configuration perspective on the CEO, executive compensation theories in line with three specific

[9] See Choi & Mai-Dalton (1998) and Choi & Mai-Dalton (1999) for an overview of concept and extensive development of self-sacrificial leadership.

views, i.e. agency theory, rent extraction theory, financial intermediation theory, and leadership theory. However, earlier literature has not examined to the extend the determinant of bonus forgoing decision, cash bonus and mortgage risk-taking as well as the role of external credit rating changes in mortgage supply. This thesis, therefore, attempts to address to main issues above with the extended study in Chapter 3, 4 and 5. Particularly, the first one is based on the theory of configuration perspective on the CEO, leadership theory and executive compensation theory, the second one continuously lies on the executive compensation theory and financial intermediation theory, and the final one mainly contributes to the financial intermediation theory.

Chapter 3

Chapter 3: Why Do Bank CEOs Forgo Their Bonus During the Financial Crisis?

Abstract

This chapter examines the determinants and consequences of U.S. bank CEOs forgoing bonus during the 2007 - 2009 financial crisis. We find that CEOs are more likely to forgo bonus if their banks are larger and better governed environment, consistent with political cost and corporate information environment hypotheses. Subsequent to bonus forgoing, these CEOs total compensation are not negatively affected, they are less likely to depart, and their bank performance is not economically improved. The results shed light to the debate on CEO compensation and support compensation "shareholder value view", suggesting that forgoing bonus is a temporary decision and has little economic impact on bank's performance.

3.1. Introduction

Politicians and public always treat CEO pay a political issue and argue that CEOs are overpaid compared to average employees. This "rent extraction" view is supported by academic literature which focuses on CEOs influential power over their boards and committees, resulting in pay that is too high and not tied to their performance (Bertrand and Mullainathan, 2001; Bebchuk and Fried, 2003; Bebchuk and Fried, 2004). As a result, it leads to the major changes of compensation legislations in the U.S. such as the SEC requirements of disclosure of compensation in 2006 and "Say-on-pay" as a part of "Dodd–Frank Act in 2010. However, recent literature has documented that high CEO pay is led by the competitive labour market forces and reflects CEO talent and firm size (Dow and Raposo, 2005; Gabaix and Landier, 2009; Edmans et al., 2009; Gabaix et al., 2014). Evidence shows that CEOs have been indeed paid for their performance and penalised when their firms are underperformed and boards do play roles in monitoring CEOs (Kaplan, 2013). Especially,

the involvement of government in reducing compensation may backfire and that leads to unintended consequences such as the increase of inequality (Murphy, 2013; Edmans, 2016).

This study extends this debate from a different angle. We noticed that a number of bank CEOs forwent their bonuses during the crisis, for example, James Cayne of Bear Stearns (19-Dec-2007), Lloyd Blankfein of Goldman Sachs (16-Nov-2008), John Thain of Merrill Lynch (08-Dec-2008), Vikram Pandit of Citigroup (31-Dec-2008), among many others. Despite the high visibility of this phenomenon in the banking sector during the recent financial crisis, little research exists on whether or not these CEOs did so because of the government or public pressure and critics on reducing CEO's compensation in the long run. Unlike the popular media which often focuses on individual cases, this study attempts to answer this question by a holistic perspective on the industry. We hypothesize that they do so under both external and internal pressure. However, we do not find that the forgoing bonuses has impact on these CEOs' long term pay, and the market does not value it as positive news.

Specifically, we consider two plausible but mutually non-exclusive explanations for why a bank CEO chooses to forgo bonus during the financial crisis. These explanations all focus on the cost of not forgoing bonus and predict bank CEOs to be more likely to forgo bonus when the cost or pressure of not forgoing is relatively high. Such pressure may come from three sources: political costs (larger banks are more prominent (Laeven, Ratnovski, & Tong, 2016)), corporate information environment (transparency of corporate information), and CEOs' loyalty to their banks. CEOs themselves may feel strong internal pressure to forgo bonus as a mean to motivate corporate morale by signalling their willingness and resolution to share the ups and downs of their banks. CEOs more loyal to the bank they work for are more likely to forgo their bonus given that their behaviour is considered as radical self-sacrificial leadership behaviour, which is "temporary postponement of personal interests in the distribution of rewards" (Choi & Mai-Dalton, 1998, p. 479) on purpose of changing the attitudes of the members, building trust, and demonstrating loyalty and dedication to the firm. We refer to this channel as "loyalty hypothesis". While these sources of pressure are practically intertwined in forcing CEOs to forgo bonus, they all point to the overwhelming cost of not forgoing bonus in presence these pressures. Thus, we refer to these channels collectively as the costs of not forgoing bonus channel explanation.

In addition to the cost of not forgoing bonus, we also consider the "opportunism" explanation that some CEOs consider the cost of forgoing bonus. Many banks evaluate CEOs' performance based on the banks' predetermined performance priorities and strategic goals. Typical performance measures include accounting earnings or ratios (Murphy, 2001). Thus, if a bank fails to achieve its performance target, the CEOs' bonus will be capped. Hence, the cost of forgoing bonuses tends to be low because their banks are likely already performing below the target during the financial crisis.

We empirically evaluate the above explanations and find supportive evidence for the political cost, corporate information environment and loyalty hypothesis. Using a sample of CEOs from 98 U.S. publicly listed banks during 2007-2009, we find the propensity to forgo bonus increases in bank size and higher transparency of corporate information (as measured by audit committee size). We also find that internally promoted CEOs are more likely than externally promoted CEOs to give up their bonus and less likely to quit their job, consistent with their willingness to signal their commitment to their banks.

Next, we examine how bank CEOs' decision to forgo bonus relates to their total compensation, and whether the decision results in a temporary or a long-term effect. It is possible that the bank takes the opportunity of the financial crisis and market pressure to reduce CEO's compensation over the long run. Our empirical analysis fails to find evidence to support this possibility. Specifically, we find no evidence that CEOs who forwent their bonus are more likely to leave their job, nor were their subsequent total compensation negatively affected. These results suggest that it is unlikely the banks have long-term decision to reduce CEOs' total compensation, which may negatively affect CEOs' subsequent compensation and their incentives to move. These results are consistent with the view that CEOs' actions to forgo bonus during the financial crisis are temporary.

Subsequently, we examine whether CEOs' forgoing decision is to send a signal to the market that the management team has strong commitment to shareholders and demonstrates their benefits to be aligned with shareholder interests during the downturn period. In the presence of asymmetric information between managers and investors, forgoing CEOs can signal to investors by distinguishing themselves from those who do not forgo their bonus. We compare the accounting and market performance of banks whose CEOs forwent bonus with those whose CEOs did not forgo bonus. The results suggest that there are weakly

statistically significant differences in the changes of bank performance between the two groups after the forgoing year when controlling for their fixed effects. In other words, bonus-forgoing decision can be considered as a signal of interest alignment of CEOs.

This study contributes to several strands of literature. First, our results suggest that the government or public pressure and critics on reducing CEO's compensation does not have material impact on CEOs' long-term compensation since forgoing bonuses during certain periods tends to be short term. These results confirm the views that CEO pay is justifiable to their talents, can be largely explained by the market capitalization of their firms (Gabaix and Landier, 2009) and has not risen faster than other highly-paid professions (Kaplan and Rauh, 2010). It is also consistent with the view that "making CEO pay a political issue should be stopped" (Edmans, 2016).

Second, our findings extend the research on one-dollar CEO salary (Loureiro, Makhija, & Zhang, 2020; and Hamm, Jung, & Wang, 2015) and help explain why CEOs forgo financial rewards. Hamm et al. (2015) find that CEOs with higher ownership and worked at firms with depressed stocks, employee tension, and headquartered on the Silicon Valley area are more likely to take $1 salary to lessen the pressure of stakeholders when their firms underperform, and that it does not signal improvement in subsequent stock returns. Loureiro et al. (2020) focus on the consequences of $1 CEO salary on CEO compensation and firm performance. They show that $1 CEOs, compared to their peers, receive higher total compensation and their firms generate lower stock market returns after $1 salary adoption. The impact on total compensation is lessened by financial restructuring and CEO entrenchment and increased by CEO overconfidence. This study differs from these studies by focusing a specific period of particular political and economic tension (the 2007-2009 financial crisis) and in an important industry (banking), which has strategic implications on the overall macro-economy and thus has received great attention from the public and legislators during the financial crisis (Fahlenbrach & Stulz, 2011).

We find that CEOs are more likely to forgo bonus when facing greater pressure and that their banks' subsequent performance did not improve. Moreover, the pressure does not seem to be derived from stock performance, but from environment and position constituents (e.g., political costs, corporate information environment and CEOs' loyalty). Our findings further suggest that forgoing decision during the financial crisis is a short-term decision rather

than having impact on the total compensation of the CEOs (Loureiro et al., 2020). In addition, rather than salaries which do not vary with the performance of the firm or the executive, we focus on bonus, which is performance-based. Focusing on bonus is also more economically significant than on salaries because the average ratio of cash bonus over salary paid for 2006 performance of the 98 U.S. large banks in our sample is 4.26 (Fahlenbrach & Stulz, 2011). According to prior accounting research, bonus also plays an essential role in managerial decisions (Healy, 1985; Holthausen, Larcker, & Sloan, 1995).

Finally, this study offers some empirical evidence on the radical self-sacrificial leadership behaviour (Choi & Mai-Dalton, 1998) when the leaders give up or postpone their legitimate share of organisational rewards to build trust, show their loyalty and dedication to the firms (Conger, 1989; House & Shamir, 1993; Yukl, 1994) . We find that the internally promoted CEOs are more likely to forgo their bonus and they are less likely to exit, demonstrating their loyalty to the banks. Taking together, these findings are consistent with the view that CEOs' behaviours are affected by their working environment, their position, and their personal characteristics (Busenbark, Krause, Boivie, & Graffin, 2016).

The remainder of this chapter proceeds as follows. Section 3.2 presents our hypotheses of the alternative explanations of why CEOs are more likely to forgo their bonus. Section 3.3 describes data and discusses the sample selection. Section 3.4 presents our empirical methods and reports our results, and Section 3.5 provides additional tests. Section 3.6 contains a brief conclusion.

3.2. Relevant literature and hypotheses development

In this section, we derive predictions from the existing literature. A large literature on managerial career concerns suggest that CEOs' decisions can be influenced by various pressures on them in the form of cost of not forging bonus during the financial crisis. On the other hand, financial crisis reduces the cost of forgoing bonus, which may also explain some CEOs' bonus-forgoing decisions. These two mechanisms jointly explain the key reasons why some CEOs forgo their bonus during the financial crisis. In this section, we outline the theoretical predictions that motivate our empirical analyses. These predictions are not

mutually exclusive. Thus, our empirical analyses are joint tests of all predictions and we do not seek to isolate each individual channel.

3.2.1. Predictions from the costs of not forgoing bonus channel

3.2.1.1. Political cost hypothesis

Previous literature provides evidence that large firms are under greater government scrutiny as well as wealth transfers than smaller firms, receiving a higher their public visibility, hence being greater exposed to government regulatory actions (Jensen and Meckling, 1976; Zimmerman, 1983; and Watts and Zimmerman, 1986). In banking industry, CEOs at larger banks are even under greater scrutiny as they are better known by the public and suffer greater vilification in case of bank failures. In contrast, CEOs at smaller banks receive less attention and are more capable of remaining under the radar. Thus, we argue that by avoiding the public attention that "bonus" draws, CEOs can reduce the likelihood of adverse political actions and, thereby, reduce its expected costs. To be specific, CEOs at larger banks are more likely to forgo their bonus rather than those at smaller banks. This is generally consistent with "political cost hypothesis" which assumes a positive association between bonus forgoing decision and bank size, explaining why banks make disclosures of CEOs forgoing decision in proxy statements to mitigate potential political costs.

Also, it has been documented that CEOs are concerned about shareholders' criticisms on issues related to their compensation and actively seek to manage their public images by carefully crafting disclosures in proxy statements (Lewellen, Park, & Ro, 1996; Yermack, 1998; Baker, 1999). Such concerns are likely exacerbated by the intense public and political controversy over bank executive compensation, causing CEOs of larger banks to face greater scrutiny and possibly more intervention in their bonus rewards. As a result, we expect these CEOs to be under higher pressure to reduce political costs by forgoing their bonus. Thus, we develop the political cost hypothesis as below:

HYPOTHESIS 3-2-1-1 *(Political cost hypothesis): CEOs at larger banks are more likely to forgo bonus to reduce political costs.*

3.2.1.2. Corporate information environment hypothesis

The current studies on corporate information environment have been shaped in three aspects, namely (i) managers' voluntary disclosure decisions, (ii) disclosures required by the governments, and (iii) reporting decisions by analysts. We develop this hypothesis based on the first dimension to examine how audit committee size affects CEOs' bonus forgoing disclosure in the proxy statements and whether this decision is more favourable financial performance of a bank. More specifically, we argue that larger audit committee size that exhibits greater information transparency in financial reporting. The results have significant implications for the role of audit committee size in the corporate reporting information environment.

Audit committees serve to protect shareholder interest by overseeing corporate reporting to assist the board of directors in monitoring the management. Audit committee effectiveness have been used to proxy for governance quality (Zaman et al. 2011, Mallin, 2013), and is also considered as an important part of the governance structure in recent years (Ghafran and O'Sullivan 2013). Prior literature on audit committees is extensive, mostly focusing on accounting quality; interestingly, they can also serve as a key factor on reporting of non-financial information, such as intellectual capital disclosures (Li, Mangena, & Pike, 2012). In this study, we mainly focus on the audit committee because they deal with agency problems directly (Xie, Davidson, and Dadalt 2003). Moreover, the bonus restrictions under EESA trigger the "clawback" provision in case of inaccuracy of bank financial statements. To be specific, the Troubled Asset Relief Program (hereafter TARP) - the largest government bailout funding program - was introduced under the Emergency Economic Stabilization Act of 2008 (EESA), allowing financial institutions to sell up to US$700 billion of their mortgage-backed and other troubled assets to the U.S. government to infuse their equity. On 14 October 2008, Capital Purchase Program (CPP), a part of TARP, has committed to US$250 billion. The dual objectives of TARP were to temporarily support unhealthy banks to recover from the financial distress and strengthen capital base for sound banks, reinstituting credit flows in the economy (Cornett, Li, & Tehranian, 2013). In view of public outrage over the fast-growing bailout costs, the US Treasury Department imposed additional restrictions on executive compensations for TARP recipients in October 2008. Specifically, TARP receiving institutions must disclose the compensation for their executives – CEO, CFO and the next 3 most highly compensated officers – to reduce excessive risk–taking;

under the “clawback” provision, arrange retrieval of any bonus or compensation based on performance measures that are subsequently proven to be inaccurate; and forbid certain types of “golden parachute” packages. Subsequently, in February 2009, the American Recovery and Reinvestment Act of 2009 (ARRA) set the cap on compensation, i.e. $500K, imposed further restrictions on golden parachutes and incentive compensation such as bonus, retention payments, and other means of compensation with the exception of restricted stocks no more than one third of the total annual compensation and to be vested after TARP repayment. These restrictions were retroactive to those which received exceptional assistance (Cadman, Carter, & Lynch, 2012). Hence, we expect that audit committees maintain an important role in enhancement of the reporting, so the disclosure of CEOs’ bonus-forgoing decisions on banks’ proxy statements.

Size is an important attribute of audit committee effectiveness. Audit committees need resources and power to be able to effectively serve their control role (Defond & Francis, 2005; Mangena & Pike, 2005). The Sarbanes-Oxley Act (SOX) of 2002 has no direct guidance on audit committee size and the empirical evidence on the effects of audit committee size is mixed. Earlier studies generally find smaller committees to be more beneficial in terms of sharing and processing information from the management more frequently and more intensively (Lipton and Lorsch 1992; Jensen 1993). The finding is consistent with the literature on organizational behaviours. For example, larger committee size has been associated with longer time for decision making (Steiner 1972), productivity losses (Hackman 1990), lower efficiency due to less cooperation and more free riding (Jensen 1993), less CEO performance-turnover sensitivity (Yermack, 1996) and higher likelihood of entrenched CEOs (Beasley, 1996; Dechow, Sloan, & Sweeney, 1996). In contrast, more recent studies find larger committees to be more advantageous due to their greater knowledge to advise and monitor the management (Klein, 2002b; Anderson, Mansi, and Reeb, 2004). The documented benefits of larger audit committees include: lower bond yield spreads (Anderson, Mansi, & Reeb 2004) and less earnings management (Cornett, McNutt, & Tehranian, 2009; Yang & Krishnan, 2005). The relation between audit committee size and financial reporting quality is however mixed and inconclusive (Abbott, Parker, & Peters 2004; Bedard, Chtourou, & Courteau, 2004; Mangena & Pike 2005; Wilbanks, Hermanson, & Sharma, 2017).

Overall, this stream of literature suggests that larger audit committees tradeoff between (a) more resources such as diversified background and skills to perform their duties, and (b) a problem of coordination and free riding that could arise to lessen their effectiveness (Laksmana 2008).

Given that our sample period overlaps more with the recent studies, which generally find larger audit committees to be associated with voluntary disclosure, implying better corporate reporting information environment, we expect a positive relation between audit committee size and CEOs' decisions to forgo bonus. Thus, we develop the following hypothesis:

HYPOTHESIS 3-2-1-2 *(Corporate information environment): CEOs at banks with larger audit committee size are more likely to forgo bonus.*

3.2.1.3. Loyalty hypothesis

In addition to pressures from regulatory bodies and corporate governance within banks, pressures can also come from within CEOs themselves either due to their sense of loyalty or as a signal of their resolution to weather the financial crisis with shareholders. By forgoing bonus, banks CEOs seek to boost corporate morale by showing their willingness to share the ups and downs of their banks. From the leadership literature, CEOs' action of forgoing bonus is viewed by employees as radical self-sacrifice, which is "temporary postponement of personal interests in the distribution of rewards" (Choi & Mai-Dalton, 1998, p.479) with the purpose to change the attitudes of the members, build trust, and demonstrate loyalty and dedication to the organization (Conger, 1989; House & Shamir, 1993; Yukl, 1994). Moreover, leaders who sacrifice during times of crisis are perceived better (Halverson et al. 2004). The pressure to forgo bonus to signal CEOs' loyalty and commitment likely differs between internally promoted CEOs and their externally hired counterparts. In terms of managerial skills, externally hired CEOs are more prized for their broader and more general knowledge and managerial skills derived from their characteristics: traits, education and experiences (Hambrick & Mason, 1984), whereas internally promoted ones specialize in firm-specific knowledge and managerial skills accumulated from prior experience within the firm (Harris & Helfat, 1997; Zhang & Rajagopalan, 2003); therefore they are better fits for firms in a strategic context (Kesner and Sebora 1994). With more skills and knowledge tied

to the specific firm, internally promoted CEOs are likely to face greater pressure to signal their loyalty and commitment to their firms than their externally hired counterparts.

Besides, in terms of collaboration within the firm, internally promoted CEOs tend to have greater social capital, which helps them do their job more effectively and cooperate more closely with the boards and other firm employees; in contrast, when CEOs are hired externally, there is uncertainty about their abilities, making collaborating more difficult (Hermalin 2005). For this reason, we expect that, compared with externally hired CEOs, internally promoted CEOs have more social capital and better connections with the employee base in the firm, and thus have more incentives to forgo bonus to align themselves with their firms.

Finally, using a sample of U.S. investment banks during 2003 – 2009, Bidwell (2011) find internally promoted CEOs to have lower exit rates than the external hires. Thus, internally promoted CEOs have longer career and greater stake in their current firms, which implies greater benefits to be gained by demonstrating their loyalty to their banks through forgoing their bonus. Taken together, the *pressure from loyalty hypothesis* thus predicts the following hypothesis:

HYPOTHESIS 3-2-1-3: *CEOs are more likely to forgo their bonus if they are internally promoted.*

3.2.2. Predictions from the opportunism channel - Costs of forgoing bonus channel

Another possible explanation for CEOs' bonus-forgoing decisions concerns the cost of forgoing bonus. During the financial crisis, the overall bank performance deteriorated, thus lowering the value of potential forgone bonus. This is because CEO bonus is usually set in reference to banks' predetermined performance priorities and strategic goals. The performance measurements vary across banks, including earnings (e.g., net income, pre-tax net income) or accounting ratios (e.g., return on assets) (Murphy 2001). During the financial crisis, these measures sharply fell short of banks' targeted financial performance and market evaluation, which implies little or no bonus reward to CEOs anyways; hence, the cost of

forgoing bonus is minimal. Thus, the *opportunism hypothesis* predicts the following hypothesis:

HYPOTHESIS 3-2-2: *CEOs are more likely to forgo bonus if their banks underperform.*

3.3. Sample, Variable Measurement, and Descriptive Statistics

To test the above hypotheses, we construct a sample and collect data on bank characteristics, bank governance, CEOs, and their compensation. In this section, we describe a sample construction, discuss the measurement of main variables, and present the sample summary statistics.

3.3.1. Sample construction

Following Fahlenbrach & Stulz (2011), we start with an initial sample of 98 U.S. banks with 294 observations focusing on financial firms (SIC code between 6000 and 6300) but excluding businesses of non-traditional banking, e.g., firms in Investment Advice (SIC code 6282), Financial Services (SIC code 6199), and Security Brokers and Dealers such as pure brokerage houses (SIC code 6211) during 2007-2009. Next, we collect compensation data from Execucomp. We determine whether a CEO gave up bonus during the financial crisis by reading and coding information from the bank proxy statements, and when available, supplemented by searching business press online such as Financial Times, Reuters, the Wall Street Journal. There are 70 observations dropped because the proxy statements are missing, and banks are delisted. The composition of CEOs separated by "forgo" and "non-forgo" group are (8, 74), (16, 58), and (7, 61) for 2007, 2008, and 2009, respectively. Out of the 98 banks, we exclude accumulated 16, 24 and 30 banks in 2007, 2008 and 2009, respectively. We list the sample banks and their bonus-forgoing CEOs in Appendix 3A, and selected examples of 'forgo decision' mentioned in the proxy statements in Appendix 3B.

Next, we merge data from three sources: (i) CEO background information from BoardEx, (ii) financial data from COMPUSTAT, and (iii) stock market data from CRSP. We collect TARP details from the TARP Investment Program Transaction Report issued by the U.S. Treasury on 29 September 2010. After merging, our final sample has 224 bank-year

observations, covering 76% of original sample of Fahlenbrach & Stulz (2011). In 31 observations from this sample, the CEOs forwent bonus during 2007–2009, accounting for 13.84% of the sample. Nearly half of these observations (16 cases) occurred in 2008 at the peak of the crisis. Table 3-1 presents the sample selection.

Table 3.1: Bank Sample Construction

Year	No of banks	N of banks dropped	Remaining banks
2007	98	16	82
2008	98	24	74
2009	98	30	68
Total	294	70	224

Note*:* This table summarises our sample selection procedures. It presents the number of banks covering the original bank sample followed by Fahlenbrach & Stulz (2011). There are 70 observations dropped because the proxy statements are missing, and banks are delisted. The composition of CEOs separated by "forgo" and "non-forgo" group are (8, 74), (16, 58), and (7, 61) for 2007, 2008, and 2009, respectively. The information is collected from the sample banks' proxy statements.

3.3.2. Variables measurement

Our hypotheses in the previous section involve two main channels: the pressure channel and the opportunism channel. We proxy the pressure from bank corporate governance is with *Audit committee size*, measured as the natural logarithm of the number of directors on the audit committee. Also, *Expertise* measrues the audit committee financial expertise, defined as the proportion of the non-executive directors (NEDs) with related functional experience such as a public accountant, auditor, principal or chief financial officer, controller, or principal or chief accounting officer on the audit committee (Carcello & Neal, 2003; (Defond et al. 2005).[10] *Bank size* is measured as the natural logarithm of total assets in millions of dollars, lagged at time year *(t-1)* (George, 2015; Laeven, Ratnovski, & Tong, 2014, 2016). We measure loyalty as *Inside appointed*, an indicator set to one for internally promoted CEOs, and zero otherwise (Kuang, Qin, and Wielhouwer 2014).

To capture the opportunism channel, we measure bank performance using both market-based and accounting-based ratios, namely Tobin's Q (*Tobin Q*), Return on Assets (*ROA*) and Returns on Equity *(ROE)*. *Tobin Q* is defined as the ratio of market to book value of assets in the prior year. *ROA, and ROE* are the ratios of net income to total assets, and total equity, respectively. We describe the definition and data sources for the variables used in our analysis in Appendix 3C.

3.3.3. Sample characteristics

Panel A of Table 3-2 presents the summary statistics.[11] Among the proxies for pressures from governance, the average audit committee size is 1.46 (corresponding to 4.42 members) similar to that reported in prior studies (Cornett et al., 2009). On average, about 10% of the audit committees have financial experts, and about 63% of the CEOs are internally promoted. The average natural logarithm of bank total assets is 10.1 (corresponding to $159 billion). For bank performance, we winsorize the variables at the 1st

[10] Noticeably, we find that the average proportion of independent NEDs sitting on audit committee is extremely high in our sample, i.e. 99 percent, consistent with the independence requirements of SOX.
[11] We re-run regressions with all variables are winsorized at the 1% level to mitigate the influence of outliers, and the results are still hold. Thus, we do not report the winsorized variables in the summary statistic table.

and 99th percentiles to mitigate undue influences of outliers or data error. The average Tobin's Q, ROA, and ROE are 1.04, 0.63%, and 6.80%, respectively.

Table 3.2: Summary Statistics

Panel A: Full Sample of All Banks

This table provides bank level and CEO level summary statistics from 2007 to 2009 for the full sample. All continuous variables are winsorized at the 1st and 99th percentile levels. Variable definitions and data sources are presented in the Appendix 3C.

	Mean	SD	Median	Min	Max	N
Forgo	0.14	0.35	0	0	1	224
TARP	0.22	0.42	0	0	1	224
Total assets ($bil)	157	390	14	2	1,938	224
Bank size	10.1	1.77	9.56	7.61	14.5	224
Tobin Q	1.04	0.072	1.04	0.91	1.24	224
ROA	0.63%	1.20%	0.92%	-4.30%	2.20%	224
ROE	6.80%	14%	9.80%	-58%	26%	224
Leverage	0.9	0.029	0.9	0.81	0.97	224
Market-to-book ratio	1.6	0.75	1.53	0.3	3.7	224
Diversification ratio	0.2	0.14	0.19	-0.026	0.59	224
Audit committee size	4.42	1.09	4	3	8	224
Ln (Audit committee size)	1.46	0.24	1.39	1.1	2.08	224
Audit committee independence	99%	6%	100%	50%	100%	224
Expertise	10%	15%	0%	0%	50%	224
Board size	12.3	2.89	12	7	20	224
Ln (Board size)	2.49	0.23	2.48	1.95	3	224
Inside appointed	0.63	0.48	1	0	1	224
Directorship experience	0.55	0.99	0	0	5	224
Ln (Directorship experience+1)	0.3	0.48	0	0	1.79	224
Duality	0.66	0.47	1	0	1	224
Tenure	9.56	7.3	8	1	27	224
Ln (Tenure)	1.87	0.98	2.08	0	3.3	224
CEO ownership (%)	1.8	3.6	0.23	0	23.2	224
Ivy League	0.21	0.4	0	0	1	224
Excess $500K ($000)	4,757	9,212	1,432	-	42,513	224
Ln (Excess $500K)	6.73	2.67	7.27	0	10.7	224
GDP ($bil)	727	590	493	37	1,984	224
Ln (GDP)	13.1	1	13.1	10.5	14.5	224

Table 3.2: Summary Statistics - Panel B: Subsamples by Banks with Forgoing and Non-Forgoing CEOs

This table provides bank level and CEO level summary statistics from 2007 to 2009 for the subsamples of forgo and non-forgo group, and the differences across the two groups using two-tailed t-tests for means and Wilcoxon signed-rank tests for medians. All continuous variables are winsorized at the 1st and 99th percentile levels. *, **, and *** denote significance at the 10%, 5% and 1% level, respectively. Variable definitions and data sources are presented in the Appendix 3C.

	Forgoing group			Non-Forgoing group			Differences	
	N	Mean	Median	N	Mean	Median	Mean	Median
TARP	31	0.39		193	0.20		0.19**	
Total assets ($bil)	31	521	65	193	99	13	422***	52**
Bank size	31	11.43	11.08	193	9.89	9.49	1.54***	1.59**
Tobin Q	31	1.03	1.02	193	1.04	1.04	-0.01	-0.02
ROA	31	1.00%	1.00%	193	1.00%	1.00%	0	0
ROE	31	7.00%	10.00%	193	7.00%	10.00%	0	0
Leverage	31	0.92	0.91	193	0.90	0.90	0.02***	0.01**
Market-to-book ratio	31	1.53	1.48	193	1.62	1.54	-0.09	-0.06
Diversification ratio	31	22%	19%	193	20%	19%	0.02	0
Audit committee size	31	5.13	5.00	193	4.30	4.00	0.83***	1***
Ln (Audit committee size)	31	1.60	1.61	193	1.43	1.39	0.17***	0.22***
Expertise	31	14%	0.00	193	10%	0.00	4%	0
Board size	31	12.58	12.00	193	12.31	12.00	0.27	0
Ln (Board size)	31	2.51	2.48	193	2.48	2.48	0.03	0
Inside appointed	31	0.81		193	0.61		0.2**	
Directorship experience	31	1.10	0.00	193	0.47	0.00	0.63***	0***
Ln (Directorship experience+1)	31	0.54	0.00	193	0.27	0.00	0.27***	0***
Duality	31	0.61		193	0.67		-0.06	
Tenure	31	8.47	6.00	193	9.74	8.00	-1.27	-2
Ln (Tenure)	31	1.80	1.79	193	1.88	2.08	-0.08	-0.29
CEO ownership	31	1.51	0.05	193	1.84	0.25	-0.33	-0.20
Ivy League	31	0.35		193	0.18		0.17**	
Bonus/Total compensation	31	0.15	0.05	193	0.19	0.18	-0.04	-0.13
Excess $500K ($000)	31	11,237	1,853	193	3,716	1,853	7,521***	434
Ln (Excess $500K)	31	6.96	7.52	193	6.69	7.26	0.27	0.26
GDP ($bil)	31	613	579	193	746	493	-133	86
Ln (GDP)	31	12.86	13.27	193	13.13	13.11	-0.27	0.16

Because we are interested in understanding the differences between banks whose CEOs forwent bonus (forgo banks/CEOs) and those that did not (non-forgo banks/CEOs), we therefore provide all summary statistics for each subsample separately in Panel B of Table 2. Columns 1 and 2 show the number of observations, mean and median value of characteristics for the forgo and non-forgo groups, respectively and column 3 reports the differences. We test the significance of the differences in means and median using two-sided t-tests and Wilcoxon signed–rank tests, respectively (Hamm, Jung, and Wang 2015).

The comparison of forgo and non-forgo groups shows that the forgo and non-forgo banks (and their CEOs) are overall comparable across a broad range of characteristics, but there are a few notable differences. For example, forgo banks are nearly twice as likely as non-forgo banks (39% versus 20%) to receive TARP funds during the 2008-2009 financial crisis, significant at the 0.05 level. The size of the forgo banks are substantially larger than that of non-forgo banks. In particular, the average total assets of forgo banks is more than five times as that of non-forgo banks ($521 billion versus $99 billion), and the average natural logarithm of total assets of forgo banks is 11.43 compared to 9.89 of non-forgo banks, and these differences are significant at the 0.01 level. The average audit committee of the forgo banks is larger than that of the other banks (5.13 versus 4.30). Forgo banks' audit committees also tend to have more financial expertise than non-forgo banks' (14% compared to 10%). Interestingly, more CEOs at the forgo banks (81%) are internally promoted than at the non-forgo banks (61%). These differences are largely consistent with hypotheses on the pressure channel, but not the opportunism channel, as we find no significant difference in the bonus-to-total-compensation ratio between the two subsamples. We present our regression analyses in the next section.

3.4. Empirical results

In this section, we present an empirical analysis of the hypotheses developed in Section 2. First, we present the evidence of the pressure mechanism. Particularly, the CEOs are more likely to forgo their bonus if their bank size are larger, the internal monitoring governance is intensifier, as well as if these CEOs are internally promoted. We do not find that the propensity of forgoing is negative with relative bank performance during the financial crisis. Finally, we provide additional evidence that the pressure mechanisms have more significant impact on the CEO's decision to forgo bonus than the magnitude of the bonus forgoing.

3.4.1. Cost of not forgoing bonus channel

To test the predictions of the pressure mechanism developed in Section 3.2, we estimate a series of binary logistic regressions. These regressions use different pressure proxies, thus allowing us to examine the impact of pressure from various sources on CEOs' bonus-forgoing decisions. We regress the likelihood of forgoing bonus on pressure indicators and control variables as follows:

$$Pr(Forgo_{i,t} = 1|Pressure_{i,t,t-1},X_{i,t,t-1}) = G(\beta_1 + \beta_2 Pressure_{i,t,t-1} + \beta_3 X_{i,t,t-1}' + \varepsilon_{it}) \qquad (1)$$

The dependent variable, $Forgo_{i,t}$, a dummy variable that takes the value of one if a CEO did forgo his/her bonus in fiscal year t, and zero otherwise. The explanatory variables of interest are pressure indicators for *corporate governance*, and *loyalty hypothesis*, respectively, consisting of *Bank size, Audit committee size, Expertise, Inside appointed* as described in Section 3.3.2. β_2 is the coefficient of interest. Our *pressure hypothesis* predicts it to be positive ($\beta_2 > 0$), indicating that CEOs are more likely to forgo bonus under pressure.

Following Hamm et al. (2015), $X_{i,t,t-1}$ is a vector of control variables, which includes $X_{i,t}$ capturing current characteristics of governance and CEOs and $X_{i,t-1}$ controlling for bank-specific and macro-economy-specific characteristics lagged at time *(t-1)*. These variables account for the factors that likely affect both the bonus-forgoing decision and pressure factors. Appendix 3C elaborates on the construction of these variables.

Our controls for characteristics of governance and CEOs include Board size, measured as the natural logarithm of the number of directors on the board. We also control for another element of monitoring effectiveness which is audit committees' financial expertise. In 2003, the SEC finalized Sections 406 and 407 of SOX, which require public firms to disclose either the names of at least one "financial expert" on audit committee, or explanations for having none. A "financial expert" must have the "education and experience as a public accountant or auditor or a principal financial officer, comptroller, or principal accounting officer of an issuer, or from a position involving the performance of similar functions" (Section 407, SOX). Financial experts should have the crucial skills and knowledge to interpret the information correctly and help the board to advise and monitor the management of increasingly complex banks. The prior literature provides evidence generally supporting the positive role of financial experts in terms of quality of financial reporting measured by restatement (Abbott, Parker, & Peters, 2004; Krishnan & Visvanathan, 2008), earnings management (Bedard, Chtourou, & Courteau, 2004; He & Yang, 2014), fraudulent manipulation of financial statements (Farber, 2005), disclosure levels (Mangena and Pike 2005), and recent studies focus on the internal control weakness, insolvency risk, and litigation risk. Particularly, Lisic, Neal, Zhang, & Zhang (2016) find that independent and financial expert of audit committee is associated with reduced CEO power, while negatively associated with internal control weaknesses. Moreover, the negative relation disappears if the CEO is overly powerful, suggesting that the monitoring effectiveness of audit committee financial expertise is contingent on the power of CEO being restrained. Furthermore, García-sánchez, García-meca, & Cuadrado-ballesteros (2017) find a positive effect on banks' insolvency risk, consistent with the monitoring effect of audit committee financial expertise. Krishnan & Lee (2009) find that firms with higher potential litigation risks are more likely to have accounting financial experts on audit committee and this relationship exists in firms with relative strong corporate governance, but not in those with weak governance. Following this stream of literature, which generally suggests a positive relation between financial expertise and monitoring advantage, we expect the financial expertise on audit committees to reflect stronger bank monitoring governance strength, thus exerting pressures on the CEOs to forgive bonus.

In addition, we control for the number of years the CEO has been in role (Tenure) (Yim 2013; Houston and James 1995; Deyoung, Peng, and Yan 2013); the percentage of shares owned by the CEO as reported in fiscal year t (Ownership) (Hamm, Jung, and Wang 2015; Yim 2013; King, Srivastav, and Williams 2016); whether the CEO chairs

the board of directors (CEO duality), a proxy for CEO power; and, an indicator for compensation in excess of $500K lagged at time (t-1) (Excess $500K) (Bayazitova; and Shivdasani 2012). Furthermore, we control for CEO characteristics such as whether the CEO graduated from one of the Ivy League universities (Ivy League) as such a CEO signals upper class status (Mattis, 2000) and is likely to possess higher centrality (El-khatib, Fogel, and Jandik 2015); and the CEO's experiences acquired by holding directorships (Directorship experience). The inclusion of these controls is motivated by the central tenet of leadership studies, which suggests that one's backgrounds, set of skills, extensive knowledge, managerial abilities and experiences distinguish executives from others by the way they interpret and assess the issues (Fama, 1980; Fama and Jensen, 1983; Elyasiani and Zhang, 2015; Finkelstein et al., 2009).

We further control for the bank-specific characteristics and the economic performance of the state where the banks are headquartered. Bank-level information is collected from the Compustat Bank Fundamentals Annual and CRSP, and the data on macroeconomic condition are obtained from U.S. Department of Commerce - Bureau of Economic Analysis. Bank-specific variables include: financial leverage measured as the ratio of total assets to stockholder's equity book values (*Leverage*), *market-to-book ratio* measured as market value of equity over book value of equity, and the diversification of the bank activities measured by the ratio of non-primary income to total operating income *(Diversification)*., and we use the natural logarithm of national gross domestic product per capita (*GDP*) to capture the macroeconomic condition.

Table 3-3 presents the pairwise (Pearson) correlations among variables, and Table 3-4 reports the estimates from the logistic regressions in Equation (1). We observe the same patterns that we noted in Table 2 Panel B. Specifically, CEOs' forgoing decisions appear to be driven by the pressures from corporate governance and loyalty. We report the marginal effects estimated at the mean for continuous variables and for a change in an indicator variable from zero to one for indicator variables. In columns (1) and (2) of Table 3.4, we include all pressure proxies with no control variable to assess and compare the effect of each pressure source with and without year fixed effects. We find significant effects from all of variables of interest. In columns (3), we use the full model with control variables and year fixed effects, and find that the strongest results come from larger banks (*Bank size*) and banks with a larger audit committee (*Ln(Audit committee size)*) and internally promoted CEOs (*Inside appointed*) are marginally more likely to forgo bonus.

We evaluate the economic significance of these pressure proxies by the marginal effects from the regressions. As hypothesized, one standard deviation increase in bank size and audit committee size is associated with an increase in the probability of bonus forgoing by 11.33% (=1.77*0.0640) and 39.68% (=exp(0.24)*0.3121). Moreover, a CEO internally promoted is 10.05% more likely to forgo bonus. Together our evidence supports the political cost, corporate information environment and loyalty hypotheses that CEOs are more likely to forgo their bonus when they face greater pressures from external and internal constituents.[12]

[12] We replace the binary logistic analysis by the probit analysis to test such relationships in the robustness tests. Because we obtain the similar findings, we do not report them.

Table 3.3: Correlation Matrix

This table reports Pearson pairwise correlation coefficients for all independent variables used in the forgo likelihood regression models. Variable definitions are presented in the Appendix 3C. All continuous variables are winsorized at the 1st and 99th percentile levels. The coefficients in bold with the symbol *, **, and *** denote significance at the 10%, 5% and 1% level, respectively.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1)	Bank size																	
(2)	Tobin Q	-0.25***																
(3)	ROA	0.01	0.59***															
(4)	ROE	0.08	0.52***	0.95***														
(5)	Leverage	0.28***	-0.02	-0.11	0.02													
(6)	Market-to-book ratio	-0.06	0.86***	0.58***	0.61***	0.25***												
(7)	Diversification ratio	0.47***	0.07	0.09	0.16**	0.17**	0.26***											
(8)	Ln (Audit committee size)	0.31***	0.02	0.05	0.12*	0.17**	0.17**	0.34***										
(9)	Expertise	0.1	-0.18***	-0.15**	-0.15**	0.11	-0.17***	0	-0.11									
(10)	Ln (Board size)	0.44***	0.05	0.14**	0.12*	-0.13*	-0.01	0.33***	0.33***	-0.17**								
(11)	Inside appointed	0.08	0.13*	0.18***	0.21***	0.13*	0.21***	0.16**	0.09	-0.07	-0.03							
(12)	Ln (Directorship experience+1)	0.48***	-0.27***	-0.12*	-0.1	0.14**	-0.25***	0.09	-0.02	0.09	0.18***	-0.05						
(13)	Duality	0.14**	0	0.08	0.1	0.04	0.02	0.05	-0.13*	0.09	0.09	0.1	0.14**					
(14)	Ln (Tenure)	-0.32***	0.05	0.05	0.05	-0.04	-0.04	-0.30***	-0.16**	0	-0.17**	0.01	-0.13*	0.38***				
(15)	CEO ownership	-0.24***	-0.01	0.05	0.07	0.14**	-0.02	-0.22***	-0.16**	0.05	-0.34***	0.17**	-0.06	0.05	0.43***			
(16)	Ivy League	0.28***	-0.12*	-0.08	-0.05	0.21***	-0.03	0.12*	0.12*	0.24***	0.08	-0.02	0.11	-0.03	0.02	0.13*		
(17)	Ln (Excess $500K)	0.46***	0.05	0.22***	0.28***	0.07	0.14**	0.30***	0.16**	-0.11	0.23***	0.11	0.07	0.26***	0.16**	0	0.08	
(18)	Ln (GDP)	0.13*	-0.02	0.1	0.11*	0.12*	0.06	0.06	-0.05	-0.09	-0.1	-0.05	0.09	0.02	-0.05	0.09	0.07	0.1

Table 3.4: Logistic Regressions of CEOs' Decisions to Forgo Bonus: the costs of non-forgoing channel

This table reports the marginal effects estimated at the mean for continuous variables and for a change in an indicator variable from zero to one for indicator variables from logistic regressions of the bonus-forgoing decision on costs of non-forgoing channel: *Bank size, Ln(Audit committee size),* and *Inside Appointed*. *Bank size* is the natural logarithm of the total assets in millions of dollars, lagged at time year (t-1), *Ln(Audit committee size)* are the natural logarithm of the number of directors sitting on audit committee. *Inside appointed* is a dummy variable that takes the value of one if a CEO is appointed from inside the bank, i.e. the year when a CEO joins the bank and that when he/she is promoted to be a CEO is the same, and zero otherwise. The sample period is 2007-2009. All continuous variables are winsorized at the 1st and 99th percentile levels. Robust standard errors clustered by banks. t-statistics are shown in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. Variable definitions are presented in the Appendix 3C.

	Prob (Forgo=1)		
	(1)	(2)	(3)
Bank size	0.0327**	0.0335**	0.0640***
	(2.05)	(2.12)	(3.72)
Ln (Audit committee size)	0.2522*	0.2585**	0.3121***
	(1.90)	(1.97)	(3.21)
Inside appointed	0.0983*	0.1015*	0.1005*
	(1.87)	(1.96)	(1.84)
Expertise	0.2551*	0.2542*	0.0923
	(1.68)	(1.67)	(0.55)
Ln (Board size)			-0.1605
			(-1.32)
Ln (Tenure)			0.0320
			(1.39)
CEO ownership			-0.0001
			(-0.01)
Duality			-0.0554
			(-1.17)
Ln (Directorship experience+1)			0.0362
			(0.73)
Ln (Excess $500K)			-0.0136
			(-1.36)
Ivy League			-0.0265
			(-0.46)
Leverage			0.3137
			(0.39)
Market-to-book ratio			-0.0105
			(-0.28)
Diversification ratio			-0.2321
			(-1.29)
Ln(GDP)			-0.0422
			(-1.52)
Year FEs	No	Yes	Yes
Observations	224	224	224

3.4.2. Opportunism channel – Cost of forgoing bonus channel

Similar to the tests of the costs of non-forgoing channel, we estimate a logistic regression wherein we model the probability of a CEO's decision to forgo bonus as a function of the bank's underperformance. We report the marginal effects in Table 3-5. We estimate the regression with year fixed effects. Our proxies for banks' underperformance include Tobin Q, ROA and ROE in column (1), (2) and (3), respectively. If CEOs took advantage of the financial crisis to forgo bonus due to the lower opportunity cost as predicted by the opportunity explanation, we would expect a negative coefficient on these proxies. However, the results in Table 3-5 show that the marginal effects of interests on bank performance are all insignificantly different from zero. Thus, we do not find supporting evidence for our opportunism hypothesis that the CEOs forgo their bonus because of the lower opportunity cost caused by their banks' underperformance.

Table 3.5: Logistic Regressions of CEOs' Decisions to Forgo Bonus: the costs of bonus forgoing channel

This table reports the marginal effects estimated at the mean for continuous variables and for a change in an indicator variable from zero to one for indicator variables from logistic regressions of the decision to forgo bonus on the cost of bonus forgoing decisions, proxied by bank performance *Tobin Q, Return on Assets (ROA), and Return on Equity (ROE)*. *Tobin Q* is defined by the ratio of market value of assets to book value of assets. The market value of total assets is computed as the book value of total assets plus market capitalization minus book value of equity, and the market capitalization is measured as common shares outstanding times the fiscal year closing price. *ROA* and *ROE* are the ratio of net income to total assets, and equity, respectively. The sample period is 2007-2009. All continuous variables are winsorized at the 1st and 99th percentile levels. Robust standard errors clustered by banks. t-statistics are shown in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. Variable definitions are presented in the Appendix 3C.

	Prob (Forgo=1)		
	(1)	(2)	(3)
Tobin Q	-0.0980		
	(-0.22)		
ROA		2.7015	
		(1.11)	
ROE			0.2218
			(1.20)
Ln (Board size)	0.0788	0.0727	0.0781
	(0.63)	(0.57)	(0.62)
Ln (Tenure)	0.0178	0.0183	0.0180
	(0.60)	(0.61)	(0.60)
CEO ownership	-0.0045	-0.0043	-0.0043
	(-0.48)	(-0.43)	(-0.43)
Duality	-0.0777	-0.0813	-0.0817
	(-1.22)	(-1.30)	(-1.29)
Ln (Directorship experience+1)	0.0912	0.1060**	0.1071**
	(1.58)	(1.97)	(2.00)
Ln (Excess $500K)	0.0037	0.0027	0.0020
	(0.41)	(0.29)	(0.22)
Ivy League	0.0445	0.0515	0.0517
	(0.66)	(0.78)	(0.79)
Leverage	2.3093**	2.6089**	2.4777**
	(2.30)	(2.30)	(2.29)
Diversification ratio	0.0558	0.0115	-0.0056
	(0.31)	(0.06)	(-0.03)
Ln(GDP)	-0.0447	-0.0483	-0.0483
	(-1.25)	(-1.39)	(-1.39)
Year FEs	Yes	Yes	Yes
Observations	224	224	224

3.4.3. The Consequences of Bonus-Forgoing

The previous sections show that CEOs are more likely to forgo their bonus if they face pressure from regulation, internal governance mechanism, and loyalty to their banks. Additionally, CEOs tend to forgo more bonus when they face greater pressure. In this section, we investigate whether the forgoing decision is temporary and how it is related to the CEO's compensation. Specifically, we are interested in understanding whether the banks take the financial crisis as an opportunity to reduce the CEOs' compensations in the long run. If this is the case, we expect a more permanent reduction in the CEOs' total compensations, and a higher turnover rate of CEOs in the following years.

3.4.4. CEOs' compensation after the CEOs forgo their bonus

We start by examining whether the CEOs' subsequent compensation is reduced after forgoing their bonus. We conduct a difference-in-differences analysis, which compares the compensation of bonus-forgoing CEOs with non-bonus-forgoing ones both before and after the year of bonus-forgoing. By differencing out common trends among the two groups, the DID approach mitigates the influence of omitted factors that may impact the two groups alike. Additionally, to mitigate the endogeneity of bonus-forgoing decision, we use the propensity score matching approach. We follow Rosenbaum and Rubin (1983) to match the forgoing CEOs (treatment group) with non-forgoing CEOs (control group) with the closest likelihood of forgoing bonus based on Equation (1). Our regression is as follows:

$$Y_{i,t} = \alpha_0 + \phi_1 \text{Post}_t + \phi_2 \text{Treat}_i + \phi_3 \text{Post}_t * \text{Treat}_i + X'_{i,t,t-1} + \varepsilon_{i,t} \qquad (4)$$

Where $Y_{i,t}$ is natural logarithm of either the total compensation or total bonus. Treat_i is an indicator variable set to one if a bank CEO forwent bonus in any year during our sample period (treatment group), and zero otherwise (control group). The time window is 4 years (4 years before to 4 years after forgoing year)[13]. Post_t equals to one for years after forgoing year, and zero otherwise. ϕ_1 measures the changes in total compensation or total bonus from before to after the forgoing year. ϕ_2 measures the changes in total compensation or

[13] We run robustness tests with time window of 5 years (5 years before to 5 years after forgoing year), and the results are still hold. Thus, we do not report the results.

total bonus of the treatment group relative to the matched control group. ϕ_3 is the coefficient of interests which measures changes in total compensation or total bonus of the treatment group relative to the matched control group from before to after the forgoing year. ($X_{i,t,t-1}$) are vectors of control variables for corporate governance and bank characteristics including, i.e. board size, audit committee size, bank size, leverage, and market-to-book ratio. We include bank fixed effects to account for time-invariant heterogeneity between forgoing banks and non-forgoing banks due to unexplained factors. Finally, we cluster the standard errors at bank level to capture within-bank correlation in residuals.

Table 3-6 reports the results. It suggests that there are no statistically significant differences in the changes of CEOs' compensation between the two groups when controlling for bank fixed effects. Thus, we do not find any evidence that the subsequent CEOs' compensation is reduced compared to their non-forgoing peers. It implies that banks do not take the opportunity of the financial crisis to strategically suppress CEO's compensation.

Table 3.6: Subsequent CEOs compensation and bonus

This table presents the results from difference-in-differences (DID) regressions by fixed effects models of changes in CEOs' total compensation and bonus. Treat is an indicator variable set to one if a CEO forwent his/her bonus (treatment group) in any year, and zero otherwise (control group). Post equals to one for years after the forgoing year, and zero otherwise. The time window is 4 years (4 years before to 4 years after forgoing year). All continuous variables are winsorized at the 1st and 99th percentile levels to address the issue of the extreme values and outliers. T-statistics are based on robust standard errors clustered by banks and shown in parentheses. * denote significance at the 10% level. Variable definitions are presented in the Appendix 3C.

	Ln (Total compensation)	Ln (Bonus+1)
	(1)	(2)
Post	0.3936	-0.6018
	(1.06)	(-0.80)
Treat*Post	-0.0313	0.5290
	(-0.13)	(0.89)
Ln (Audit committee size)	-0.5723	-1.3614
	(-1.08)	(-0.97)
Ln (Board Size)	0.2978	1.1681
	(0.69)	(0.72)
Bank size	0.0748	-1.8159**
	(0.23)	(-2.21)
Leverage	1.5540	7.8466
	(0.44)	(0.47)
Market-to-book ratio	0.0501	0.0869
	(0.29)	(0.18)
Constant	5.6300	15.7490
	(1.02)	(1.19)
Year FEs	Yes	Yes
Bank FEs	Yes	Yes
Observations	251	251
R-squared	0.708	0.318

3.4.5. CEOs' turnovers after the CEOs forgo their bonus

In this section, we track CEO tenure after forgoing bonus. If the bonus forgoing is a long-term gesture, we expect forgoing CEOs to leave their jobs earlier than non-forgoing CEOs because of a loss of compensation. We compare *Tenure_CEO* and *Tenure_bank* of forgoing and non-forgoing CEOs in the post period following the forgoing year. We measure *Tenure_CEO* by the number of years in the CEO position after the forgoing year, and *Tenure_bank* as the number of years between the forgoing year and the year when the executive leaves her/his bank.

As shown in Table 3-7, we have data for 65 CEOs in the sample period. We use two-tailed t-tests and Wilcoxon signed ranked tests for the statistical significance of the differences in mean and median between groups. The mean (median) of *Tenure_CEO* and *Tenure_bank* following the forgoing year of CEOs for the forgoing and the non-forgoing samples are 4.32 (3.16), and 5.73 (4.66), respectively. We find no significant difference in the *Tenure_CEO* or *Tenure_bank* between these two groups, indirectly suggesting that bonus forgoing is not a long-term action.

Table 3.7: Bonus Forgoing and Executive Tenure and Turnover

This table compares bonus-forgoing and non-forging CEOs' tenure time in the CEOs' role (*Tenure_CEO*) at the time of forgoing (measured by the number of years in the CEO position after the forgoing year) and the time to turnover (*Tenure_bank*), measured by the number of years between the forgoing year and the year when the executive leaves her/his bank. We report means and medians for each subsample and use two-tailed t-tests for means and Wilcoxon signed-rank tests for medians. None of the differences are statistically significant at the 10% level.

Variables	Obs	Forgo sample			Non-forgo sample			Difference	
	N	*N*	*Mean*	*Median*	*N*	*Mean*	*Median*	*Mean*	*Median*
Tenure_CEO	65	19	4.32	3.00	46	3.16	1.62	1.16	1.38
Tenure_bank	65	19	5.73	8.96	46	4.66	4.31	1.07	4.65

3.4.6. Subsequent bank performance and bank risk-taking

In this section, we continue to examine the subsequent bank performance and risk-taking between the forgoing banks and non-forgoing banks to see whether forgoing decision served as a signal to the market that the interests of managers align with shareholders' ones during the financial crisis. If the CEO truly wishes to align their interests with shareholders, we expect that the bank performance will be improved, and overall risks will be reduced.

We reproduce the DID analysis which is similar to that in the section 3.4.4. In this scenario, "treatment group" is the group of banks with their CEOs forgoing their bonus and "control group" is the group of banks with their CEOs who did not. The estimation equation is similar to (4). Similarly, the time window is 4 years (4 years before to 4 years after forgoing year)[14]. In this case, $Y_{i,t}$ are the bank performance indicator, measured by stock performance (*Returns*) as annualised of monthly stock returns, market valuation (*Tobin Q*), accounting performance (return on assets (*ROA)* and return on equity (*ROE*); and bank risk-taking behaviour captured by the *volatility* as the annualized standard deviation of stock monthly returns, standard deviation of ROA (*SD(ROA))*, standard deviation of ROE (*SD(ROE))*, rolling over 3 years, respectively, loan loss provisions over total assets (*Loan loss provisions/Assets*), and the natural logarithm of Z-score *(ln(Z-score))* where Z-score is the average bank return on assets plus bank equity to assets ratio, scaled by the standard deviation of return on assets rolling over 3 years. ϕ_1 measures the changes in bank performance and risk-taking indicators from before to after the forgoing year. ϕ_2 measures the changes in bank performance and risk-taking indicators of the treatment group relative to the matched control group. ϕ_3 is the coefficient of interests which measures changes in bank performance and risk-taking indicators of the treatment group relative to the matched control group from before to after the forgoing year. ($X_{i,t,t-1}$) are vectors of control variables for corporate governance and bank characteristics including board size, audit committee size, bank size, leverage, market-to-book ratio.

[14] We run robustness tests with time window of 5 years (5 years before to 5 years after forgoing year), and the results remain unchanged.

Table 3-8 presents the results. The interaction terms of interest are weakly statistically positively significant for ROA, but not for the other indicators. Hence, the results do not show strong evidence that CEO tend to align their interests with shareholders after forgoing their bonuses. Again, this evidence is consistent with the results reported in the previous sections that bonus-forgoing is a temporary rather than long term decision.

Table 3.8: Subsequent bank performance and risk-taking

This table presents difference-in-differences (DID) regression results of comparing changes in performance of bonus-forgoing (treatment group) and non-forgoing (control group) CEOs' banks with different performance proxies, i.e. buy-and-hold returns, Tobin Q, ROA, ROE; and bank risk-taking, i.e. volatility, standard deviation of ROA (SD(ROA)), standard deviation of ROE (SD(ROE)), loan loss provisions/Assets, and Ln(Z-score). The time window is 4 years (4 years before to 4 years after forgoing year). All continuous variables are winsorized at the 1st and 99th percentile levels. Robust standard errors clustered by banks. t-statistics are shown in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. Variable definitions are presented in the Appendix 3C.

	Performance				**Risk-taking**				
	Tobin Q	Returns	ROA	ROE	Volatility	SD(ROA)	SD(ROE)	Loan loss provisions/Assets	Ln(Z-score)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post	-15.2309	0.0447	0.0041	0.0503	-0.0014	-0.0016	0.1029*	-0.0024	0.0069
	(-1.21)	(0.41)	(1.08)	(1.32)	(-0.11)	(-1.01)	(1.78)	(-1.10)	(0.03)
Treat*Post	5.1396	0.0355	0.0042*	0.0370	-0.0049	-0.0026	-0.0234	-0.0023	0.4616
	(0.49)	(0.49)	(1.76)	(1.25)	(-0.43)	(-1.10)	(-0.30)	(-1.17)	(1.68)
Audit committee size	-17.8790	-0.2138	-0.0059	-0.0547	0.0052	-0.0013	0.0075	-0.0002	-0.3384
	(-1.01)	(-1.70)	(-0.97)	(-0.67)	(0.24)	(-0.39)	(0.09)	(-0.03)	(-0.95)
Board size	35.2906	0.2792*	0.0131	0.1931*	-0.0046	-0.0096	-0.2389	-0.0050	0.8781
	(1.25)	(1.73)	(1.63)	(1.86)	(-0.18)	(-1.55)	(-0.88)	(-0.62)	(1.37)
Bank size	-39.7507**	-0.2266***	-0.0024	-0.0167	-0.0141	-0.0016	-0.2372**	0.0003	0.1723
	(-2.60)	(-3.16)	(-0.87)	(-0.38)	(-1.59)	(-0.59)	(-2.45)	(0.10)	(0.54)
Leverage	-577.6788***	-0.0695	-0.0091	-0.7959	0.3747	0.0823**	8.6468***	0.0006	-6.1885*
	(-3.94)	(-0.06)	(-0.17)	(-0.74)	(1.41)	(2.33)	(2.89)	(0.01)	(-1.74)
Market-to-book ratio	36.2610***	-0.1090*	0.0094***	0.1793**	-0.0263***	-0.0035	-0.1309	-0.0070***	0.2643
	(4.02)	(-1.76)	(3.61)	(2.75)	(-3.96)	(-1.51)	(-1.05)	(-3.14)	(1.02)
Constant	955.7537***	2.2726	-0.0035	0.2223	-0.0514	-0.0190	-4.4645*	0.0304	4.9222
	(4.09)	(1.51)	(-0.04)	(0.17)	(-0.18)	(-0.46)	(-1.89)	(0.34)	(0.94)
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	168	251	251	251	251	251	251	225	246
R-squared	0.820	0.374	0.480	0.504	0.688	0.574	0.477	0.555	0.652

3.5. Conclusions

One important question is why the CEOs forgo their bonus in banking industry during the financial crisis and whether or not these CEOs did so because of the government or public pressure and critics on reducing CEO's compensation in the long run. To address this question, we provide evidences that the propensity of forgoing decision is positively related to bank size and the transparency of information environment. In addition, we point out that the internally promoted CEOs are more likely to do that, consistent with their willingness to signal strong commitment. However, we do not find the evidences on the relationship between forgoing decision and bank relatively low performance. These findings suggest that bank CEOs tend to forgo their bonus when the cost or pressure of not forgoing is relatively high, but not for the cost of forgoing bonus. However, we do not find that the forgoing bonuses has impact on these CEOs' long term pay.

Additionally, there is no evidence that CEOs who gave up their bonus tend to leave their jobs, nor were their subsequent total compensation negatively affected. We find no significant difference in accounting and market-based performance measures. Thus, we do not find that the forgoing bonuses has impact on these CEOs' long term pay. These results together suggest that the bonus-forgoing decision is likely a bank temporary decision and they also shed light to the debate on CEO compensation and support compensation "shareholder value view", suggesting that forgoing bonus has little economic impact on bank's performance.

Chapter 4

Chapter 4: Cash Bonus and Mortgage Risk-Taking

Abstract

Using a unique dataset of mortgage origination at loan level in the bank holding companies (BHC) operating in the USA, this chapter examine how incentive mechanisms embedded in CEO cash bonuses influenced the origination of risky mortgages prior to the housing market collapse of 2008–2009. We find that banks were more likely to deny risky mortgages when CEOs' cash bonus represented a higher proportion of total compensation. The findings are robust to exogenous shocks such as proximity to terrorist attacks and the adoption of FAS 123R. By identifying changes in cash bonus instigated by these shocks, we show that banks located near the attacks preferred cash bonus over other forms of compensation, and that cash bonuses increased following the change of accounting policy. Taken together, these findings suggest that cash bonus mitigated the origination of risky mortgages, consistent with theories and empirical studies that predict that the incentive to take risks reduces when cash bonus forms a higher proportion of pay, and that levels of bank CEO cash bonus did not contribute to the 2008/9 financial crisis.

4.1. Introduction

Executive compensation at financial firms has received considerable attention since the financial crisis because compensation contracts incentivized managers at those firms to undertake excessive risks during the financial crisis (Bebchuk & Spamann, 2010; Gande & Kalpathy, 2017). Politicians and public continually bring up CEO compensation in stock options as a political issue, and are supported by some literature finding that stock options increase the sensitivity of executive compensation to the firm's risk and encourage bank managers to engage in more risky banking activities (Deyoung, Peng, & Yan, 2013; Mehran & Rosenberg, 2007). As a result, the Securities and Exchange Commission (SEC) adopted more stringent requirements on stock options as part of CEO compensation.

There is an argument against the effectiveness of these policy changes because firms respond to them by increasing the CEO's cash bonus while meeting the requirement on stock options, leaving the overall CEO compensation unchanged. While it is legitimate to keep CEOs' total compensation at a competitive level, since recent research suggests that the level of CEO pay is led by competitive labour market forces and reflects CEO talent and firm size (Dow and Raposo, 2005; Gabaix and Landier, 2009; Edmans et al., 2009; Gabaix et al., 2014, Edmans, 2016), to replace a significant portion of CEOs' stock options with cash bonus may have significant implications for firms. CEOs aiming to maximize cash bonus are more likely to avoid risk as they do not face pressure from either ownership and compensation incentives or active monitoring (Berger, Ofek, & Yermack, 1997). However, the risk-reducing effect of cash bonuses disappears as banks move closer to the point of default and the financially distressed banks seek to maximize the value of the financial safety net. In addition, some suggest that bonus contracts are designed to encourage short-term behaviour because they are contingent on annual performance goals. What the effects on bank risk-taking are, where cash bonus is a significant part of CEO total compensation, thus remains an empirical question.

This study investigates the relationship between cash bonus as a portion of CEO total compensation and bank mortgage-lending decisions, using US data from 2003 to 2008 inclusive. The challenge in making a causal claim is the difficulty of isolating mortgage-lending decisions from the structure of CEO compensation and other bank characteristics. First, in any cross-section of mortgage loans, some unobservable bank characteristics may have driving effects on both the CEO compensation structure and rates of mortgage denial. Second, if mortgage-lending strategy is aggressive (or conservative), CEO pay strategy may be conservative (or aggressive), i.e. reverse causality may be in play. Finally, any fixed effects model which focuses on time-series variations in lending decisions may ignore macroeconomic factors and policy initiatives that might be independent of the structure of CEO compensation and yet still induce changes in the composition of mortgage borrowers over time.

We overcome these challenges by exploiting two shocks outside the banking markets that might plausibly have induced exogenous variation in the likelihood of banks increasing

the proportion of CEO total compensation represented by cash bonus, compared to other banks with similar observable characteristics.

First, we pin down the causal impact of a terrorist attack as an exogenous shock to CEO bonus, which might affect bank mortgage-lending activity. In particular, we examine whether or not CEOs prefer cash bonus over other forms of compensation following terrorist attacks, because of uncertainty and to avoid adverse impacts on stock or option payments, as prior studies have suggested (Dai et al., 2020). We employ the difference-in-differences (DiD) method, and define the treated group as banks whose headquarters are located within 100 miles of the attack and where no other attack occurred within 100 miles of the same bank over the previous three years, and a control group that includes banks in the treatment group before the attack and all remaining banks (Dai et al., 2020). Thus, the banks in the control group are not likely to have been affected by the terrorist attacks. In line with our expectation, we find that after the terrorist attacks CEO cash bonus became a higher proportion of total compensation and the treated banks were more likely than the control banks to deny risky mortgage applications, indicating that the treated banks became more risk-averse after the shocks. These findings are consistent with the ordinary-least squares (OLS) results, which implies that endogeneity between CEO cash bonus and mortgage risk-taking is less likely.

Second, following Hayes, Lemmon, & Qiu (2012) and Mao & Zhang (2018), we also use the change in the accounting treatment brought in by FAS 123R "Share-Based Payment" as an exogenous shock. This accounting standard was issued by the Financial Accounting Standard Board (FASB) and took effect in December 2005. Prior to the implementation of FAS 123R, firms were allowed to expense stock options at "intrinsic value", i.e. the difference between exercise price and the underlying stock price on the measurement date. Thus, firms could take advantage of this recognition method by issuing stock options with exercise price identical to the stock price on the issue date. The implementation of FAS 123R requires firms to expense all stock-based compensation at their "fair value" (Mao & Zhang, 2018). Such a change of accounting treatment can constitute an exogenous shock to executive compensation as firms might have adjusted the structure of executive compensation after FAS 123R by reducing stock options and increasing other components of total pay. We find that FAS 123R speeded up the increase in the proportion of CEO pay attributable to cash bonus, and that this then translated to mortgage denial becoming more likely.

Specifically, we examine whether cash incentives embedded in executive compensation contracts mitigate risky mortgage origination, since cash bonus is widely believed to reduce risk-taking in the literature (Smith & Stulz, 1985; Leone, Wu, & Zimmermanb, 2006; Fahlenbrach & Stulz, 2011; Indjejikian, Mateˇjka, Merchant, & Van Der Stede, 2014; Vallascas & Hagendorff, 2013). We conducted our analysis on a merged sample of 6,266,755 loan applications to 60 Bank Holding Companies (BHCs) from 2003 to 2008, of which 1,128,016 were denied. We took advantage of Home Mortgage Disclosure Act (HMDA) loan-level data, which allowed us to examine bank risk-taking at the origination stage and thus capture ex ante risk-taking behaviour; the previous studies concentrate on ex post bank risk-taking. By examining all loan applications, for both approved and denied loans, covering an approximate majority of residential mortgages issued in 2003–8, our empirical strategy distinguished changes in bank mortgages granted (supply) from changes in borrower demand. We find that cash bonus incentives are positively linked to denial, both of mortgages in general and of risky mortgages in particular. These findings suggest that the incentives embedded in cash bonuses do not encourage the origination of risky mortgages.

To further address the endogeneity concern, we included bank-location fixed effects (by the counties in which banks were located) to control for all time-invariant omitted variables at the bank-county level that may have impacted on mortgage risk-taking and were related to CEO cash bonus, such as the mortgage allocation to local bank branches. We also considered county-year fixed effects, to sweep out potential confounding factors from the demand side in a given county and year which might have been related to bonus incentives at the county level. The results after including both sets of fixed effects remain unchanged, suggesting that the findings are not driven by any association between cash bonus incentives, bank characteristics and county characteristics.

Localized effects may be endogenous to CEO cash bonus; however, the locations of our bank sample are well diversified to lessen this concern. For instance, the closure of one branch of Bank of America in New York unlikely influences Bank of America at the BHC level. However, to address this issue, we perform a series of regressions, similar to our main analysis, but on a limited sample where we exclude the mortgages located within the same state as the bank headquarters. The results remain unchanged in these tests, and are more pronounced for risky mortgages, suggesting that endogeneity is not a concern.

Taken together, our evidence shows that increasing the proportion of cash bonus in total CEO pay is associated positively with the denial of mortgages, and this association is cash bonus to CEOs does not encourage managers to engage in risky investment projects.

Our study contributes to two strands of the literature. First, it augments the findings of previous studies on CEO compensation incentives and bank risk-taking in general (Smith & Stulz, 1985; Leone, Wu, & Zimmermanb, 2006; Fahlenbrach & Stulz, 2011; Indjejikian, Mateˇjka, Merchant, & Van Der Stede, 2014; Vallascas & Hagendorff, 2013), and mortgage risk-taking in particular (Sun, 2018), and this is the first study to examine how incentives embedded in CEO cash bonus affect the origination of risky mortgages that uses loan-level data; we are not aware of any attempt to measure this relationship. Additionally, HMDA loan-level data allows us to examine the impacts of increasing CEO cash bonuses by reference to the characteristics of the demand side – most previous studies have limited their focus to risk-taking aggregated at bank level (Vallascas & Hagendorff, 2013); and simultaneously to examine such effects at the origination stage, supporting the whole picture of risk shifting its channel in banks when there is a change in cash compensation incentives. The evidence confirms that increasing the proportion of cash bonus reduces the level of risk accepted in bank mortgage origination.

Second, our analysis enables us to shed some light on the debate over whether increasing the cash component of CEO compensation, which has been blamed for contributing to the financial crisis, undesirably encouraged risky mortgage lending (Bebchuk, Cohen, & Spamann, 2010; Financial Crisis Inquiry Report, 2011), and whether, as an additional factor, it contributed to the relaxation of lending standards prior to the crisis. We find no evidence that CEO cash bonuses contributed to the risky retail lending in banks prior to the 2008–9 financial crisis, suggesting that they did not.

The remainder of this chapter proceeds as follows. The next section discusses our study's literature review and the hypotheses that we tested in our analysis. Section 4.3 describes the construction of our sample and the measurement of variables and discusses the summary statistics. Section 4.4 presents our empirical methods and reports our results, and Sections 4.5 and 4.6 provide evidence of how the proportion of cash bonus changed in response to the terrorist attacks, as a quasi-natural experiment. Section 4.7 reports the tests for robustness that we carried out and Section 4.8 sets out our conclusions.

4.2. Relevant literature and hypotheses development

In this section, we review the literature on the effects of compensation on bank risk-taking, specifically focusing on cash bonuses paid to CEOs because they account for the critical component of manager compensation. We discuss the literature in order to show how we developed the hypotheses that we wished to test on how executive cash bonuses affect the taking of excessive risks on mortgage lending in financial institutions.

In general, executive compensation is designed to align the interests of management and shareholders in how corporate resources should be used and the kinds of risk the firm should take. Agency theory suggests that optimal compensation should encourage managers to commit to increasing the risks taken while holding on to projects offering positive net present value (Jensen & Meckling, 1976; Smith & Stulz, 1985) and thus align the interests of risk-averse managers with those of risk-neutral shareholders.

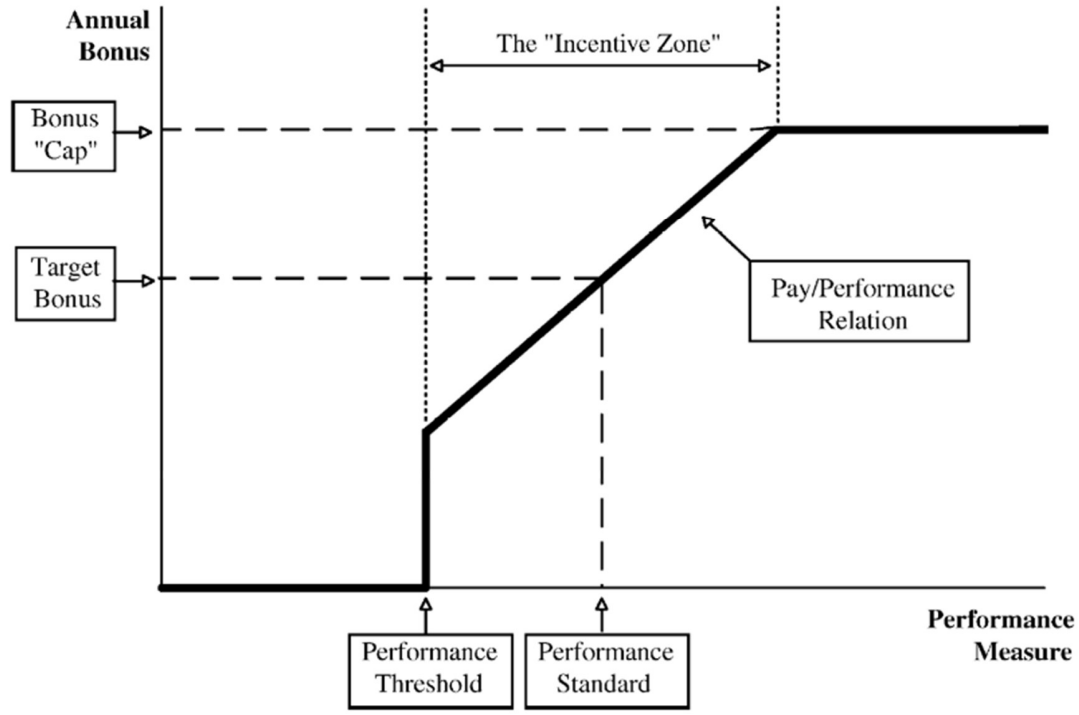
In the banking sector, the monitoring of managerial risk-taking incentives presents a theoretical moral hazard. Banks are highly leveraged in nature. Their shareholders adopt high-risk strategies to promote the volatility of assets (Jensen & Meckling, 1976; John & John, 1993). However, given that deposit insurance and bail-out policies protect bank creditors from losses in the event of bank failure and lower the likelihood that executives can be restricted from taking excessive risks, bank shareholders are encouraged to take greater risks (John, Saunders, & Senbet, 2000; John, Mehran, & Qian, 2010), so they are more likely to promote management's risk-taking and shift risk to regulators and debtholders (Benston, Hunter, & Wall, 1995; Hubbard & Palia, 1995; Bolton, Mehran, & Shapiro, 2015).

Incentives to earn cash bonus may have different effects on managerial risk preference to equity incentives. Typical cash bonus incentives are targeted over one year or multiple years and annual pay-outs are conditional on the achievement of firm accounting performance targets (e.g. revenue or earnings). Prior to 2006, annual bonuses were reported separately from pay-outs from long-term performance plans but, from 2006 onwards, annual cash bonuses from both short-term incentive plans and long-term performance plans are reported under "non-equity incentive" if they are rewarded on the basis of pre-established performance targets, and "discretionary bonuses" otherwise (Murphy, 2012). Over time, the

number of firms with bonus plans based on more than one year's accounting performance has increased: for example, about 43% of S&P 500 firms had multiple-year bonus plans in 2008 compared to 17% in 1996 (Li & Wang, 2016). Figure 2.1 illustrates how a typical bonus plan is structured relates the amount of bonus given to performance. There are two performance thresholds. No bonus is given unless a lower threshold is passed. From this point onwards, there is an "incentive zone" in which the amount of bonus increases in line with performance achieved; this is typically a linear association, as shown in Figure 2.1. Once a "bonus cap" has been reached, no further bonus will be paid regardless of additional performance (Murphy, 2001). Thus, CEO bonus compared to CEO option holdings, normally do not show the convex pay-outs (Smith & Stulz, 1985) and hence, may not encourage excessive risk-taking (Noe, Rebello, & Wall, 1996; Duru et al., 2005). However, stock options granted to CEOs are the convex function of stock return volatility, hence, promote excessive risk-taking activities (Guay, 1999; Rajgopal & Shevlin, 2002; Coles, Daniel, & Naveen, 2006). Both cash bonus plans and performance-based equity have been criticised for potential to foster the manipulation of performance. In particular, the executives might inflate performance to pass the lower threshold or defer above-plan performance to the next reporting period (Murphy, 2013).

Additionally, the incentives embedded in cash bonus plans and stock options have different strengths. Increases in the value of stock holdings have a greater impact on wealth than bonus payments do (Hall & Liebman, 1998); however, the performance measures linked to cash bonuses can be affected by the decisions of executives more directly than stock prices can. Accordingly, incentives in cash bonus plans may be perceived to have a more direct impact on wealth (See Figure 4-1) (Murphy, 2013).

Figure 4.1: A "typical" bonus incentive plan



Notes: This figure presents a typical bonus incentive plan. Adapted from Murphy (2001).

4.2.1. Cash bonus and bank risk-taking

Theoretical studies show that CEO cash bonuses play a vital role in reducing managerial incentives to increase risk taking. Smith & Stulz (1985) find that if cash incentives are more a linear function of the firm's performance, the pay-outs for these bonuses are non-convex and so discourage the management from risk-seeking. When forecast performance is within the 'incentive zone', bonuses are payable, and pay-outs are linear functions of firm performance. As a result, these pay-outs will progressively discourage risk-averse CEOs from engaging the bank in risk-taking activities to obtain higher bonus payments. However, when forecast performance falls short of the performance threshold, pay-outs from a cash bonus plan and resemble a call option in having a convex relationship to firm value, which cancels out the concave utility function of the CEO's natural risk aversion (Vallascas & Hagendorff, 2013).

Past empirical studies provide different views of the relationships between CEO cash bonus incentives and bank risks but support the view that cash bonuses reduce management's

preference for taking risks. (Balachandran, Kogut, & Harnal, 2010) show that bonuses and other cash incentives lower the likelihood of bank default. Additionally, Vallascas & Hagendorff (2013) find, when cash bonuses are higher, both in absolute value and relative to total cash compensation, a link to lower levels of bank default risk, and they find no evidence that cash bonuses reduce bank risk-taking in financially distressed banks, or in banks operating in a weak regulatory environment. Moreover, bonus pay-outs also impact on the long-term level of default risk which CEOs target. Two elements moderate the effect of cash bonuses on bank risk-taking: first, the bank's overall riskiness, e.g. the higher the default risk, the stronger the link between cash bonuses and bank risk-taking; and second, that risk-reducing effects only exist in banks operating under strong bank regulatory regimes. John & John (1993) and Edmans & Liu (2011) go further, arguing that because the pay-outs from cash bonus plans are made while the bank remains solvent, they encourage CEOs to avoid bankruptcy. Duru et al. (2005) suggest that CEOs manage in a way that maintains stable cash flows, to meet the contractual debt obligations represented by earnings-based cash bonuses, indicating that higher cash bonus has an explicit role in lowering agency conflicts with debt holders, and mitigating incentives to shift risk. In addition, Fahlenbrach & Stulz (2011) show that the poorer performance during the crisis did not result from cash bonuses offered to bank CEOs becoming a higher proportion of their pay, suggesting that cash bonus incentives are not related to bank risk-taking.

Other authors find that, rather than having no impact on or mitigating bank risk-taking, bonuses encourage managers to take risks. In particular, Harjoto & Mullineaux, (2003) find that bonus payments promote volatility of returns, so encourage risk-taking. In addition, Noe, Rebello, & Wall (1996) and Benston & Evan (2006) suggest that cash bonuses foster risk-taking in financially distressed banks.

Similarly, another view claims that cash bonuses promote risk-shifting in banks (Financial Stability Board (FSB) 2009).[15] This point of view is based on two assumptions that have been challenged by empirical evidence recently (Vallascas & Hagendorff, 2013). The first assumption is that cash bonus plans enable managers to receive greater rewards when taking greater risks to achieve performance targets, but do not adequately expose them

[15] See Financial Stability Board, 2009. Principles for Sound Compensation Practices. Retrieved from website: https://www.fsb.org/wp-content/uploads/r_090925c.pdf

to downside risks. Despite this assumption, empirical evidence shows that bonus plans are more likely to penalise underperformance rather than reward overperformance (Leone et al., 2006; Indjejikian et al., 2014). Moreover, the second assumption is that cash bonus plans encourage short-term behaviour because they depend on annual performance goals. Thus, managers aim to strive to take on higher risk in order to hit these targets. However, empirical evidence shows that managers aim to obtain productive achievements to maximize bonus payments (Holthausen, Larcker, & Sloan, 1995; Bouwens & Kroos, 2011), and accept longer-term plan design (Gibbons & Murphy, 1992; Indjejikian et al., 2014). These authors find that bonus contracts are used to align managers' efforts with long-term incentives, and that when firms design the compensation packages for managers, they include trade-offs between bonus pay-outs and career incentives over multiple-year horizons.

Even though there have been different views on the association between cash bonus and bank risk-taking, the most common view is that cash bonus reduces risk-taking incentives, we, therefore, posit that cash bonus has an impact on a CEO's incentive to engage in mortgage lending activities via risky mortgage denial. Specifically, we developed the following hypothesis:

HYPOTHESIS: Cash bonus proportion is positively associated with denial of risky mortgage credit.

4.2.2. Terrorist attacks as a quasi-natural experiment

There is a load of literature showing the impacts of terrorist attacks on the economy in general and the stock market specifically, but only a few studies focus on firms and executives (Dai et al., 2020). Terrorist activities have heightened in recent years and this raises issues for executives. For example, Price Waterhouse Coopers strongly emphasizes that "geopolitical uncertainty (exacerbated by regional conflicts and increased terrorism attacks) is a top concern for nearly three-quarters of CEOs".[16] Fortunately, data on terrorism is available for research and education. The National Consortium for the Study of Terrorism and Response to Terrorism (START) has constructed a Global Terrorism Database (GTD)

[16] See PwC, 2016. The 19th Annual Global CEO Survey. Retrieved from website: https://www.pwc.com/gx/en/ceo-survey/2016/landing-page/pwc-19th-annual-global-ceo-survey.pdf , p. 2.

covering more than 190,000 terrorist attacks worldwide from 1970, including 2,794 in the United States from 1970 to 2016.[17].

Dai et al. (2020) show that nonmonetary factors do indeed affect CEO compensation and that terrorist attacks tend to be followed by increases in cash bonus. Specifically, if CEOs care about the impact of terrorist attacks on their pay, they can be expected to prefer cash rewards to stock options after such events. To examine this, we attempt to pin down the impact of a terrorist attack on the cash proportion of CEO pay. Such attacks can be considered as distinct and specific events that occur unexpectedly and present immediate management (and financial) problems for CEOs, and thus seen as a quasi-natural experiment that captures an exogenous change in CEO cash compensation, so can therefore be used to examine how cash bonus as a proportion of CEO pay affects mortgage lending activities.

4.2.3. Accounting change under FAS 123R which serves as a natural experiment

In 1972, Opinion No.25 "Accounting for Stock Issued to Employees" was issued by the Accounting Principles Board (APB). It recommended that expense relating to the issuing of stock options be recognised based on the "intrinsic value" of the option, which it defined as the difference between exercise price and the current price of the stock on the measurement date ("underlying price"). Firms could take advantage of this valuation method by setting the exercise price for stock options they issued at the underlying price.

Later, in 1995, the Financial Accounting Reporting Board (FASB) issued FAS 123 to modify APB Opinion No.25, encouraging the recognition of option expense at "fair value" (e.g. the Black & Scholes model). However, because the intrinsic value method is seen as usually more beneficial to firms than the fair value method, and fair value was not mandated by FAS 123, most firms continued to issue stock options at-the-money and disclose in footnotes how much option expense would be on a pro forma basis if the fair value method were used. As a result, no expenses for option compensation were recognised in these firms' income statements.

[17] See START, 2017. The National Consortium for the Study of Terrorism and Responses to Terrorism (START), Retrieved from website: https://www.start.umd.edu/pubs/START_IdeologicalMotivationsOfTerrorismInUS_Nov2017.pdf. p. 1.

Accordingly, in December 2004 FASB issued FAS 123R "Share-Based Payment", superseding FAS 123, which required firms to disclose a fair value for stock option expense. FAS 123R came into effect from the first fiscal year after 15 June 2005 for large public firms, and after 15 December 2005 for small public and private firms. Thus, the implementation of FAS 123R removed the intrinsic value method for recording stock option expense.

Such a change of accounting policy can serve as an exogenous shock to executive compensation, given that if firms pay attention to the perceived accounting costs of options, they may adjust the structure of executive compensation by reducing stock options and increasing other components of total pay.

4.3. Data, Sample Construction, Variable Measurement, and Summary Statistics

In this section, we describe how our sample was constructed, discuss how we measured the main variables, and summarize the characteristics of our sample.

4.3.1. Data and Sample Construction

To build our data set, we drew all financial firms (SIC code between 6000 and 6999) from Execucomp, to obtain the cash incentives paid to their CEOs. We also collected equity incentives (Delta and Vega) from Lalitha Naveen's website. Next, we obtained the permanent company identification numbers (PERMCO) for these financial firms from the database of The Center for Research in Security Prices (CRSP), which link to the RSSDID in the linkage file of the Federal Reserve Bank of New York. The RSSDID is the unique identifier for the Call Report that allows us to collect bank financial data.

To measure lending activity, we used detailed mortgage data collected from a comprehensive sample reported annually to the Federal Reserve under provisions of the Home Mortgage Disclosure Act (HMDA) Loan Application Registry, which covers 90% of mortgage lending in the USA. HMDA, passed into law in 1975 and expanded in 1988, informs the public whether a financial institution serves local credit demand adequately and identifies discriminatory lending. The data allowed us to determine not only the lenders but

also the location (county and metropolitan statistical area) of the property securing the mortgage (Duchin & Sosyura, 2014; Gilje, Loutskina, & Strahan, 2016). Each observation is a mortgage application which contains information about applicants (e.g. income, gender, race), the loan requested (e.g. amount of loan, type of loan, purpose of loan), bank decision on loan (e.g. approved, denied, or withdrawn), and whether a loan was securitised during the year of its origination. The raw HMDA data contains more than 73 million applications to financial institutions reporting to the Federal Deposit Insurance Corporation (FDIC), Federal Reserve (FR), and Office of the Comptroller of the Currency (OCC) during 2003-2008. I choose this sample period to address a debate on bonus compensation structure providing incentives to take risks, contributing the housing market collapse 2008 – 2009. We applied the following filter rules to derive the final sample.

First, we limited our sample to loan applications that were approved or denied (removing applications that were uncompleted or withdrawn), leaving about 23 million applications. To study the inherent riskiness of new mortgage origination, we restricted our sample to new home purchases (removing refinancing loans and home improvement loans). Next, we confined our attention to conventional loans, which are exposed to different risks than loans insured by the government (e.g. FHA, VA, FAS, or RHS loans). These filters leave us with about 7 million mortgage applications.

After removing invalid loan records, each application for each year inclusive was aggregated at the bank holding company (BHC) level. Specifically, we merged it with the bank financial data from the Federal Reserve of New York Call Report at the fourth quarter of the year prior to the mortgage application, using bank identifiers in HMDA files which match to RSSDID. To be specific, RSSD9055 with agency code 1 was used for banks that report to Office of the Comptroller of the Currency (OCC), RSSD9001 with agency code 2 for banks that report to the Federal Reserve, and RSSD9050 with agency code 3 for banks that report to the Federal Deposit Insurance Corporation (FDIC). We aggregated financial institutions at the BHC level and merged this data with the data on incentives collected for our sample banks. After merging the two samples, we are left with 6,266,755 mortgage observations to 60 BHCs of which 5,138,739 were approved and 1,128,016 denied, which we call the final sample. A summary of this mortgage data is given in Table 4-1.

4.3.2. Variable Measurements

4.3.2.1. Incentives embedded in cash bonus

We expressed the total value of the annual bonus (Bonus) and nonequity incentive (Nonequity) both as percentages of total compensation, to capture their *ex ante* incentive strength (Indjejikian et al., 2014; Vallascas & Hagendorff, 2013) to draw a clearer picture of the magnitude of the bonus in the total compensation packages for CEOs (Hagendorff and Vallascas 2011).[18].

4.3.2.2. Mortgage denial and risky mortgage

The variable *Denial* is a dummy variable that takes the value 1 if the mortgage application was denied, and 0 if it was approved. Since our empirical strategy was to explore the impact of the incentives embedded in CEO cash bonus plans on the degree of mortgage risk the bank accepted, we defined a loan as risky if the loan-to-income (LTI) ratio is greater than 3, where the LTI ratio is the ratio of loan amount to borrower income (*Risky-loan*) (Chu & Qiu, 2019).[19]

4.3.2.3. Control variables

In these analyses, we used a set of variables to control for characteristics of banks, observed at the first lagged time *(t–1)*, including the natural logarithm of the bank's total assets *(Bank size)*, return on assets *(ROA)*, ratio of deposits to assets *(Deposit)*, financial leverage measured as the ratio of book total assets to stockholder's equity (*Leverage*), and bank activities measured by the share of noninterest income to total operating income *(Diversification)*. We used another set of variables to control for characteristics of borrowers: gender *(Male)*, ethnicity *(Hispanic)* and race *(White, Asian, Black)*. Finally, we also used CEO age (*CEO age*).

[18] High correlation between cash compensation and Relbonus, vega and delta would invalidate the joint inclusion of cash compensation with Relbonus, vega and delta in a single regression model. Thus, we just report the correlations between them for reference but did not include total cash compensations in our models.

[19] We used LTI ratio as a proxy to measure the riskiness of borrowers because it has been widely used in recent studies (Chu & Qiu, 2019; Duchin & Sosyura, 2014).

4.3.3. Summary Statistics

Table 4-1 presents summary statistics for our sample of mortgage applications, CEO compensation, loan characteristics and bank characteristics. To quote examples, loan applications denied account for 18% of the total sample observations; the average borrower earned US$113,800 per year and applied for a mortgage of US$202,800; the mean loan-to-income ratio was 2.116, consistent with previous studies of mortgage lending and 25.3% of loan applications meet our criteria to be considered as risky loans. In our sample, the average total compensation of CEOs was US$19,746,000, US$6,332,700 in cash, with the proportion of cash bonus accounting for 29.50% of total compensation (*RelBonus*). The average natural logs of delta and vega were 7.54 and 6.82, respectively. The mean natural log of bank total assets in thousands (*Bank Size*) was 19.81, or US$401.2 billion. The ratio of noninterest income to total operating income (*Non-Interest Income*) for the banks in our sample is 35.9% and the mean of leverage is 91.4%.

Table 4.1: Summary statistics

This table present summary statistics of all variables in use for the full sample. The mortgage loan application data was obtained from HMDA Loan Application Registry for 60 BHCs from 2003 to 2008 inclusive. All continuous variables were winsorized at the 1st and 99th percentiles. Variable definitions and data sources are presented in Appendix 4.

	Mean	SD	Median	Min	Max	N
Denial	0.180	0.384	0	0	1	6,266,755
RelBonus	0.295	0.114	0.284	0	0.666	6,266,755
TDC1 ($'000)	19746.0	9911.6	20404.0	926.9	54768.5	6,266,755
Cash bonus ($'000)	6332.7	4345.7	6500	0	19557.4	6,266,755
Ln (Delta)	7.535	0.741	7.722	3.667	8.566	6,259,251
Ln (Vega)	6.821	0.803	7.043	1.960	7.879	6,254,623
Loan-to-income (LTI) ratio	2.116	1.323	2.031	0.132	5.783	6,266,755
Risk	0.253	0.435	0	0	1	6,266,755
Applicant income ($'000)	113.8	107.7	82	14	700	6,266,755
Loan amount ($'000)	202.8	182.6	150	10	1000	6,266,755
Ln(applications)	6.102	1.763	6.354	0.693	9.016	6,266,755
Male applicants	0.665	0.472	1	0	1	6,266,755
Hispanic applicants	0.106	0.307	0	0	1	6,266,755
Asian applicants	0.0646	0.246	0	0	1	6,266,755
White applicants	0.741	0.438	1	0	1	6,266,755
Black applicants	0.0707	0.256	0	0	1	6,266,755
CEO Age	59.38	4.148	60	45	70	6,266,755
Bank size	19.81	1.090	19.99	15.55	21.51	6,266,755
ROA	0.0138	0.00406	0.0144	-0.00400	0.0200	6,266,755
Deposit/assets ratio	0.554	0.120	0.590	0.0953	0.804	6,266,755
Income diversification	0.359	0.0625	0.358	0.130	0.530	6,266,755
Leverage	0.914	0.0106	0.911	0.873	0.944	6,266,755

4.4. Empirical results

In this section, we examine the impact of incentives embedded in CEO cash bonus plans on the supply of local bank mortgage lending. We organised the loan application data by loan, bank, county, year for consistency among our all various hypotheses. Section 4.4.1 presents our results for cash bonus and denial of mortgages and Section 4.4.2 examines the effects on risky mortgage lending.

4.4.1. Cash bonus and mortgage denial

We begin by testing the effects of incentives embedded in cash bonus plans on bank lending using a series of ordinary-least squares (OLS) regressions and constructing heteroskedasticity-robust standard errors clustered at the bank-county level to allow for within bank-county correlation of residuals in loan denials. Follow the recent studies on mortgage loan activities, we chose linear rather than nonlinear regressions to study the data on loan denials, given that nonlinear specifications are likely to generate biased estimates with specifications including short time series and involving many fixed effects, resulting in incidental parameter problems and delivering inconsistent estimates (Duchin & Sosyura, 2014; Puri, Rocholl, & Steffen, 2011). Moreover, nonlinear fixed-effects models may also produce biased estimates for interaction terms, which is one of the main coefficients estimates we are interested in (Ai and Norton 2003). As a result, linear models appear to be a better fit than nonlinear models.

Accordingly, to evaluate how cash bonus affects denials of mortgage, we estimated the following regressions:

$$Denial_{ijkt} = \alpha_{jk} + \alpha_{kt} + \beta_1 RelBonus_{j,t-1} + \beta_2 LTI_{it} + \gamma_1 X_{it} + \gamma_2 Z_{j,t-1} + \varepsilon_{ijkt} \qquad (1)$$

where i represents the borrower, j represents the lender, k represents the county, and t represents the year of application. We absorbed county*year effects (α_{kt}), thus removing time-varying, unobservable, county-level, demand-side shocks related to housing demand, industry composition, business cycle, and idiosyncratic economy shocks, etc. Moreover,

since bank and county characteristics could result in variation in our dependent variable, we also included bank*county fixed effects (α_{jk}) in the more fully specified models.

The key dependent variable in our regression specifications, $Denial_{ijkt}$, is a dummy variable that takes the value 1 if the application is denied in a given fiscal year t, and 0 if it is approved. The explanatory variable we are chiefly interested in is incentive from cash bonus ($RelBonus_{jt-1}$), the ratio of cash bonus to total compensation. LTI_{it} is the ratio of amount of loan to applicant income, X_{it} contains vectors of control variables for borrowers (e.g. gender, Hispanic, White, Asian, and Black), and Z_{jt-1} contains vectors of control variables for lenders' characteristics (e.g. the natural logarithm of the total assets in millions of dollars (*Bank size*), return on assets (*ROA*), ratio of deposits to total assets (*Deposit*), bank activities measured by the ratio of noninterest income to total operating income *(Diversification)*, financial leverage across banks as the ratio of total liabilities to total assets (*Leverage*), and the natural logarithm of the CEO's age *(Ln(Age))*.

In our specification, β_1 is a coefficient that captures the effect of managerial incentives on the denial of risky mortgage credit, and ($\beta_1 > 0$) implies that these incentives encourage banks to deny more risky credit.

In Table 4-3, we report the results from applying Equation (1). Columns (1) to (3) present the results with different specifications, with and without control variables and wih and without various fixed effects: bank-fixed effects and/or county-fixed effects and/or year-fixed effects. Coefficient estimates (β_1) for *RelBonus* were positive across the three specifications and are statistically significant at the 1% level. In addition, consistent with expected results, the higher the loan-to-income ratio (*LTI*), the more likely it was that loan applications would be denied, controlling for other factors. In addition, the effects for equity incentives were in line with those derived from Delta and opposite to Vega (Sun, 2018). Taken together, these results show that CEOs for whom cash bonus was a higher proportion of total compensation headed banks that were less likely to originate mortgage loans; in other words, those CEOs did not encourage the supply of mortgages.

Table 4.2: Correlation matrix

This table reports Pearson pairwise correlation coefficients for all independent variables used in the regressions. All continuous variables are winsorized at the 1st and 99th percentiles. Variable definitions are presented in the Appendix 4. The coefficients in bold with the symbol *, **, and *** denote significance at the 10%, 5% and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) Denial																		
(2) RelBonus	0.10***																	
(3) Ln(Cash compensation)	0.09***	0.76***																
(4) Ln(Age)	0.03***	0.06***	0.09***															
(5) Ln(Delta)	0.03***	0.56***	0.84***	0.21***														
(6) Ln(Vega)	-0.04***	0.46***	0.66***	0.08***	0.79***													
(7) Loan-to-income (LTI)	0.03***	-0.01***	0.03***	0.02***	0.07***	0.04***												
(8) Risky loan	0.04***	-0.01***	0.02***	0.02***	0.04***	0.01***	0.78***											
(9) Ln(applications)	-0.04***	0.05***	0.20***	0.07***	0.26***	0.25***	0.15***	0.13***										
(10) Male	-0.03***	0.01***	-0.00**	0.01***	0.01***	0.01***	-0.06***	-0.05***	-0.03***									
(11) Hispanic	0.08***	0.01***	0.04***	-0.01***	0.04***	0.01***	0.06***	0.07***	0.16***	0.02***								
(12) Asian	0.01***	0.04***	0.07***	0.01***	0.06***	0.04***	0.07***	0.07***	0.13***	0.00***	-0.08***							
(13) White	-0.08***	-0.00***	-0.02***	0.01***	0.00*	0.01***	-0.05***	-0.06***	-0.13***	0.19***	0.08***	-0.45***						
(14) Black	0.08***	-0.04***	-0.04***	-0.02***	-0.03***	-0.03***	0.02***	0.03***	0.04***	-0.08***	-0.08***	-0.07***	-0.47***					
(15) Bank size	-0.02***	0.37***	0.67***	-0.24***	0.54***	0.54***	0.02***	0.01***	0.21***	-0.03***	0.05***	0.06***	-0.04***	-0.00***				
(16) ROA	-0.06***	-0.07***	0.03***	0.30***	0.30***	0.30***	0.03***	0.02***	0.15***	0.03***	-0.01***	-0.00***	0.02***	0.01***	-0.25***			
(17) Deposit/Assets	-0.21***	-0.39***	-0.46***	-0.12***	-0.19***	-0.01***	0.02***	-0.01***	-0.03***	0.03***	-0.08***	-0.06***	0.06***	0.00***	-0.19***	0.26***		
(18) Income diversification	0.10***	0.41***	0.40***	0.08***	0.30***	0.27***	-0.01***	-0.00***	0.09***	0.01***	0.04***	0.01***	-0.01***	-0.01***	0.04***	0.07***	-0.42***	
(19) Leverage	0.07***	0.09***	0.16***	0.08***	0.02***	0.03***	-0.03***	-0.01***	0.03***	-0.01***	0.01***	0.03***	-0.02***	-0.01***	0.10***	-0.22***	-0.37***	0.18***

Table 4.3: OLS regressions on cash bonus and risky mortgage denial

This table presents the OLS regression results on the effect of cash bonus incentives on denial of mortgages. The dependent variable is *Denial*: an indicator is set to 1 if the mortgage application is denied, and 0 if it is approved. The independent variables are cash bonus incentives, measured by the ratio of cash bonuses to total compensation (*RelBonus*); the ratio of applicant loan amount to borrower income (*LTI*); other controls for characteristics of loan applicants and bank controls. All variables are as defined in Appendix 4 and all continuous variables were winsorized at the 1st and 99th percentiles. Standard errors clustered at the bank*county level. T-statistics are reported in parentheses below the coefficient estimates. Significance levels at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

	Denial = (0,1)		
	(1)	(2)	(3)
RelBonus	0.0868***	0.0606***	0.0281***
	(9.85)	(6.76)	(2.80)
LTI	0.0117***	0.0124***	0.0129***
	(22.39)	(24.69)	(25.98)
Male applicants	-0.0130***	-0.0111***	-0.0107***
	(-14.16)	(-13.37)	(-13.26)
Hispanic applicants	0.0925***	0.0903***	0.0905***
	(28.03)	(30.58)	(30.56)
Asian applicants	-0.0107***	-0.0112***	-0.0114***
	(-3.29)	(-3.32)	(-3.41)
White applicants	-0.0447***	-0.0442***	-0.0447***
	(-29.38)	(-30.35)	(-30.57)
Black applicants	0.0873***	0.0848***	0.0838***
	(22.72)	(22.32)	(22.42)
Ln (Delta)			0.0639***
			(13.31)
Ln (Vega)			-0.0277***
			(-18.56)
Ln (Applications)			-0.0307***
			(-19.72)
Ln (Age)			0.0990***
			(8.90)
Bank size			-0.0739***
			(-6.92)
ROA			-0.6161
			(-0.77)
Deposit_Assets			-0.2995***
			(-8.91)
Income diversification			0.1219***
			(2.67)
Leverage			2.2950***
			(15.14)
Constant	0.1563***	0.1611***	-0.8417***
	(51.94)	(53.95)	(-2.76)
Bank FEs	Yes		
County FEs	Yes		
Year FEs	Yes		
Bank*County FEs		Yes	Yes
County*Year FEs		Yes	Yes
Observations	6,266,739	6,260,723	6,243,656
Adj R-squared	0.092	0.114	0.117

4.4.2. Cash bonus and denial of risky mortgages

We move on to test the effects of incentives embedded in cash bonus plans on denial of risky mortgages. We examined these relationships using the following OLS regressions:

$$Denial_{jjkt} = \alpha_{jk} + \alpha_{kt} + \mu_1 RelBonus_{j,t-1} \times Riskyloan_{ijt} + \mu_2 RelBonus_{j,t-1} + \mu_3 Riskyloan_{ijt} + \gamma_1 X_{it} + \gamma_2 Z_{jt-1} + \varepsilon_{ijkt} \quad (2)$$

where *i*, *j*, *k*, and *t* represent the same things as in Equation (1). For consistency with Equation (1), we absorbed county*year effects (α_{kt}), thus removing time-varying, unobservable, county-level, demand-side shocks related to housing demand, industry composition, business cycle, and idiosyncrasies of the local economy, etc. Moreover, since bank and county characteristics could result in variation in our dependent variable, we also included bank*county-fixed effects (α_{jk}) in the more fully specified models.

The dependent variable, $Denial_{ijkt}$, was set in the same way as for Equation (1). $Riskyloan_i$ is a dummy variable that takes takes the value 1 if the loan-to-income ratio is greater than three, and 0 otherwise. The explanatory variables were $RelBonus_{j,t-1}$ calculated as for Equation (1), and we used the same set of control variables in these regressions as in Equation (1). Likewise, we constructed heteroskedasticity-robust standard errors clustered at the bank-county level to account for the correlation of residuals within bank-county pairs in all analyses. In our specification, μ_1 and ($\mu_1 > 0$) are calculated in the same way as Equation (1) and mean the same.

In Table 4-4, we report the results from applying Equation (2). Those for our main tests include the interaction terms on *Relbonus* and *Riskyloan* with various specifications which combine control variables and different effects fixed by bank and/or county and/or year. Coefficient estimates (μ_2) on *RelBonus* remained statistically positively significant. Moreover, consistent with expected results, the riskier the loan applications, the more likely they were to be denied, controlling for other factors.[20]

[20] We also tried *LTI* ratio in the place of the indicator variable *Riskyloan* to fully capture the effect of mortgage risk on the lending decisions, and the results were qualitatively similar.

As expected, the estimate coefficients for the interaction term (μ_1) between *RelBonus* and *Riskyloan* were statistically positively significant at the 1% level, consistent with our hypotheses on denial of risky mortgages. Generally, these results show that CEOs with cash bonuses representing a higher proportion of total compensation were less likely to approve risky mortgage applications; in other words, they suggest that such CEOs did not encourage the supply of risky mortgages.

Table 4.4: OLS regressions on cash bonus and risky mortgage origination

This table presents the OLS regression results on the effect of cash bonus incentives on origination of risky mortgages. The dependent variable is *Denial*: an indicator is set to 1 if the mortgage application is denied, and 0 if it is approved. The independent variables are cash bonus incentives, measured by the ratio of cash bonuses to total compensation (*RelBonus*); the ratio of applicant loan amount to borrower income (*LTI*); *Riskyloan* is a dummy variable that takes the value 1 if the loan-to-income ratio is greater than three, and 0 otherwise; other controls for characteristics of loan applicants and bank controls. All variables are as defined in Appendix 4 and all continuous variables were winsorized at the 1st and 99th percentiles. Standard errors clustered at the bank*county level. T-statistics are reported in parentheses below the coefficient estimates. Significance levels at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

	Denial = (0,1)		
	(1)	(2)	(3)
RelBonus	0.0784***	0.0486***	0.0172*
	(8.61)	(5.24)	(1.71)
*RelBonus*Riskyloan*	0.0367***	0.0510***	0.0556***
	(3.21)	(6.04)	(7.02)
Riskyloan	0.0206***	0.0183***	0.0174***
	(6.32)	(7.39)	(6.94)
Male applicants	-0.0135***	-0.0116***	-0.0113***
	(-14.85)	(-14.14)	(-14.11)
Hispanic applicants	0.0928***	0.0907***	0.0910***
	(28.32)	(30.86)	(30.86)
Asian applicants	-0.0102***	-0.0107***	-0.0108***
	(-3.16)	(-3.19)	(-3.27)
White applicants	-0.0443***	-0.0438***	-0.0443***
	(-29.16)	(-30.06)	(-30.23)
Black applicants	0.0879***	0.0855***	0.0845***
	(22.85)	(22.42)	(22.58)
Ln (Delta)			0.0639***
			(13.34)
Ln (Vega)			-0.0279***
			(-18.67)
Ln (Applications)			-0.0287***
			(-18.77)
Ln (Age)			0.0970***
			(8.70)
Bank size			-0.0771***
			(-7.20)
ROA			-0.5748
			(-0.72)
Deposit_Assets			-0.3051***
			(-9.12)
Income diversification			0.1255***
			(2.76)
Leverage			2.2459***
			(14.75)
Constant	0.1754***	0.1824***	-0.7117**
	(61.64)	(64.20)	(-2.32)
Bank FEs	Yes		
County FEs	Yes		
Year FEs	Yes		
Bank*County FEs		Yes	Yes
County*Year FEs		Yes	Yes
Observations	6,266,739	6,260,723	6,243,656
Adj R-squared	0.092	0.114	0.116

4.5. Terrorist attacks as a quasi-natural experiment

4.5.1. The effects of terrorist attacks on CEO cash bonus

A recent wave of terrorist attacks around the globe is relevant to empirical studies of wider consequences. While most of them focus on the global economy and stock market, few have studied the consequences of such attacks for firms and executives. Motivated by Dai et al. (2020), we have decided to include terrorist attacks in our study to address the causality and endogeneity issues that arise between a specific nonmonetary factor and CEO cash bonuses.

Previous researches suggest that terrorist attacks may adversely influence the performance of financial markets and the macroeconomy (Abadie & Gardeazabal, 2003; Blomberg, Hess, & Weerapana, 2004; Bandyopadhyay, Sandler, & Younas, 2014; Chesney, Reshetar, & Karaman, 2011), and increase the preference of executives for cash compensation to avoid uncertainty and mitigate the risks associated with equity rewards in falling or unstable markets (Dai et al., 2020).

First, we tested whether (and if so, how) the various forms of CEO compensation in banks were affected by the terrorist attacks recorded in the START database, to make sure that a terrorist attack has any impact at all on CEO bonus. For this purpose, we followed Bertrand & Mullainathan (2003) and Dai et al. (2020) in using a difference-in-differences model (DiD) to capture the effects of such attacks. We defined a treatment group of banks with headquarters within 100 miles of a terrorist attack, and excluded those where another attack happened within 100 miles of its headquarters over the previous three years (Dai et al., 2020), so that we could construct a control group consisting of treatment banks before the attack and all other banks in our sample group before and after the attack. To measure the radius of 100 miles, we first collected the latitude and longitude of the headquarters of all banks in our sample, and then calculated the distance between these coordinates and the locations (latitude and longitude) of terrorist attacks recorded in the START database (Vincenty, 1975). Finally, we regressed the log value of total compensation, and the proportion of total pay attributable to each of five main pay components, using an indicator for the treatment group (*Attack*) as follows:

$$\text{Compensation}_{j,t+1} = \alpha + \alpha_j + \delta_t + \phi_1 \text{Attack}_t + X'_{j,t} + \varepsilon_{j,t+1} \qquad (3)$$

where *j* denotes the bank and *t* denotes the year. $\text{Compensation}_{j,t+1}$ is the main dependent variable of interest: it includes the natural logarithm of total compensation (to reduce skewness) and the ratio of its composition in year *t+1*. Specifically, total compensation is the item TDC1, which we obtained from Execucomp: the sum of salary, bonus, restricted stock, stock options, and other elements of compensation, expressed in thousands of dollars. To examine the effects on different components of CEO compensation, we used a set of variables expressed as the ratio of various components to total compensation, i.e. salary (*Salary_p*), cash bonus (*Cashbonus_p* or *RelBonus*), value of options (*Option_p*), value of stock held (*Stock_p*), and other elements (*Others_p*), respectively.

The main variable in which we were primarily interested is *Attack*, a time-variant indicator variable that takes the value 1 if a bank's headquarters was located within the attack radius, i.e. within 100 miles of a terrorist attack, and no other attack happened within 100 miles of the same bank over the previous three years (Dai et al., 2020), and 0 for the treatment banks in the pre-attack period and for all other banks in our sample group.

To control for heterogeneity between the two groups of banks, we included bank-fixed effects that account for time-invariant differences attributable to unexplained factors that differ across banks. This enabled us to capture the average within-bank changes in total executive compensation and its components, as a function of independent variables in the regressions. We also included year-fixed effects, which means that our results essentially explain the variation in executive compensation and its composition across banks during a given year and mitigates the effect of the time trend. Additionally, we clustered standard errors at bank level to capture within-bank correlation in residuals. The data collected covered complete reporting years from the one beginning in 2003 to the one beginning in 2008, inclusive.

Following the compensation literature surveyed in section 4.2, we used $X_{i,t}$, vectors of control variables for bank-specific characteristics, in our models in year *t*. These included bank size, ROA, deposit, income diversification, and leverage as in Equations (1) and (2). We also controlled for CEO age (*Ln(Age))* as a proxy to capture

personal circumstances that might have affected an individual CEO's choice of compensation structure (Gibbons & Murphy, 1992; Yim, 2013; Dai et al., 2020).

Table 4-5 reports the estimate coefficients from the DiD regressions applying Equation (3). Consistent with previous studies, the results suggest that CEOs switched to cash compensation after terrorist attacks. In columns (3) and (9), the coefficients of *Attack* on *Cashbonus_p* are positive, i.e. 0.0672, and 0.0742 in the fuller model, and statistically significant at better than the conventional level, indicating that after attacks the compensation of CEOs of banks headquartered within the attack radius included higher cash bonuses than that of CEOs in safer areas. Taken together, the results suggest that the proportion represented by cash bonus increased as a consequence of terrorist attacks, which is consistent with the findings of Dai et al. (2020). Accordingly, in the next section we treat these consequences of terrorist attacks as a quasi-natural experiment to test the effects of cash bonus on banks' inclination to approve risky mortgages.

Table 4.5: Changes in compensation structure around the terrorist attacks

This table presents bank-fixed effects regressions illustrating changes in the structure of chief executive officer (CEO) compensation around terrorist attacks within 100 miles of a bank's headquarters. The sample includes 227 bank-year observations over fiscal years 2003 to 2008. The dependent variables are log (total compensation) (*Ln(TDC1)*) and individual components of compensation expressed as share of total compensation (salary (*Salary_p*), cash bonus (*Cashbonus_p* or *RelBonus*), restricted stock (*Stock_p*), stock options (*Option_p*), and other elements (*Others_p*)) in the year *(t+1)*. The independent variables consist of *Attack,* a time-variant indicator variable that takes the value 1 if a bank's headquarters were within 100 miles of the attack during and after the attack, and 0 for the treatment banks before the attack and all other banks (Dai et al., 2020), and control variables as defined in Equation (3). All variables are as defined in Appendix 4. All continuous variables were winsorized at the 1st and 99th percentiles. Robust standard errors are clustered at the bank level to account for within-bank correlations in regression residuals, and T-statistics are shown in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

	Ln (TDC1)	***Salary_p***	***Cash bonus_p (RelBonus)***	***Option_p***	***Stock_p***	***Others_p***	***Ln (TDC1)***	***Salary_p***	***Cash bonus_p (RelBonus)***	***Option_p***	***Stock_p***	***Others_p***
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Attack	0.2705	-0.0503	0.0672***	0.0180	-0.0251	-0.0037	0.1034	0.0044	0.0742**	0.0072	-0.0738	-0.0078
	(1.36)	(-1.06)	(2.69)	(0.21)	(-0.37)	(-0.14)	(0.48)	(0.08)	(2.31)	(0.09)	(-0.80)	(-0.25)
Ln(Age)	0.8473	-0.3298	-0.1923	0.6421**	0.2095	-0.2924	0.5954	-0.2864*	-0.1284	0.5405*	0.2762	-0.3577*
	(0.77)	(-1.29)	(-0.60)	(2.42)	(0.48)	(-1.53)	(0.71)	(-1.71)	(-0.40)	(1.94)	(0.65)	(-1.80)
Bank size							-0.1587	0.0200	-0.1105	-0.0499	0.1377	-0.0043
							(-0.40)	(0.28)	(-1.45)	(-0.42)	(1.05)	(-0.06)
ROA							4.6345	-2.3909	-2.2817	2.3637	0.9549	1.2705
							(0.43)	(-0.69)	(-0.91)	(0.52)	(0.21)	(0.61)
Deposit_Assets							-0.7751	0.0599	0.3133	-0.1730	0.0812	-0.2558
							(-0.70)	(0.20)	(1.07)	(-0.54)	(0.20)	(-1.30)
Income diversification							4.2425***	-0.9964***	0.2681	0.2561	0.4683	0.0473
							(3.03)	(-2.88)	(1.21)	(0.82)	(1.15)	(0.23)
Leverage							1.0901	-0.6266	0.6889	-1.6512	2.6464	-0.9116
							(0.17)	(-0.43)	(0.59)	(-1.04)	(1.31)	(-1.26)
Constant	4.9466	1.5826	1.0244	-2.3468**	-0.7113	1.2964	6.7004	1.9629	1.7815	0.4234	-5.9924	2.5980
	(1.10)	(1.53)	(0.78)	(-2.17)	(-0.40)	(1.66)	(0.54)	(0.85)	(0.74)	(0.14)	(-1.56)	(1.45)
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	227	227	227	227	227	227	227	227	227	227	227	227
Adj R-squared	0.112	0.103	0.306	0.071	0.050	0.014	0.236	0.252	0.317	0.083	0.064	0.007

4.5.2. Changes in executive cash bonus and mortgage risk-taking: Evidence from terrorist attacks

Both incentives to take risks and CEO cash bonuses are endogenously determined by a bank's characteristics. Accordingly, after establishing that a terrorist attack is an exogenous shock to the executive cash bonus, we examined consequences at a second remove. Such attacks provide a context in which we can test how the level of cash bonus payable to CEOs affects a bank's risk-taking as shown in mortgage-lending decisions.

We continued to use the difference-in-differences framework for our analysis. DiD analysis can test the consequences of terrorist attacks for the banks in our treatment group (located within 100 miles of the attack; no attacks over the previous three years). Given that we are examining the difference over time between two groups, the DID approach could supply factors that impact on the two groups alike but are not apparent from the raw data, and also rule out hidden trends that correlate with risky mortgage lending activities and executive compensation in the treatment and control groups. Again, we examined the effects of incentives embedded in cash bonus on denial of risky mortgages, using an indicator for the treatment group (*Attack*) as follows:

$$Denial_{ijkt} = \alpha_{jk} + \alpha_{kt} + \mu_1 Attack \times Riskyloan_{it} + \mu_2 Attack + \mu_3 Riskyloan_{it} + \gamma_1 X_{it} + \gamma_2 Z_{j,t-1} + \varepsilon_{ijkt} \quad (4)$$

where *i*, *j*, *k* and *t* represent the same things as in Equation (1). For consistency with earlier analysis, we absorbed county*year-fixed effects (α_{kt}), and bank*county-fixed effects (α_{jk}) in the full models. The dependent variable, $Denial_{ijkt}$, is a dummy variable that takes the value 1 if a mortgage application is denied in a given fiscal year *t*, and 0 if it is approved. *Attack* is a time-variant indicator variable, set in the same way as for Equation (3). $Riskyloan_i$ is a dummy variable set in the same way as for Equation (2). In our specification, μ_1 is a coefficient that compares risky mortgage credit origination at the treated banks with risky mortgage credit origination at banks located in safer areas *(Attack*Riskyloan)*, and ($\mu_1 > 0$) implies that one consequence of the terrorist attacks was tighter supply of risky mortgages. We used the same set of control variables in these regressions as in Equation (1). Likewise, we also constructed heteroskedasticity-robust standard errors clustered at the bank-county level to account for the correlation of residuals within bank-county pairs throughout our analysis.

One concern for the DiD analysis in this context is that treated banks and banks located in safer areas may have been fundamentally different so, even if no terrorist attacks had taken place, that might explain why executives of one group of banks were rewarded with more cash bonus than executives in the other group of banks. To address this possibility, we tested the characteristics of the two groups by performing univariate tests for differences in mean between them. We applied the kernel-matching method to generate the treatment and control groups, because that would minimise this concern and ultimately produce fewer bad observations than other approaches. Table 4-6 presents the results. The important thing that can be observed is that the treated and control banks are likely to share similar specific characteristics when all of the difference tests between treated banks and control banks are statistically insignificant. In other words, the results lessen the concern that there might have been fundamental differences between the two groups that might not have been observable once the data had been aggregated.

In Table 4-7, we present a formal analysis of how denial of mortgages changed after terrorist attacks, which is derived from applying Equation (4). The main coefficients of the interaction of *Attack* and *Riskyloan*, the ones in which we are chiefly interested for this analysis, are reported along with less to more fully specified models. As expected, all coefficients of the interaction term (μ_1) were statistically positively significant at the conventional level. Taken together, the results are consistent with what we expected: after nearby terrorist attacks the likelihood increases that mortgage applications would be denied, in other words that the supply of risky mortgage lending would reduce, controlling for the other factors.

Table 4.6: Bank characteristics: treatment group versus control group

This table presents the mean values of bank characteristics for the control and the treatment groups. All variables are as defined in Appendix 4. The differences in the mean values between treated and control banks are reported and their statistical significance at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

	Treated (a)			Control (b)			Treated – Control (a)-(b)		
	Mean	**S.D.**	**Obs**	**Mean**	**S.D.**	**Obs**	**Mean**	**S.D.**	**Obs**
Bank size	17.93	1.53	64	17.96	1.69	73	-0.03	-0.16	137
ROA	0.01	0.004	64	0.01	0.004	73	0.00	0.00	137
Deposit/Assets	0.66	0.09	64	0.64	0.16	73	0.02	-0.07	137
Income diversification	0.32	0.10	64	0.29	0.12	73	0.03	-0.02	137
Leverage	0.91	0.01	64	0.91	0.02	73	0.000	-0.009	137

Table 4.7: Terrorist attacks and risky mortgage origination

This table presents OLS regression results on the effect of attack on denial of risky mortgages. The dependent variable is *Denial*: an indicator is set to 1 if the mortgage application is denied, and 0 if it is approved. The independent variables are *Attack*, a time-variant indicator variable that takes the value 1 if a bank's headquarters were within 100 miles of the attack during and after the attack, and 0 for the treatment banks before the attack and all other banks (Dai et al., 2020). *Riskyloan* is a dummy variable that takes the value 1 if the loan-to-income ratio is at or above the 75th percentile of the LTI ratios of the whole sample, and 0 otherwise, and other controls for characteristics of loan applicants and banks. All variables are as defined in Appendix 4 and all continuous variables were winsorized at the 1st and 99th percentiles. Standard errors clustered at the bank*county level. T-statistics are reported in parentheses below the coefficient estimates. Significance levels at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

	Denial = (0,1)	
	(1)	(2)
Riskyloan	0.0314***	0.0316***
	(17.16)	(17.84)
Attack*Riskyloan	0.0048*	0.0050**
	(1.92)	(2.04)
Male	-0.0117***	-0.0113***
	(-17.10)	(-16.74)
Hispanic	0.0908***	0.0914***
	(35.17)	(35.46)
Asian	-0.0097***	-0.0099***
	(-4.39)	(-4.50)
White	-0.0434***	-0.0438***
	(-34.74)	(-35.56)
Black	0.0858***	0.0852***
	(30.88)	(30.75)
Ln (Delta)		0.0898***
		(22.77)
Ln (Vega)		-0.0334***
		(-24.15)
Ln (Applications)		-0.0333***
		(-23.40)
Ln (Age)		0.1286***
		(10.02)
Bank size		-0.1821***
		(-17.85)
ROA		-0.3152
		(-0.72)
Deposit_Assets		-0.5397***
		(-18.93)
Income diversification		0.0011
		(0.04)
Leverage		1.1235***
		(9.18)
Constant	0.1931***	2.3170***
	(151.92)	(9.22)
Bank*County FEs	Yes	Yes
County*Year FEs	Yes	Yes
Observations	6,148,737	6,131,670
Adj R-squared	0.109	0.112

4.6. FAS 123R as a quasi-natural experiment

4.6.1. Changes of cash bonus around the adoption of the FAS 123R

In this section, we examine how various forms of CEO compensation in banks were affected by the adoption of FAS 123R. To do this, we regressed the log value of total pay, and the proportion of total pay attributable to each of five main elements of pay, using an indicator for the period after FAS 123R came into force and control variables for bank characteristics. Following Mao & Zhang (2018), our estimates are presented as follows:

$$\text{Compensation}_{j,t} = \alpha + \alpha_j + \text{Post}_t + \text{X}'_{j,t} + \varepsilon_{j,t} \qquad (5)$$

where j and t denote the same things as for Equation (3). $Compensation_{j,t}$ is the main dependent variable in which we are interested; it includes the natural logarithm of total compensation (to reduce skewness) and the ratio of its composition in each year during 2002–7, respectively. Total compensation is the same as described for Equation (3). To examine the effects on different elements of CEO compensation, we used the same set of variables as for Equation (3). We included bank-fixed effects in all regressions to control for any unobserved time-invariant heterogeneity across banks. This allowed us to capture the average within-bank changes in CEO compensation and its components as a function of independent variables in the regressions.

Consistent with previous studies, the results suggest that the mandated change in how option costs are expensed in income statements prompted changes in elements of CEO compensation. Whether those changes in CEO pay were associated with risky mortgage lending remains an open question which is explored in later sections of this study. Specifically, the *Post* indicators in Table 4-8 indicate that, among the five components of CEO pay we identified, on average total pay increased by about 16.04%, on average the proportion of total pay represented by cash incentive pay increased by 5.63%, and on average the proportion of total pay represented by stock options decreased by 9.59% following the adoption of FAS 123R, suggesting that banks switched to other forms of compensation following the adoption of "fair value" expensing, e.g. to cash incentives from options. Taken together, these results seem to suggest that banks substitute towards performance-based pay.

We found that overall bank CEO compensation increased after the adoption of FAS 123R, that cash bonuses and restricted stocks formed a higher proportion of overall compensation and options a lower, even though the value of options granted increased.

Table 4.8: Changes in compensation structure around the Adoption of FAS 123R

This table presents bank-fixed effects regressions illustrating changes in the structure of bank CEO compensation around the adoption of FAS 123R. The sample includes 335 bank-year observations over fiscal years 2002 to 2007. The dependent variables are log (total compensation) (*Ln(TDC1)*) and individual components of compensation expressed as share of total compensation (salary (*Salary_p*), cash bonus (*Cashbonus_p* or *RelBonus*), restricted stock (*Stock_p*), stock option (*Option_p*), and other elements (*Others_p*)). The independent variables consist of an indicator (*PostFAS*) which equals 1 for the period after FAS 123R was adopted, i.e. fiscal years 2005 to 2007, and 0 for earlier years, and bank control variables. All variables are as defined in Appendix 4. All continuous variables were winsorized at the 1st and 99th percentiles. Robust standard errors are clustered at the bank level to account for within-bank correlations in regression residuals, and T-statistics are shown in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

	Ln (Total compensation)	Salary_p	Cash bonus_p (RelBonus)	Stock_p	Option_p	Others_p
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.1807**	-0.0137	0.0402*	0.0675**	-0.0946**	-0.0254
	(2.09)	(-0.53)	(1.83)	(2.58)	(-2.42)	(-0.88)
Bank size	-0.0942	0.0687	-0.0476	0.0553	-0.0575	-0.0342
	(-0.64)	(1.58)	(-0.95)	(1.06)	(-0.57)	(-0.59)
ROA	11.0980	1.9339	-4.0070	2.7322	-4.9988	5.4371
	(1.39)	(0.59)	(-0.92)	(0.73)	(-0.88)	(1.64)
Deposit_Assets	1.3281*	-0.4015*	0.0669	0.0583	0.3513	-0.3077
	(1.75)	(-1.80)	(0.25)	(0.24)	(0.92)	(-1.27)
Income diversification	1.0859	-0.4821*	0.3480*	-0.2386	0.0799	0.4119***
	(1.65)	(-1.83)	(1.84)	(-1.17)	(0.34)	(2.78)
Leverage	4.3178	-1.5415	2.6928***	2.0049**	-3.8402*	1.3106
	(1.62)	(-1.32)	(3.24)	(2.16)	(-1.85)	(1.59)
Constant	4.4126	0.9087	-1.5280	-2.6685**	4.5923	-0.4644
	(1.21)	(0.75)	(-1.24)	(-2.01)	(1.65)	(-0.36)
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	335	335	335	335	335	335
Adj R-squared	0.833	0.598	0.253	0.401	0.387	0.253

4.6.2. FAS123 R and mortgage denial

We regard the introduction of FAS 123R as having generated exogenous change in cash bonus plans because FAS 123R made it costlier (in accounting terms) to grant stock options, resulting in lower incentives to accept greater mortgage risk (Carter, Lynch, & Tuna, 2007; Chava & Purnanandam, 2010; Bakke, Mahmudi, Fernando, & Salas, 2016) . For this reason, we tested how mortgage origination changed around the time FAS 123R came into force, to provide evidence of the relationship between levels of cash bonus and supply of mortgage lending.

Following Mao & Zhang (2018), we divided our sample into two subsamples, by whether the adoption of FAS 123R had a high impact *(High_impact group)* or relatively little impact *(Low_impact group)*, based on the perceived costs of option expensing before and after adoption. For this purpose, before FAS 123R (e.g. fiscal years 2002–4) the perceived costs of the options issued were calculated as the value of the pro forma option expenses (deflated by fully diluted shares). Additionally, to further mitigate the impacts of endogeneity, we used a propensity score-matching approach, to match each member of *High_impact group* (the treatment group) with a corresponding member of *Low_impact group* (the control group) sharing similar characteristics: bank size, ROA, deposit to asset ratio, income diversification, and leverage. Our regressions were as follows:

$$Denial_{ijkt} = \alpha_{jk} + \alpha_{kt} + \phi_1 Post_t + \phi_2 High\_impact_i + \phi_3 (Post \times High\_impact)_{it} + \gamma_1 X_{it} + \gamma_2 Z_{j,t-1} + \varepsilon_{ijkt} \quad (6)$$

where *i*, *j*, *k*, and *t* represent the same things as in Equation (1). For consistency with earlier analysis, we absorbed county*year-fixed effects (α_{kt}), and bank*county-fixed effects (α_{jk}) in the more fully specified models. The dependent variable, $Denial_{ijkt}$, is set in the same way as for Equation (4). $High\_impact_i$ is an indicator variable set to 1 if the perceived costs of the options granted to CEOs at banks are at or above the median for *High_impact group*, and 0 for other banks (the control group). The sample period runs from financial year 2003 to financial year 2008 (excluding financial year 2006) to get rid of confused effects in the year of implementation (Mao & Zhang, 2018). $Post_t$ was set to 1 if a mortgage application originated within financial years 2007 or 2008, and 0 otherwise. ϕ_3 is a coefficient that compares the effects of FAS 123R on mortgage

origination at *High_impact group* banks with the effects at *Low_impact group* banks, and ($\phi_3 > 0$) implies that the supply of mortgages reduced after the adoption of FAS 123R. ($X_{i,t,t-1}$) are vectors of control variables similar to those in Equations (1) and (4) but they exclude *Ln(Delta)* and *Ln(Vega)* because the *Post* indicator absorbs these. For consistency with earlier analysis, we also constructed heteroskedasticity-robust standard errors clustered at the bank-county level to account for the correlation of residuals within bank-county pairs in all analyses. To control for heterogeneity between treatment banks and control banks, bank-fixed effects were employed to account for time-invariant differences attributable to unexplained factors that differ across banks.

One concern for the DiD analysis in this context is that *High_impact group* and *Low_impact group* banks may have been fundamentally different so, even if FAS 123R had not been introduced, that might explain why executives in one group were awarded higher levels of cash bonus than executives in the other. To address this issue, we tested the characteristics of the two groups after matching propensity scores of the two neighbours, because that would minimise this concern and ultimately produce fewer bad observations than other PSM approaches. For this purpose, we performed univariate tests of the differences in mean between them. The results are reported in Table 4-9. Importantly, it can be observed that *High_impact group* banks and *Low_impact group* banks share similar specific characteristics when the difference tests are statistically insignificant. In other words, the results lessen the concern that there might have been unobservable differences between the two groups.

The results of our mortgage origination calculations are reported in Table 4-10. The coefficients of particular interest are ϕ_3 on the interaction terms $Post_t * Highimpact_i$. These are in line with the coefficients of Equation (1) in the economic significance term. Conclusively, the results of these analyses show that the compensation structure changes following the adoption of FAS 123R had little effect on mortgage origination. The results are consistent with what we expected: adoption of FAS 123R speeded up the trend to increase the cash bonus share of total CEO pay, which in turn translated to higher likelihood of mortgage denial; in other words, it led to a reduction in the supply of mortgage lending, controlling for other factors. These findings confirm our main hypothesis.

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Table 4.9: Bank characteristics: High policy impact versus Low policy impact

This table presents the mean values of bank characteristics for *High_impact_group* banks and *Low_impact_group* banks. We define banks having pro forma option expenses above the sample median after adoption of FAS 123R as *High_impact_group* banks and the remaining banks as *Low_impact_group* banks (Mao and Zhang, 2018). We used the two nearest neighbours, based on matching propensity scores, to define the sample during 2003–2008, and excluded 2006 (fiscal year of FAS 123R adoption) (Mao and Zhang, 2018). All variables are as defined in Appendix 4. The differences between treated and control banks in the mean values are reported and their statistical significance at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

	High policy impact group (a)			**Low policy impact group (b)**			**(a) – (b)**		
	Mean	**S.D.**	**Obs**	**Mean**	**S.D.**	**Obs**	**Mean**	**S.D.**	**Obs**
Bank size	17.905	1.6239	50	17.9182	1.517	72	-0.0132	0.1069	122
ROA	0.0139	0.0032	50	0.0129	0.0037	72	0.001	-0.0005	122
Deposit/Assets	0.6747	0.1191	50	0.6619	0.107	72	0.0128	0.0121	122
Income diversification	0.3017	0.1132	50	0.2979	0.1049	72	0.0038	0.0083	122
Leverage	0.9064	0.0189	50	0.908	0.0157	72	-0.0016	0.0032	122

Table 4.10: FAS123R and mortgage origination

This table presents OLS regression results on the effect of CEO cash bonus incentives on mortgage origination, calculated using Equation (6). The dependent variable is *Denial*: an indicator is set to 1 if the mortgage application is denied, and 0 if it is approved. The independent variables are *High_impact*, which is an indicator variable set to 1 if, after adoption of FAS 123R, the perceived costs of share options issued to CEOs were above the sample median for the *High_impact_group*, and 0 for other banks (the control group). The sample period ran from financial year 2003 to financial year 2008 (excluding financial year 2006, the year of FAS 123R adoption) (Mao & Zhang, 2018). The dependent variables are *Post*, which equals 1 if the mortgage application originated within financial years 2007 or 2008, and 0 otherwise; the ratio of applicant loan amount to borrower income (*LTI*); and other controls for characteristics of applicants and banks. All variables are as defined in Appendix 4 and all continuous variables were winsorized at the 1st and 99th percentiles. Standard errors clustered at the bank*county level. T-statistics are reported in parentheses below the coefficient estimates. Significance levels at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

	Denial = (0,1)		
	(1)	(2)	(3)
*Post*High_impact*	0.0081**	0.0297***	0.0152***
	(2.08)	(7.46)	(4.63)
Post	0.0170***		
	(4.73)		
High_impact	-0.0306***		
	(-9.15)		
LTI	0.0071***	0.0099***	0.0113***
	(10.87)	(15.55)	(18.15)
Male	-0.0173***	-0.0147***	-0.0132***
	(-20.14)	(-17.36)	(-16.42)
Hispanic	0.1025***	0.1017***	0.1011***
	(29.70)	(31.69)	(32.93)
Asian	-0.0081***	-0.0077***	-0.0080***
	(-3.12)	(-3.00)	(-3.11)
White	-0.0511***	-0.0469***	-0.0463***
	(-32.47)	(-33.55)	(-35.56)
Black	0.0777***	0.0831***	0.0822***
	(27.12)	(29.94)	(29.18)
Ln (Applications)		-0.0154***	-0.0381***
		(-17.39)	(-27.96)
Ln (Age)		0.0863***	0.1368***
		(5.70)	(12.11)
Bank size		0.1076***	0.0651***
		(8.24)	(6.30)
ROA		-6.0533***	0.8218
		(-8.68)	(1.34)
Deposit_Assets		0.3992***	0.2032***
		(11.34)	(7.73)
Income diversification		0.2780***	0.2149***
		(10.40)	(8.73)
Leverage		1.6458***	0.4583***
		(10.01)	(3.74)
Constant	0.1792***	-3.9825***	-2.0902***
	(43.70)	(-10.51)	(-7.22)
Bank FEs	No	Yes	No
County FEs	Yes	Yes	No
Year FEs	No	Yes	No
Bank*County FEs	No	No	Yes
County*Year FEs	No	No	Yes
Observations	3812841	3812841	3808763
Adj R-squared	0.039	0.052	0.065

4.7. Robustness tests

An endogeneity concern could arise when we examine the link between CEO cash bonus and bank risk-taking at the BHC level, i.e the executive is likely to be rewarded with higher cash bonus when banks perform well (within the incentive zone). The geographic spread of the banks in our sample mitigates this concern, as we believe that localised effects may be more endogenously associated with CEO bonus at the main headquarters of BHCs and with lending decisions. That said, we addressed the potential endogenous effect in our testing by rerunning a series of the main baseline regressions with a limited sample, from which we excluded loans approved within the same state as the headquarters bank. Removing these observations reduces the potential for such localised effects.

Tables 4-11A and 4-11B present the results of regressions over the limited sample. The coefficient estimates on *RelBonus* were still statistically positively significant in all specifications at the 1% level. Additionally, the results show that the estimated interactions between *RelBonus* and *Riskyloan* were also positive and statistically significant in all specifications at the 1% level, suggesting that denial of loans to risky borrowers increased or, in other words, that the incentives embedded in cash bonus plans reduced the supply of risky mortgages. This is consistent with the previous main findings and lessens the concern at possible endogeneity.

Table 4.11A: Robustness tests - OLS regressions on cash bonus and risky mortgage denial

This table presents OLS regression results on the effect of CEO cash bonus incentives on denial of mortgages, excluding mortgages originating within the same state as the headquarter banks. The dependent variable is Denial: an indicator is set to 1 if the mortgage application is denied, and 0 if it is approved. The independent variables are the ratio of cash bonuses to total compensation (RelBonus); the ratio of applicant loan amount to borrower income (LTI); Riskyloan, a dummy variable that takes the value 1 if LTI is at or above the 75th percentile of the LTI ratios for the whole sample group, and 0 otherwise; other controls for characteristics of applicants and banks; . All variables are as defined in Appendix 4 and all continuous variables were winsorized at the 1st and 99th percentiles. Standard errors clustered at the bank*county level. T-statistics are reported in parentheses below the coefficient estimates. Significance levels at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

	Denial = (0,1)		
	(1)	(2)	(3)
RelBonus	0.1193***	0.0700***	0.0488***
	(10.82)	(6.27)	(3.68)
LTI	0.0125***	0.0132***	0.0137***
	(23.34)	(27.03)	(27.64)
Male	-0.0129***	-0.0109***	-0.0105***
	(-14.13)	(-13.57)	(-13.45)
Hispanic	0.0941***	0.0919***	0.0921***
	(26.24)	(28.82)	(28.85)
Asian	-0.0081***	-0.0079***	-0.0082***
	(-3.07)	(-3.16)	(-3.29)
White	-0.0436***	-0.0428***	-0.0436***
	(-25.25)	(-27.47)	(-28.16)
Black	0.0904***	0.0879***	0.0866***
	(22.59)	(22.50)	(22.58)
Ln (Delta)			0.0695***
			(12.83)
Ln (Vega)			-0.0300***
			(-17.30)
Ln (Applications)			-0.0298***
			(-18.05)
Ln (Age)			0.0675***
			(5.24)
Bank size			-0.1093***
			(-12.72)
ROA			-0.2982
			(-0.31)
Deposit_Assets			-0.4296***
			(-17.28)
Income diversification			0.0570
			(0.91)
Leverage			2.5177***
			(16.53)
Constant	0.1404***	0.1518***	-0.1639
	(38.59)	(41.01)	(-0.87)
Bank FEs	Yes	No	No
County FEs	Yes	No	No
Year FEs	Yes	No	No
Bank*County FEs	No	Yes	Yes
County*Year FEs	No	Yes	Yes
Observations	5,471,429	5,465,566	5,452,767
Adj R-squared	0.087	0.111	0.114

Table 4-11B: OLS regressions on cash bonus and risky mortgage denial

This table presents the OLS regression results on the effect of cash bonus incentives on denial of risky mortgages. The dependent variable is *Denial*: an indicator is set to 1 if the mortgage application is denied, and 0 if it is approved. The independent variables are cash bonus incentives, measured by the ratio of cash bonuses to total compensation (*RelBonus*); the ratio of applicant loan amount to borrower income (*LTI*); *Riskyloan* is a dummy variable that takes the value 1 if the loan-to-income ratio is at or above the 75th percentile of the LTI ratios of the whole sample, and 0 otherwise; other controls for characteristics of loan applicants and banks . All variables are as defined in Appendix 4 and all continuous variables were winsorized at the 1st and 99th percentiles. Standard errors clustered at the bank*county level. T-statistics are reported in parentheses below the coefficient estimates. Significance levels at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

	Denial = (0,1)		
	(1)	(2)	(3)
RelBonus	0.1093***	0.0577***	0.0388***
	(9.81)	(5.07)	(2.97)
*RelBonus*Riskyloan*	0.0447***	0.0551***	0.0570***
	(4.86)	(7.70)	(7.78)
Risky loan	0.0215***	0.0205***	0.0204***
	(7.42)	(7.86)	(7.48)
Male	-0.0133***	-0.0114***	-0.0110***
	(-14.83)	(-14.30)	(-14.25)
Hispanic	0.0945***	0.0923***	0.0926***
	(26.50)	(28.97)	(29.02)
Asian	-0.0076***	-0.0075***	-0.0077***
	(-2.91)	(-2.99)	(-3.10)
White	-0.0432***	-0.0424***	-0.0431***
	(-25.15)	(-27.34)	(-27.96)
Black	0.0910***	0.0886***	0.0873***
	(22.66)	(22.52)	(22.64)
Ln (Delta)			0.0693***
			(12.75)
Ln (Vega)			-0.0301***
			(-17.32)
Ln (Applications)			-0.0277***
			(-17.03)
Ln (Age)			0.0659***
			(5.08)
Bank size			-0.1125***
			(-13.10)
ROA			-0.1803
			(-0.19)
Deposit_Assets			-0.4360***
			(-17.72)
Income diversification			0.0576
			(0.92)
Leverage			2.4556***
			(16.07)
Constant	0.1610***	0.1740***	-0.0227
	(45.87)	(48.60)	(-0.12)
Bank FEs	Yes	No	No
County FEs	Yes	No	No
Year FEs	Yes	No	No
Bank*County FEs	No	Yes	Yes
County*Year FEs	No	Yes	Yes
Observations	5471429	5465566	5452767
Adj R-squared	0.087	0.111	0.114

4.8. Conclusion

This chapter examines how incentive mechanisms embedded in cash bonus plans for bank CEOs influenced the supply of mortgage lending, in particular risky mortgages, prior to the housing market collapse of 2008–2009. We find that banks were more likely to deny risky mortgages when their CEOs received a higher proportion of their total compensation in cash bonus. In other words, these findings suggest that cash bonus incentives mitigate the origination of risky mortgages rather than promoting it.

We adopted several methods to address concerns of potential endogeneity and causality. First, we controlled for county*year-fixed effects to reduce the concern that compensation incentives may also be associated with unobservable demand-side factors at the county level. The results after including the bank*county-fixed effects and the county*year-fixed effects remained unchanged, indicating that the findings are not driven by an association between compensation incentives and bank-county characteristics, or by county characteristics. Next, we examined two kinds of exogenous shock – nearby terrorist attacks and the adoption of FAS 123R – and the findings are robust vis-à-vis these shocks. To do this, we employed difference-in-differences tests comparing results before and after these shocks to confirm causal relationships between cash bonus incentives, mortgage supply and mortgage risk-taking. Finally, we excluded mortgage loans issued within the same state as the bank headquarters from the main regressions to lessen the potential for local economic condition changes to affect either mortgage loan approvals or CEO compensation, because the cash bonus may be affected by endogenous factors in banks with a more regional focus.

Overall, these findings suggest that cash bonus plans mitigated the origination of risky mortgages during the survey period. This is consistent with the theories and empirical studies that we surveyed, which predicted that incentives to take risks ought to reduce if more of the CEO compensation comes in the form of cash bonus. Moreover, it confirms that the level of bank CEO cash bonus was not an element contributing to the 2008/9 financial crisis.

Chapter 5

Chapter 5: Bank Holding Company Credit Rating Changes and The Supply of Local Credit

Abstract

This chapter explores the impact of bank holding company (BHC) credit rating changes on the supply of local bank mortgage lending to address the question whether banks manage to maintain their current highly favourable ratings. We find evidence that BHC credit rating upgrades contribute to a tightening in the supply of mortgage credit in the markets served by the BHC's bank(s). Additionally, the results show no association between credit rating downgrades and mortgage lending at loan level. Further, we also find that reductions in the supply of credit after a BHC rating upgrade are most pronounced for riskier loans and in markets with less competition. Recognizing potential market-based endogeneity, we examine the results for loans originated outside of the BHC's state of domicile and find similar results. Finally, we do not find evidence that the banks held by upgraded BHCs are moving into other types of loans after the upgrade. Collectively, the results suggest that BHCs move to protect their improved rating after the upgrade at the expense of the supply of local credit.

5.1. Introduction

Yet, little is known about the implications of credit rating management on bank financing decisions. Do bank managers manage to maintain the current credit ratings? This study attempts to address this question in the context of risky mortgage lending. If managers care about maintaining better ratings, they seek to keep the higher ratings to protect their bank reputation and direct their bank(s) to constrain lending to all but the safest of borrowers (but not necessarily after a downgrade). Credit ratings are used to access the creditworthiness of an entity, e.g. a bank, so they reflect the quality of the organization: the higher credit rating levels, the more benefits to a bank. Prior literature provides evidence of the effects of credit ratings, not only the cost of borrowing and funding (Katz, 1974; Grier and Katz, 1976; Hand et al., 1992; Wansley, Glascock, and Clauretie, 1992; Hite and Warga, 1997; Durand, 2011; and Watkins, 2012, among others),

but also capital market reactions on the stock and bond valuations (Holthausen and Leftwich, 1986; Ederington, Yawitz, and Roberts, 1987; Hand, Holthausen, and Leftwich, 1992; Ederington and Goh, 1998; Dichev and Piotroski, 2001; Purda, 2007).

In the banking sector, previous research focuses only on bank downgrades rather than upgrades (Karam, Merrouche & Souissi, 2014; and Adelino & Ferreira, 2016). In addition, anecdotal financial press articles also support that rating changes, especially unfavourable rating changes affect bank's access to funding, such as bank downgrades have "an immediate impact on the ability of money market funds to provide short-term financing to banks, because some clients stipulate that counterparties must have a minimum credit rating" (Watkins, 2012). However, a bank upgrade is also important. An upgrade reflects bank's *"strengthened profitability, which has enhanced the bank's earnings diversification and reduced its reliance on the inherently more volatile earnings from capital markets businesses."* What could happen after a rating change? A bank could be upgraded if it was *"to lower its interest rate sensitivity on a sustainable basis without significantly reducing its profitability"* or it could be downgraded if it *"suffers a sustained decline in profitability, experiences a significant deterioration in capital or liquidity levels relative to peers and targets, exhibits a marked increase in its risk appetite, or experiences a sizeable operational risk charge or control failure."*

Given the above discussion, a rating change would lead to the discrete changes in bank's cost of external finance, so that could be a great concern when banks are making decisions. In addition, there is lack of empirical evidence on bank behaviour after an upgrade. A rating change would have great incentives for banks try to attempt an upgrade, avert from a downgrade. In other words, a bank upgrade creates strong motivations for managers to take actions to maintain their new favourable credit ratings. We, therefore, hypothesize that when a bank is upgraded, the bank likely to reduce the risky mortgage lending.

However, it is unclear, a priori, if, and how, a BHC level credit rating change will affect bank lending behaviour. For instance, a credit rating downgrade may affect the BHC's, cost of funding. Consistent with Durand (2011) and Watkins (2012), if the BHC faces the increased costs of funding, the BHC may respond by directing its bank(s) to move further out on the risk curve making loans to less-qualified mortgages in an attempt to chase higher yields in order to offset its increased costs. Conversely, the downgrade may induce a move to conservativism as the BHC moves to repair the damage to its

reputation, thus restricting lending by its bank(s). Likewise, with a rating upgrade, a BHC may face reductions in its costs of funding, thus enabling the BHC to direct its bank(s) to increase its lending. The effects of credit rating changes at the BHC level on bank lending is, therefore, an empirical matter.

Moreover, changes at the bank holding company (BHC) level, exogenous to bank financial health or local economic conditions, can engender real impacts on the local economy. Ashcraft (2005) documents significant and lasting effects to local economies subsequent to failure of two, otherwise, "healthy" banks. Ashcraft's study highlights both the specialness of banks in the intermediation process and identifies an external factor that can affect the efficacy of the intermediation process, i.e., changes emanating from the BHC. Taking together, to fill the void in the literature, we examine whether credit rating adjustments at the BHC level change bank mortgage lending supply of local banks.

We recognize the problem of endogeneity in using BHC credit rating changes as an external shock to the local bank. However, we argue that the BHC level rating is largely exogenous to local bank lending behaviour for at least two reasons: 1) that the firms in our sample (i.e., credit-rated BHCs) are large enough that their bank holdings are sufficiently diversified across regional/local economies such that only macro events, correlated across several geographies, would lead to a BHC level credit ratings change originating from the banks held by the BHC; and, 2) that industry-wide shifts to non-interest income and off-balance sheet products increasingly concentrate income generation responsibilities to BHCs themselves creating disparate incentive regimes between banks and their holding companies.

We quantify the impact of BHC level credit rating changes on bank lending behaviour by studying the changes in mortgage lending for banks whose BHC experiences a credit rating change relative to those whose BHCs do not. Mortgage lending is our primary area of focus as the Home Mortgage Disclosure Act (HMDA) Loan Application Register, our primary data source, reports data on mortgage applications, not simply mortgage approvals, thus allowing us to control for contemporaneous changes in loan demand. We examine the changes in mortgage lending behaviour subsequent to both credit rating downgrades and credit rating upgrades.

We find evidence that BHC credit rating upgrades contribute to a tightening in the supply of mortgage credit in the markets served by the BHC's bank(s). Mortgage loan

denial rates at the bank level increase in the year subsequent to a credit rating upgrade by the bank's holding company. We interpret this as evidence consistent with a BHC moving to protect, or invest in, its recently improved reputation. To further explore the BHC's reputational considerations, we find that banks are more likely to deny riskier mortgage loans subsequent to a credit rating upgrade by its BHC. We do not find evidence that BHC level credit rating downgrades lead to changes in bank-level, mortgage loan denial rates subsequent to the downgrade, on average. We then examine competition as a mitigating factor of our main results. We find that mortgage denials increase subsequent to a credit rating upgrade, on average, but less so for banks operating in more competitive markets. Again, we interpret this result as evidence consistent with the notion that BHCs seek to protect their improved reputation subsequent to a credit rating upgrade. When pressured by competitive forces to a lesser degree, BHCs have greater flexibility to invest in reputational considerations.

Again, the first-order challenge in our identification strategy is disentangling the endogeneity that exists between bank performance and the credit rating of the bank's holding company. For example, when the financial health of a BHC's bank is improving as the result of robust local economic growth, it is more likely, ceteris paribus, that the BHC will experience a credit rating upgrade. To address this concern, we reperform our analysis over a sample where we drop mortgage loan applications originating in the BHC's state of domicile. Our findings hold over this restricted sample. Mortgage loan denial rates increase for banks in the year following a credit rating upgrade for the bank's holding company. Again, this result is most pronounced for risky loans. Additionally, we find no effects on loan denial rates subsequent to a credit rating downgrade.

To better understand changes in the lending behaviour of banks subsequent to BHC level credit rating changes, we examine the effects of the ratings change on the loan composition of the bank. For example, it could be the case that mortgage denial rates subsequent to a credit rating upgrade increase as the bank finds it more advantageous to pursue other lending opportunities, e.g., if a bank's cost of funding is reduced subsequent to an upgrade, then it may be in the bank's interest to pursue loan opportunities in other loan classes. We explore this possibility by studying changes in bank balance sheets subsequent to a rating change at the holding company level. Two important results emerge: 1) generally, we find no significant changes in asset composition subsequent to a credit rating change (upgrade or downgrade); and, 2) we find evidence that banks shift

mortgage lending to conforming loans and decrease lending to non-conforming loans subsequent to a credit rating upgrade at the holding company level. The lack of movement to other asset classes and the shift in focus to conforming loans is consistent with the notion of BHCs moving to protect their improved rating.

We further explore this result by examining alternative explanations for our main findings. First, we investigate the impact of credit rating changes on a bank's cost of funding by conditioning our results on the composition of liabilities for the banks in our sample. If credit rating changes impact a bank's cost of funding, then the impact should be most pronounced for banks more reliant on non-core liabilities. Overall, we show that mortgage loan denial rates increase following a holding company level upgrade and that this result is consistent regardless of the originating bank's reliance on non-core funding. However, subsequent to a BHC level credit rating downgrade, we find that loan denial rates increase for banks that are more reliant on non-core funding. Collectively, these results suggest that BHCs and their banks focus on reputational considerations when cost-effective (i.e., after an upgrade) and cost considerations when mandated (i.e., after a downgrade when the bank is relatively more reliant on non-core funding). Second, we consider the possibility that the reputational considerations of BHCs differ as a function of the BHC's rating level. For example, a highly rated BHC may have lower marginal incentives to invest in their reputation relative to a lower rated BHC given their higher initial rating. We find that the increases in loan denial rates for highly rated BHCs who experience a credit rating upgrade are significantly reduced relative to lower rated BHCs that experience a similar upgrade. Finally, we explore the possibility that the increases in mortgage loan denial rates we observe after credit rating upgrades are the result of a pre-selection issue. That is, are both the upgrade and the subsequent increases in loan denial rates a function of a trend in denial rates that existed prior to the rating change. We address this concern by conducting a propensity matched-sample analysis and find no discernible difference in denial rates between the BHCs in our credit rating upgrade and control samples prior to the credit rating change.

We contribute to two main strands of literature. First, this study links to credit rating literature in the banking sector. To the best of our knowledge, we are the first study to investigate bank financing decision when considering the cost-effective (i.e., after an upgrade) of their credit rating and rating level differences. Bank managers act to maintain their current favourable ratings level. BHCs seek to protect their improved reputation

subsequent to a credit rating upgrade and a highly rated BHC has lower marginal incentives to invest in their reputation compared to a lower rated BHC. When pressured by competitive forces to a lesser degree, BHCs have greater flexibility to invest in reputational considerations.

Second, our study contributes to the literature on the unique role banks serve. Given the importance of banks in the financial intermediation process, it is tantamount that bankers, regulators, and societies at large better understand the factors, internal and external, that affect the efficacy of banks in the intermediation process. Numerous studies have explored and debated the "specialness" of banks. In the model of Diamond and Dybvig (1983), it is the ability of banks to transform "illiquid assets into liquid liabilities" that makes them unique. Banks offer an efficient means of intermediating between the suppliers of capital and the users of capital enabling real economic growth. Our results contribute to our understanding of the unique role banks play in the intermediation process by documenting the impact that credit rating changes originating from the BHC can engender on local lending.

The remaining sections of this chapter are organized as follows. Section 5.2 develops our concept and discusses the related literature. Section 5.3 describes our data and sample identification procedures. The results of our main empirical analyses are presented in Section 5.4. We discuss the results of additional analyses in Section 5.5. Section 5.6 concludes.

5.2. Concept Development and Related Literature

Allen and Santomero (2001) paint a compelling picture that the traditional banking business of accepting deposits and making loans is in decline. Commercial banks, the authors argue, have been able to maintain relevance in the financial intermediation process by innovating and switching from their traditional business to fee-producing activities. Boyd and Gertler (1994) provide evidence supporting the notion that traditional banking is changing, though not necessarily in decline. For example, the authors show that the share of financial intermediation conducted by commercial banks is declining relative other financial intermediaries, but that the ratio of bank assets to GDP is actually increasing. Boyd and Gertler argue that banks are simply changing. For example, the authors show 1) that non-interest income as a percentage of bank assets increased roughly

167% in the industry from the late 1970s to early 1990s; and, 2) that the use of off-balance sheet derivative instruments as a means to hedge and to generate non-interest income has "exploded" over recent years.

Indeed, over our sample period of 1990 through 2010, the industry average ratio of non-interest income to total income for U.S. BHCs has increased by approximately 118% from 13.7% to 29.9%. The shift to non-interest income is not, however, uniform across BHCs of different size. Figure 5-1 shows that the changes in non-interest income are most notable for the largest holding companies.

The ratio of non-interest income to total income grew by 165.4% over our sample period for the top-ten largest BHCs while it grew by a more modest, yet robust 83.7% for BHCs below the 80th percentile in size. The use of off-balance sheet instruments over our sample period tells a similar story. The ratio of off-balance sheet instruments to total assets increased from 38.1% to 314.9% from 1990 to 2010. For the ten largest BHCs, this ratio increased nearly tenfold from 133.9% of total assets in 1990 to 1221.8% of total assets in 2010.

The data support the notion that the financial intermediation landscape for BHCs and their banks is changing, markedly so for the largest BHCs. As the industry shifts from its traditional business of decentralized deposit-taking and loan-making to one of more-centralized, non-interest income and off-balance sheet activities, it is of utmost importance that bankers, regulators, and societies understand how the change affects the strategic mission of BHCs, their bank(s), and, ultimately, how this shift impacts local economies.

Credit rating changes provide a useful setting to explore how changes at the BHC affect local lending for several reasons. For one, credit ratings and credit rating changes are informative. Credit ratings and rating changes apprise markets to the economic prospects of the rated entity (Holthausen and Leftwich, 1986; Ederington, Yawitz, and Roberts, 1987; Hand, Holthausen, and Leftwich, 1992; Ederington and Goh, 1998; Dichev and Piotroski, 2001; Purda, 2007). Norden and Weber (2004) show that the market response to credit rating changes is timely as credit default swap markets respond nearly instantaneously to the news of a rating change. The authors argue that this response stems from the fact that credit ratings represent the judgment of sophisticated market

participants. Rating agencies seem to serve a crucial role in mitigating information asymmetries in financial markets.

Secondly, credit ratings represent a forward-looking assessment of the likelihood that a credit issuer will be able to meet their financial obligations. For BHCs, this assessment evaluates the likelihood that the holding company will be able to effectively generate the revenues necessary to meet their debt obligations. As the industry shifts from its traditional business of deposit-taking and lending to one of off-balance sheet instruments and non-interest income, the assessment increasingly evaluates the ability of BHC headquarters to generate fee-based, non-interest income and not the ability of the holding companies' bank(s) to generate interest income from traditional business lines. In that sense, the credit rating of a BHC is arguably, and to an increasing extent, exogenous to the operations of a BHC's banks(s).

Figure 5.1: Non-Interest Income to Total Income

This figure graphs the mean ratio of non-interest income to total income for all U.S. BHCs over the period fiscal year-end 1990 through fiscal year-end 2013. The ratio of non-interest income to total income is defined as the ratio of the BHC's noninterest income (BHCK4079) to the sum of interest income (BHCK4107) and noninterest income (BHCK4079). The categories of BHCs are defined as follows: "Top Ten" includes the largest ten BHCs, "11th to Top 5th" includes the 11th largest BHC through the 5th percentile BHC, "Top 5th to Top 20th" includes BHCs from the 5th percentile to the 20th, and "Bottom 80th" includes BHCs below the 20th percentile. BHCs are assigned to a given category in a given year based on their book value of total assets in that year.

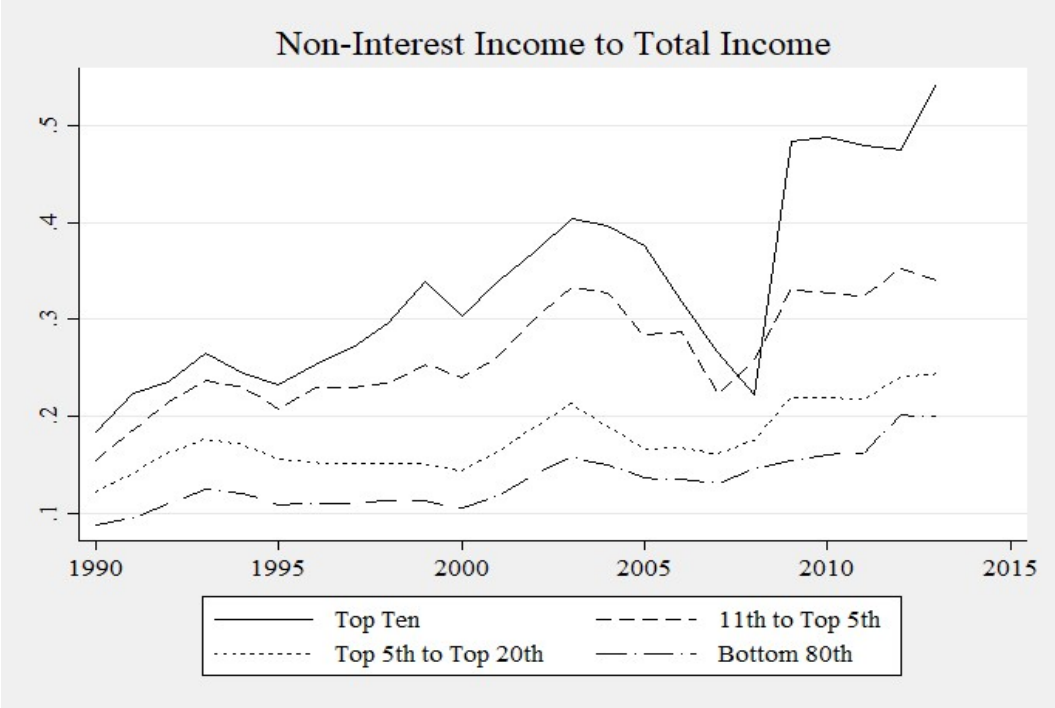
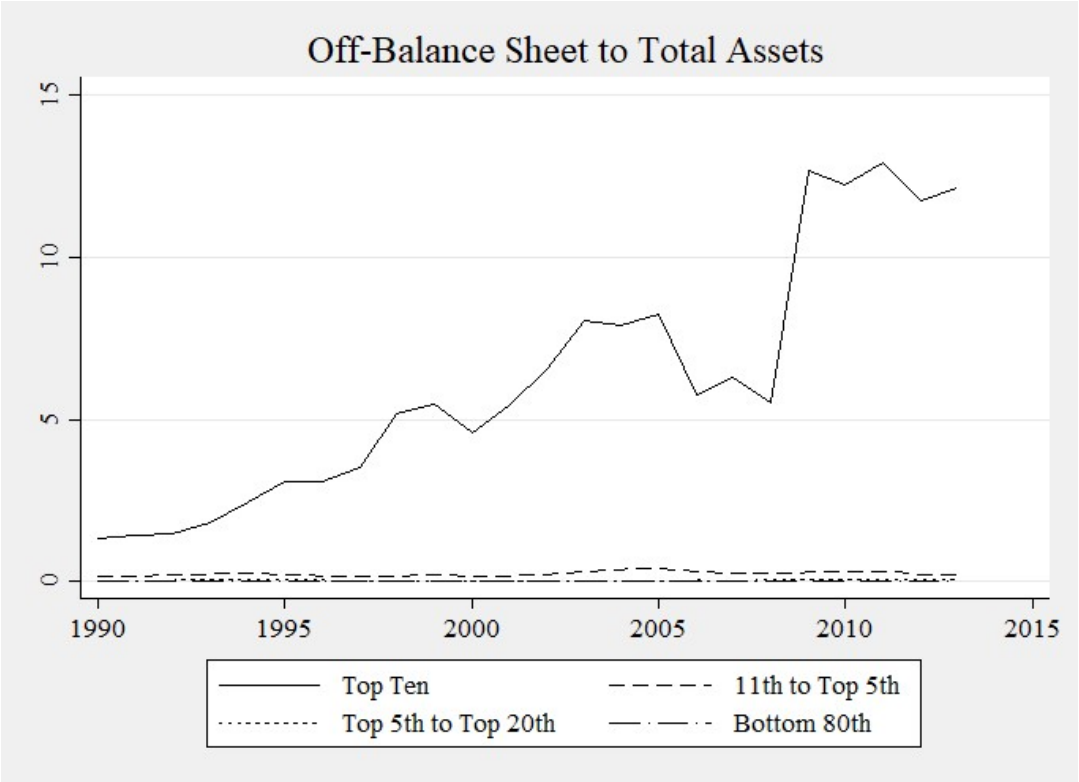


Figure 5.2: Off-Balance Sheet to Total Assets

This figure graphs the mean ratio of off-balance-sheet activities to total assets for all U.S. BHCs over the period fiscal year-end 1990 through fiscal year-end 2013. The ratio of off-balance-sheet activities to total assets is defined as the ratio of the BHC's off-balance sheet activities (BHCK3450) to the BHCs total book assets (BHCK2170). The categories of BHCs are defined as follows: "Top Ten" includes the largest ten BHCs, "11th to Top 5th" includes the 11th largest BHC through the 5th percentile BHC, "Top 5th to Top 20th" includes BHCs from the 5th percentile to the 20th, and "Bottom 80th" includes BHCs below the 20th percentile. BHCs are assigned to a given category in a given year based on their book value of total assets in that year.



Finally, credit rating changes engender real economic consequences for rated issuers. Improvements (deteriorations) is an obligor's credit rating often lead to reductions (increases) in its cost of borrowing (Katz, 1974; Grier and Katz, 1976; Hand et al., 1992; Wansley, Glascock, and Clauretie, 1992; Hite and Warga, 1997; among others). Debtors use credit rating changes as a means to inform their assessment of the likelihood that a credit issuer will be able to meet its financial obligations and respond accordingly with adjustment to the issuers cost of debt. For BHCs, changes in the holding company's cost of borrowing resulting from changes in its credit rating may affect the lending behaviour of the BHCs bank(s). Understanding how the funding costs for banks may change a result of changes in the financial characteristics of the bank's BHC is increasingly important as banks increase their reliance on non-core sources of funding (Bhaskar and Gopalan, 2009).

We recognize the potential endogeneity problem in using BHC credit rating changes as external shocks to bank lending. For example, a BHC may experience a credit rating downgrade when its bank(s) underperforms thus increasing the likelihood of default. Despite the concern, there are at least two characteristics about the BHCs in our sample and the shifting industry landscape that, at least partially, alleviate this concern. First, the firms in our sample (i.e., credit-rated banks) are large, money center banks. Our sample includes 71 of the largest U.S.-based, credit-rated BHCs with a mean book value of total assets of $288.4 billion. The scope and breadth of rated BHCs mean that their bank(s) are arguably well-diversified across regional/local economies such that only macro events, correlated across several geographies, would lead to a BHC level credit ratings change originating from the bank(s) held by the BHC. For example, a factory may close in a city served by a regional bank thus affecting the locality, however, it is unlikely that this will systematically affect the BHC in its entirety. Second, the industry-wide shift to non-interest income and off-balance sheet products increasingly concentrates income generation responsibilities to the BHCs themselves. Indeed, for the top-ten largest banks in our sample, the ratio of non-interest income to total income approaches 50% in the later years of our sample period. The shift to non-interest income and off-balance sheet products arguably creates divergent incentive regimes for BHCs and their bank(s). For example, as holding companies shift their focus to non-interest income and off-balance sheet products, their strategic mission will likely follow suit diversifying away from one of decentralized deposit-taking and lending.

So, what is the net effect of a BHC level credit rating change on the lending behaviour of its bank(s)? The answer to this question is an empirical matter. For example, suppose that a BHC experiences a credit rating downgrade. All else equal, it would be reasonable to expect that the borrowing costs for the BHC would increase the BHC's cost of funding (Durand, 2011; Watkins, 2012). Assuming that the BHC and its bank(s) are price takers, the increased borrowing costs would lead to a tightening in the net interest margin of the BHC's bank(s). As a result, the BHC may direct its bank(s) to increase lending to higher-margin borrowers or pursue riskier loans in response. We call this the "risk writing" hypothesis as BHCs and their bank(s) attempt to recover from the negative situation by increasing their willingness to expand lending to riskier loans (see the bottom-left box of Figure 3). Conversely, the BHC may direct its bank(s) to restrict lending and undertake only the safest deals following the downgrade. The higher borrowing costs of the BHC and the desire to see its reputation repaired may induce the BHC to direct its bank(s) to select only the best deals, or, alternatively, the bank may find itself priced out of otherwise okay deals. We call this the "loan contraction" hypothesis as BHCs act to prevent further damage to their credit rating (see the bottom-right box of Figure 5.3). In either case, the lending of the BHC's bank(s) is likely affected by the credit rating downgrade of the BHC.

What would be expected subsequent to a credit rating upgrade? Consistent with Durand (2011) and Watkins (2012), credit rating upgrades may expand the funding available to BHCs thus reducing their borrowing costs. Again, assuming that the BHC and its bank(s) are price takers, the reduced borrowing costs would reduce interest expenses at the BHC's bank(s). As a result, the BHC may direct its bank(s) to increase lending to deals which were marginal prior to the rating upgrade. We call this the "loan expansion" hypothesis as BHCs would be willing to move further out on the risk curve in an attempt to maximize profits by undertaking previously marginal deals (see the top-left box of Figure 3). Alternatively, BHCs may direct their bank(s) to restrict lending subsequent to the credit rating upgrade in an attempt to preserve their improved reputation. As net interest margin increases as a result of the upgrade, the BHC needs its bank(s) to make fewer loans in order to achieve the same profits. As a result, the BHC can afford to direct its bank(s) to limit lending to marginal deals in an attempt to protect its improved rating. We call this the "reputation protection" hypothesis as BHCs move to restrict lending following an upgrade in an attempt to protect its improved reputation.

Figure 5.3: Credit Rating Changes and Bank Lending

This figure illustrates the various hypothesized links between BHC credit rating changes and bank lending. The left-hand column lists the direction of the rating change. The top row lists the hypothesized effects on lending.

Rating Change Direction	More Lending/Risk Increasing	No Effect	Less Lending/Risk Decreasing
Upgrade	Loan Expansion		Reputation Protection
Downgrade	Risk Recovery		Loan Contraction

5.3. Data, Sample Identification, and Variable Measurement

Our credit rating change data come from Bloomberg Data Services (Bloomberg). Bloomberg maintains data on long-term foreign currency issuer rating changes. We use Bloomberg's data to identify all Standard and Poor's long-term issuer credit rating changes over the period January 1st, 1990 through December 31st, 2010. We map the Bloomberg rating data into a numeric scale by converting the alphanumeric data to 22 numerical categories where 22 is the highest rating equivalent to AAA, and 1 is the lowest equivalent to default.

Table 5-1 provides descriptive statistics on the distribution of credit rating changes for the credit-rated firms in our sample. There are 671 bank-year observations in our sample period. Of those, there are 119 instances of credit rating changes year-over-year, or approximately 18% of the bank-year observations in our sample. The credit rating changes are split, almost equally, between credit rating upgrades (60 instances) and credit rating downgrades (59 instances).

We use mortgage approval data to measure changes in bank lending subsequent to credit rating changes. The mortgage lending data comes from the Home Mortgage Disclosure Act (HMDA) Loan Application Register. Most banks are required to report mortgage application and loan data to the Federal Reserve as a result of the Home Mortgage Disclosure Act passed into law in 1975 and expanded in 1988. The HMDA data covers approximately 90% of mortgage application and loans in the United States. The HMDA data are useful in our analysis for at least two reasons. First, the data contains

instances of all applications regardless of their ultimate approval/denial. The fact that we have data on all applications enables us to control for concurrent changes in loan demand. Secondly, the HMDA data allows us to determine not only the lenders but also the location of origin for the application/loan based on the location (county and state) of the property securing the mortgage. Prior studies have utilized the HMDA data for exactly these reasons (e.g., Duchin and Sosyura, 2014; Gilje, Loutskina, and Strahan, 2016). The HMDA data are organized such that each observation is a unique mortgage application containing demographic information on the applicant (e.g., income, gender, race, etc.), on the characteristics of the loan (e.g., amount of loan, type of loan, purpose of loan, etc.), and on the funding decision of the bank (e.g., approved, denied, withdrawn, etc.).

The raw HMDA data contains more than 164 million applications to financial institutions reporting to the Federal Deposit Insurance Corporation (FDIC), Federal Reserve (FR), and Office of the Comptroller of the Currency (OCC) during 1990-2010. We apply the following filters to obtain our final sample. First, we limit our sample to only loan applications that were either approved or denied, thus removing applications that were incomplete or withdrawn, leaving about 50 million applications. Additionally, we restrict our sample to home purchase loans, removing refinancing and home improvement loans. Further, we limit our sample to only those applications for conventional loans. Conventional loans engender different risk exposure for the BHC and its bank(s) relative to other types of loans insured by the government (e.g., FHA, VA, FAS, or RHS loans). These filters leave us with nearly 13 million mortgage applications.

Finally, we merge the HMDA data with the bank regulatory Call Report data to obtain bank financial data. Specifically, we merge the HMDA data with the Call Report data from the fourth quarter of the year prior to the year of the mortgage application. In addition to our credit rating change, HMDA, and financial data, we also obtain county-specific data to control for contemporaneous changes in county characteristics used in later testing. Specifically, we obtain data on the county House Price Index (HPI) from the Federal Housing Finance Agency (FHFA), the county unemployment rate from the Bureau of Labor Statistics (BLS), and the county population from Census Bureau.

The final sample includes 10,625,992 mortgage applications from 71 BHCs over the period January 1st, 1990 through December 31st, 2010. We follow Gilje, Loutskina, and Strahan (2016) and drop bank-county-year combinations where there are fewer than

15 loan applications per year to remove the effect of outliers in our testing, and adding the last filter reduces the our final sample to 9,953,461 mortgage applications. Descriptive statistics on our final sample of mortgage applications are presented in Table 5-2. Formal variable definitions are provided in Appendix 5A.

Loans applications are denied for 20% of the observations in our sample. The mean loan amount to applicant income (LTI Ratio) for the applicants in our sample is 1.971. We follow Chu, Ma, and Zhao (2019) to define a loan as risky if the ratio of the loan amount to applicant income is greater than three (Risky Loan). We find that 22% of the applications in our sample meet the criteria to be defined as a risky loan. As for the characteristics of the banks in our sample at the time of the loan application, 20% (8%) of the applications are reviewed by a bank whose BHC experienced a credit rating upgrade (downgrade) in the year prior to the application date. The mean natural log of bank total assets in thousands (Bank Size) for the banks in our sample is 19.53, or $288 billion. The mean ratio of non-interest income to total operating income (Non-Interest Income) for the banks in our sample is 33%. The mean ratio of non-core funding to total assets (Non-Core Funding) is 42% for the banks in our sample. Finally, 10% of the loan applications in our sample do not qualify for securitization by the various government-sponsored purchasers of mortgages due to their loan amount and thus are considered to be non-conforming. Non-Conforming Loan is an indicator variable that takes the value of one if the loan application if for a non-conforming loan (jumbo loan) whose loan principal is above the loan limit for one-unit single-family set by the FHFA.[21]

[21] https://www.fhfa.gov/DataTools/Downloads/Pages/Conforming-Loan-Limits.aspx

Table 5-1: Distribution of Credit Rating Changes

The sample consists of all Standard and Poor's (S&P) long-term issuer credit rating changes reported for U.S. BHCs in Bloomberg's rating change data over the period January 1st, 1990 through December 31st, 2010. The column entitled "Rating Changes" reports the number of credit rating changes in a given year. The column entitled "Total Rated BHCs" reports the total number of BHCs rated by S&P in a given year. Formal variable definitions are provided in Appendix 5A.

Year	Upgrade	Downgrade	Rating Changes	Total Rated BHCs	Change (%)
1990	1	1	2	15	13%
1991	0	7	7	14	50%
1992	0	4	4	21	19%
1993	5	0	5	23	22%
1994	7	1	8	24	33%
1995	4	1	5	25	20%
1996	1	1	2	26	8%
1997	2	0	2	29	7%
1998	1	1	2	31	6%
1999	5	2	7	35	20%
2000	0	0	0	34	0%
2001	3	3	6	37	16%
2002	1	0	1	42	2%
2003	2	2	4	42	10%
2004	4	2	6	39	15%
2005	1	1	2	45	4%
2006	4	2	6	42	14%
2007	10	0	10	37	27%
2008	6	1	7	37	19%
2009	1	8	9	36	25%
2010	2	22	24	37	65%
Total	**60**	**59**	**119**	**671**	**18%**

Table 5-2: Descriptive Statistics

The table reports descriptive statistics on the loan, applicant, bank, and county and state-level characteristics for the observations in our full sample and limited sample. The sample consists of all mortgage loan applications reported to HMDA that satisfy the following criteria: 1) the loan application must be reported as "approved" or "denied"; 2) it must be for the purchase of a home; 3) the application must meet the requirements to be defined as a conventional loan. Variable definitions are provided in Appendix 5A.

Variable	Mean	Std. Dev.	Median	Min	Max	No. of Obs.
Loan/Applicant Characteristics						
Denial	0.20	0.40	0	0	1	9,953,461
LTI ratio	2.00	1.27	1.89	0.13	5.65	9,953,461
Risky loan	0.22	0.41	0	0	1	9,953,461
Applicant income ($'000)	105.40	103.60	75.00	15.00	680.00	9,953,461
Amount of loan ($'000)	180.30	173.60	129.00	10.00	980.00	9,953,461
Male	0.67	0.47	1	0	1	9,953,461
Hispanic	0.07	0.26	0	0	1	9,953,461
Asian	0.06	0.24	0	0	1	9,953,461
White	0.73	0.45	1	0	1	9,953,461
Black	0.07	0.25	0	0	1	9,953,461
Bank Characteristics						
Rating	17.97	1.58	18.00	7.00	21.00	9,953,461
Upgrade	0.20	0.40	0	0	1	9,953,461
Downgrade	0.08	0.28	0	0	1	9,953,461
Bank size	19.53	1.34	19.87	15.78	21.51	9,953,461
ROA	0.01	0.00	0.01	0.00	0.02	9,953,461
Non-Interest Income	0.33	0.08	0.33	0.12	0.52	9,953,461
Leverage	0.92	0.01	0.92	0.87	0.94	9,953,461
Non-Core Funding	0.42	0.11	0.40	0.17	0.84	9,953,461
High Non-Core Funding	0.51	0.50	1.00	0.00	1.00	9,953,461
Non-Conforming Loans	0.10	0.31	0.00	0.00	1.00	9,953,461
Ln (Applications)	5.98	1.55	6.03	2.71	9.01	9,953,461
County-Level Characteristics						
County HPI Change	5.48	8.60	4.38	-19.30	28.00	9,941,430
County Unemployment	5.20	1.96	4.80	2.20	12.50	9,943,480
Ln (Population)	13.04	1.37	13.16	9.58	16.09	9,953,461

5.4. Empirical results

In this section, we evaluate the association between BHC credit rating changes and supply of local bank mortgage lending. We test the loan application data for consistency with our various hypotheses. Section 5.4.1 presents our main results. Section 5.4.2 examines the effects of competition as a mitigating factor on the association.

5.4.1. Credit Rating Changes and Bank Lending

To evaluate how BHC credit rating changes affect bank lending and to control for within-sample variation, we conduct a series of ordinary least squares (OLS) regressions. We use a linear estimator, as opposed to a non-linear estimator, i.e., a probit or logit estimator, for two reasons. First, non-linear fixed effects regressions have been shown to produce biased estimates for interaction terms. Second, non-linear models have also been shown to produce biased estimates over short time series and many fixed effects (Ai and Norton, 2003). Therefore, we follow the recent literature examining loan approvals and and use linear models for our regression testing **(**Duchin and Sosyura, 2014; Chu, Ma, and Zhao, 2019).[22] The general OLS specification we use is given by the following:

$$Denial_{ijkt} = \alpha_j + \alpha_{kt} + \beta_1 Upgrade_j + \beta_2 Downgrade_j + \beta_3 Upgrade_j * Risky\ Loan_{ijkt} + \beta_4 Downgrade_j * Risky\ Loan_{ijkt} + \beta_5 Risky\ Loan_{ijkt} + \beta_6 Ln(Applications)_{jkt} + \boldsymbol{\gamma_1 X_{it}} + \boldsymbol{\gamma_2 Z_{j,t-1}} + \boldsymbol{\gamma_3 M_{k,t-1}} + \varepsilon_{ijkt} \quad (1)$$

where *i* denotes the borrower, *j* the lender, *k* the county, and *t* the year of application. The dependent variable in our regressions specifications is *Denial* which is an indicator variable that takes a value of one if the loan application was denied, and zero otherwise. Our primary explanatory variables of interest in these specifications are *Upgrade* and *Downgrade*, indicator variables which take a value of one if the lending bank's holding company experiences a credit rating upgrade or downgrade, respectively, in the year preceding the year of application. In addition to the main effects on *Upgrade* and *Downgrade*, we are also interested in the coefficient estimates on the interaction between those measures and *Risky Loan*. We use *LTI Ratio* as a proxy to measure the riskiness of borrowers consistent with prior literature (e.g., Duchin and Sosyura, 2014; Chu, Ma, and

[22] For robustness, we reproduce our main regression specification using a probit specification and find qualitatively similar results. We present the output from this additional test in Appendix 5D.

Zhao, 2019). We include various fixed effects, as denoted by Table 5.3, to account for variation in our dependent variable which may be the result of time effects or from bank and/or county characteristics. To be specific, we absorb county*year effects to remove time-varying, unobservable county-level demand-side shocks related to, for example, housing demand, industry composition, business cycle, and idiosyncratic economy shocks, etc. Moreover, we include bank*county fixed effects in the more-fully specified models to account for the possibility that some banks are simply more likely to reject mortgage loans relative to other banks within the same county. Vectors **X**, **Z**, and **M** represent controls for the applicant, bank, and county, respectively, and are included where denoted by Table 5.3.[23] All specifications compute heteroskedasticity robust, clustered standard errors by bank to account for the correlation of residuals within banks.

[23] Vectors **X**, **Z**, and **M** comprise all control variables listed in Table 5-2 that are not explicitly included in the covariates listed in Table 5-3.

Table 5-3: Credit Rating Changes and Bank Lending

This table reports the results of ordinary-least-squares testing on the relation between BHC credit rating changes and mortgage loan denial at the loan level. *Denial* is an indicator variable that takes the value of one if the loan application is denied, and zero otherwise. *Upgrade* and *Downgrade* are indicator variables that take the value of one if the bank is upgraded or downgraded in the year prior to the year of the loan application, respectively, and zero otherwise. Formal variable definitions are provided in Appendix 5A. Fixed effects are included as denoted by the table. All specifications compute robust standard errors clustered at the bank level. t-statistics are reported in the parentheses below the coefficient estimates. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable = Denial (0,1)			
	(1)	(2)	(3)	(4)
Upgrade	0.0250***	0.0203**	0.0230**	0.0188**
	(2.69)	(2.57)	(2.45)	(2.46)
Downgrade	0.0336	0.0240	0.0337	0.0240
	(1.65)	(1.16)	(1.60)	(1.13)
LTI ratio	0.0081*	0.0077**		
	(1.77)	(2.25)		
Risky loan			0.0279***	0.0272***
			(3.69)	(4.03)
Upgrade*Riskyloan			0.0093***	0.0059*
			(3.15)	(1.86)
Downgrade*Riskyloan			-0.0016	-0.0022
			(-0.17)	(-0.23)
Ln (Applications)	-0.0190***	-0.0305***	-0.0185***	-0.0293***
	(-3.85)	(-5.13)	(-3.45)	(-5.01)
Male	-0.0247***	-0.0195***	-0.0246***	-0.0195***
	(-4.18)	(-3.87)	(-4.16)	(-3.99)
Hispanic	0.0986***	0.0937***	0.0979***	0.0931***
	(9.18)	(7.95)	(9.29)	(7.99)
Asian	-0.0306***	-0.0327***	-0.0305***	-0.0326***
	(-3.13)	(-4.13)	(-2.98)	(-4.02)
White	-0.0721***	-0.0673***	-0.0717***	-0.0670***
	(-12.97)	(-13.49)	(-12.61)	(-13.17)
Black	0.0710***	0.0654***	0.0713***	0.0655***
	(5.04)	(5.82)	(4.94)	(5.80)
Bank size	-0.0367**	-0.0213	-0.0366**	-0.0211
	(-2.05)	(-1.26)	(-2.06)	(-1.27)
ROA	3.7489**	3.7074**	3.7446**	3.6955**
	(2.17)	(2.36)	(2.16)	(2.32)
Income diversification	-0.0852	-0.0010	-0.0858	-0.0037
	(-0.79)	(-0.01)	(-0.79)	(-0.03)
Leverage	2.4613**	1.9025**	2.4674**	1.9005**
	(2.27)	(2.08)	(2.31)	(2.11)
HPI change	-0.0011*		-0.0011*	
	(-1.96)		(-1.95)	
Unemployment rate	-0.0044		-0.0044	
	(-1.01)		(-1.01)	
Ln (Population)	-0.0815		-0.0807	
	(-0.94)		(-0.94)	
Constant	-0.1185	-0.9619	-0.1297	-0.9603
	(-0.17)	(-1.56)	(-0.19)	(-1.57)
Year FEs	Yes		Yes	
Bank FEs	Yes		Yes	
County FEs	Yes		Yes	
Bank*County FEs		Yes		Yes
County*Year FEs		Yes		Yes
Observations	9,931,449	9,931,449	9,931,449	9,931,449
Adj R-squared	0.123	0.161	0.124	0.161

Columns (1) and (2) of Table 5-3 present the results from our main tests exclusive of the *Upgrade* and *Downgrade* interaction terms. Coefficient estimates on *Upgrade* are positive in both specifications and are statistically significant at better than the 5% level. Coefficient estimates on *Downgrade* are positive across the specifications but are statistically indistinguishable from zero. Consistent with prior studies, loans with higher values of *LTI Ratio* are more likely to be declined controlling for other factors. The results in columns (1) and (2) indicate an increase in loan denial in the year following a BHC credit rating upgrade.

The remaining two columns of Table 5-3 present results inclusive of the interaction terms between *Upgrade* and *Downgrade* and *Risky Loan*. Coefficient estimates on *Upgrade* remain positive and statistically. Estimates on the interaction term between *Upgrade* and *Risky Loan* are positive and statistically significant at conventional levles. Increases in denial subsequent to a BHC credit rating upgrade are most pronounced for riskier loan applications. We do not find a statistically significant association between mortgage denial and *Downgrade* or *Downgrade* and its interaction with *Risky Loan*.

5.4.2. Credit Rating Changes, Bank Lending, and Competition

The effects of competition on bank profitability, risk-taking, and financial stability remain a debated subject in the academic literature. The conventional theory, the competition-fragility hypothesis, posits that competition erodes market power thus reducing bank charter values (Marcus, 1984; Chan, Greenbaum, and Thakor, 1986; and Keeley, 1990). The downward pressures on bank charter values incentivize managers to take increased asset risks, thus leading to greater fragility. More recent literature develops the argument that competition increases bank stability, i.e., the competition-stability hypothesis. Boyd and De Nicolo (2005) develop a model wherein banks in less competitive markets exploit their ability to charge higher interest rates on assets. The higher rates, *ceteris paribus*, increase the difficulty faced by borrowers in servicing their debt thus exacerbating the problems of asset substitution and increasing instability. Various empirical studies provide support for the competition-stability hypothesis (e.g., Boyd, De Nicolo, and Jalal, 2006; De Nicolo and Loukoianova, 2006; Schaeck, Cihak, and Wolfe, 2009).

For our purposes, we are less concerned with the implications of this literature and are more concerned with the underlying assumptions. Specifically, we seek to exploit the

assumption that banks operate as profit (wealth) maximizers subjected to the forces of competition. If, for example, bank managers are able to extract greater rents, then we assume that they will do so. This notion suggests that competition will likely affect the association between BHC credit rating changes and bank lending. For example, a downgraded BHC will likely face higher costs of funding. The higher costs in a highly competitive market may force the BHC and its bank(s) to increase their asset risk exposure in an attempt to maintain profitability, consistent with the competition-fragility hypothesis. In much the same way, an upgraded BHC that now faces lower costs of funding in a highly competitive market may not be able to "afford" to invest in protecting its reputation as competition lurks. Questions regarding the mitigating or exacerbating effects of competition on the association between BHC credit rating changes and bank lending are empirical matters we address in this section.

To account for the influencing effects of competition, we include an additional covariate and its interactions with the *Upgrade* and *Downgrade* covariates present in our main regression specification. Specifically, we construct a competition index based on the interstate branching restrictiveness index (state-level R&S Index) following Rice and Strahan (2010). The state-level R&S Index is the sum of various restrictions and ranges from zero (deregulated, most open toward interstate entry and competition) to four (highly regulated, most restrictive toward interstate entry and competition) based on the deregulation changes in a state. The state-level R&S Index takes a value of four for all years before the state implements interstate bank branching deregulation. We define a variable, Competition, as five minus the R&S Index such that higher values of Competition represent more competitive markets.

Table 5-4 presents results of testing on the association between *Upgrade*, *Downgrade*, and *Denial* conditioned on market competition. Again, coefficient estimates on *Upgrade* are positive and statistically significant in both specifications. Coefficient estimates on *Downgrade* are positive but are statistically insignificant. As for the effects of competition as an influencing factor, estimates on the interaction between *Upgrade* and *Competition* are negative and are statistically significant. The negative estimates suggest that increased competition reduces the ability, or willingness, of banks to invest in protecting its reputation.[24]

[24] In unreported results, we construct a measure of competition at the state-level following Krishnan, Nandy, and Puri (2014). Our results are qualitatively similar using the alternate measure.

Table 5.4: Credit Rating Changes, Bank Lending, and Competition

This table reports the results of ordinary-least-squares testing on the relation between BHC credit rating changes, mortgage loan denial at the loan level, and competition. *Denial* is an indicator variable that takes the value of one if the loan application is denied, and zero otherwise. *Upgrade* and *Downgrade* are indicator variables that take the value of one if the bank is upgraded or downgraded in the year prior to the year of the loan application, respectively, and zero otherwise. *Competition* is defined following a version of Rice and Strahan (2010) where higher values represent more competitive markets. Formal variable definitions are provided in Appendix 5A. Fixed effects are included as denoted by the table. All specifications compute robust standard errors clustered at the bank level. *t*-statistics are reported in the parentheses below the coefficient estimates. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable = Denial (0,1)	
	(1)	(2)
Upgrade	0.0292*	0.0316***
	(1.81)	(3.70)
Downgrade	0.0135	0.0311
	(0.78)	(1.10)
LTI ratio	0.0067**	0.0077**
	(2.03)	(2.25)
Competition*Upgrade	-0.0031*	-0.0038***
	(-1.70)	(-2.71)
Competition*Downgrade	0.0008	-0.0023
	(0.36)	(-0.56)
Male	-0.0199***	-0.0195***
	(-3.98)	(-3.88)
Hispanic	0.0932***	0.0937***
	(7.77)	(7.95)
Asian	-0.0325***	-0.0327***
	(-3.97)	(-4.13)
White	-0.0665***	-0.0673***
	(-11.55)	(-13.49)
Black	0.0655***	0.0653***
	(5.42)	(5.82)
Ln(applications_county)		-0.0304***
		(-5.11)
Bank size		-0.0212
		(-1.26)
ROA		3.7284**
		(2.37)
Income diversification		-0.0016
		(-0.01)
Leverage		1.9101**
		(2.09)
Constant	0.2306***	-0.9712
	(15.43)	(-1.58)
Bank x County FEs	Yes	Yes
County x Year FEs	Yes	Yes
Observations	9,953,461	9,931,449
Adj R-squared	0.160	0.161

5.5. Additional tests

In this section, we conduct various robustness tests and explore alternative explanations for our findings. In section 5.5.1 we exclude loan applications originating from the same state as the state of domicile for the BHC in an attempt to mitigate potential endogeneity issues. In section 5.5.2 we examine asset substitution occurring within banks subsequent to the rating change as an alternative explanation. We condition our results on bank reliance on non-core funding in section 5.5.3 to explore, more directly, the costs of funding effects resulting from a rating change. In section 5.5.4 we explore the trends in loan denial rates before the credit rating change. Finally, in section 5.5.5 we investigate the effects of credit rating changes on loan denial conditioned on the rating level of the BHC.

5.5.1. Excluding Loans Originating in the Same State as the BHC

The primary challenge we face in examining the link between credit rating changes at the BHC level and bank lending in the problem of endogeneity, e.g., the BHC is more likely to experience a credit upgrade when its bank(s) performs well. We feel, however, that the composition of the firms in our sample (i.e., the largest, money-centre BHCs) combined with the shifting nature of the banking industry (i.e., to fee-generating, non-interest income activities originating from few, central offices) significantly alleviates this concern. As it relates to the scope of the BHCs in our sample, the firms' bank(s) are relatively well-diversified across many geographies and localities such that only correlated, systematic economic changes would likely affect the BHC. To account for systematic effects, all of our prior tests include year fixed effects.

As for more localized effects that may be endogenously related to the BHC credit rating change, the geographic diversification for the banks in our sample would, arguably, mitigate these concerns. For example, it is unlikely that a plant closure in Fayetteville, AR (a city served by Bank of America) would affect Bank of America at the BHC level. However, to address this potential more directly in our testing, we perform a series of regression tests, similar to those presented prior, over a limited sample. Specifically, we drop mortgage loan applications originating in the same state as the state of domicile for the BHC. For instance, continuing with our use of Bank of America as an example, we remove loan applications originating for properties located in the state of North Carolina. Removing these applications from our sample mitigates the potential that localized

economic changes affect both the mortgage loan applications and the BHC. The results of regression testing over the limited sample are presented in Table 5-5.

Again, coefficient estimates on *Upgrade* are positive and statistically significant in both specifications. We do not find a relation between *Downgrade* and loan denial. Additionally, we find that loan denial increases most markedly following a credit rating upgrade for risky borrowers (i.e., estimates on the interaction between *Upgrade* and *Risky Loan* are positive and significant).

Table 5.5: Excluding Loans Originating in the Same State as the BHC

This table reports the results of ordinary-least-squares testing on the relation between BHC credit rating changes and mortgage loan denial at the loan level for loans originating outside of the state of domicile for the BHC. For this series of tests, we drop loan applications originating within the same state and as the state of domicile for the BHC. *Denial* is an indicator variable that takes the value of one if the loan application is denied, and zero otherwise. *Upgrade* and *Downgrade* are indicator variables that take the value of one if the bank is upgraded or downgraded in the year prior to the year of the loan application, respectively, and zero otherwise. Formal variable definitions are provided in Appendix 5A. Fixed effects are included as denoted by the table. All specifications compute robust standard errors clustered at the bank level. *t*-statistics are reported in the parentheses below the coefficient estimates. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable = Denial (0,1)	
	(1)	(2)
Upgrade	0.0186***	0.0171***
	(2.84)	(2.72)
Downgrade	0.0331	0.0329
	(1.57)	(1.54)
LTI ratio	0.0092***	
	(2.69)	
Risky loan		0.0299***
		(4.34)
Upgrade*Riskyloan		0.0064*
		(1.74)
Downgrade*Riskyloan		-0.0019
		(-0.16)
Ln(Applications)	-0.0317***	-0.0302***
	(-3.93)	(-3.81)
Male	-0.0182***	-0.0183***
	(-3.46)	(-3.54)
Hispanic	0.0958***	0.0954***
	(8.16)	(8.22)
Asian	-0.0297***	-0.0295***
	(-4.19)	(-4.05)
White	-0.0657***	-0.0654***
	(-15.37)	(-14.99)
Black	0.0682***	0.0686***
	(6.12)	(6.12)
Bank size	-0.0240	-0.0235
	(-1.28)	(-1.27)
ROA	4.2064***	4.2047***
	(2.84)	(2.79)
Income diversification	-0.0376	-0.0417
	(-0.37)	(-0.41)
Leverage	2.1653**	2.1560**
	(2.07)	(2.09)
Constant	-1.1383	-1.1346
	(-1.40)	(-1.39)
Bank*County FEs	Yes	Yes
County*Year FEs	Yes	Yes
Observations	8,188,632	8,188,632
Adj R-squared	0.167	0.167

5.5.2. Asset Substitution Subsequent to Credit Rating Changes

An alternative explanation for the changes we observe in mortgage lending subsequent to BHC credit rating changes is asset substitution. Roughly speaking, realizing that their costs of funding have changed as a result of the rating change, BHCs instruct their bank(s) to pursue other loan categories. Although we cannot directly observe the strategic objectives of the banks in our sample, we attempt to address this concern in two ways. First, our prior regression specifications include a bank fixed effect. The bank fixed effect captures the differences in strategic objectives across the banks in our sample.

A second way we address this concern is by conducting a series of tests examining changes in other loan categories subsequent to a credit rating change. Namely, we perform a series of OLS tests using the following measures of asset composition as dependent variables: conforming loans, non-conforming loans, total loans, real estate loans, C&I loans, consumer loans, agricultural loans, and other loans where all of the measures are scaled by total assets. If the asset substitution hypothesis holds in aggregate, then we would expect to see changes in one, or more, of these asset categories subsequent to a rating change. The results from these tests are provided in Table 5-6.

Table 5.6: Asset Substitution Subsequent to Credit Rating Changes

This table reports the results of ordinary-least-squares testing on the changes in the asset composition of the banks in our sample subsequent to credit rating changes at the BHC level. The dependent variables in this series of tests are the values of the different asset categories, as reported by bank call report data, scaled by the total book assets of the bank. *Upgrade* and *Downgrade* are indicator variables that take the value of one if the bank is upgraded or downgraded in the year prior to the year of the loan application, respectively, and zero otherwise. Formal variable definitions are provided in Appendix 5A. Fixed effects are included as denoted by the table. All specifications compute robust standard errors clustered at the bank level. *t*-statistics are reported in the parentheses below the coefficient estimates. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable	Conforming	Non-Conforming	Total Loans	Real Estate Loans	C&I Loans	Consumer Loans	Ag. Loans	Other Loans
Upgrade	0.0378**	-0.0345*	0.0085	0.0016	-0.0015	0.0005	-0.0003	0.0027
	(2.14)	(-1.97)	(0.85)	(0.26)	(-0.35)	(0.14)	(-1.11)	(0.81)
Downgrade	-0.0108	0.0131	0.0003	0.0062	-0.0038	-0.0059	-0.0000	0.0015
	(-0.39)	(0.49)	(0.03)	(0.68)	(-0.59)	(-1.43)	(-0.10)	(0.31)
Constant	-0.0474	1.1872	1.3150	0.4823	0.2904	-0.3058	0.0137	0.3081
	(-0.04)	(0.99)	(1.41)	(0.82)	(0.74)	(-1.34)	(0.73)	(1.19)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	657	644	667	667	667	667	667	667
Adj. R^2	0.717	0.745	0.775	0.869	0.824	0.836	0.874	0.764

For credit rating upgrades, we find that the portion of conforming loans increases and, conversely, that the portion of non-conforming loans falls following the upgrade. We find no significant association between *Upgrade* and any of the other asset categories. This result is interesting for at least two reasons. First, there does not seem to be movement into other asset classes after an upgrade, on average. Second, the increased lending in conforming loans after the upgrade is consistent with banks limiting their risk exposure consistent with a move to protect their improved reputation. Consistent with our prior results, we do not find a discernible shift in asset composition subsequent to credit rating downgrades.

5.5.3. Non-core Funding Reliance, Credit Rating Changes, and Bank Lending

Our findings are generally consistent with banks acting to preserve their improved reputation subsequent to a credit rating upgrade by restricting lending, particularly to riskier borrowers. Conversely, we do not find an association between credit rating downgrades and bank lending despite the extensive literature documenting increased funding costs for downgraded firms (e.g., Katz, 1974; Grier and Katz, 1976; Hand et al., 1992; Wansley et al., 1992; Hite and Warga, 1997; among others). This is particularly concerning as it implies that either a) banks are impervious to increased funding costs, or b) that credit rating changes at the BHC level do not affect the funding costs of banks and, by extension, our results are simply a contemporaneous artifact. The first seems unlikely given the extensive literature documenting the competitive nature of banking. As price-takers, operating in nearly perfectly competitive markets, it is unlikely that cost increases will simply be absorbed by banks. Perhaps, then, BHC credit rating changes do not affect the funding costs of banks.

We explore this possibility by studying the link between credit rating downgrades and bank lending for the banks that are most sensitive to changes in the costs of external funding, i.e., banks that rely more heavily on non-core funding. The funding costs for banks reliant on non-core funding are relatively more rate sensitive as prior literature documents an inverse relation between credit quality, as measured by credit ratings, and debt costs. As such, a credit rating downgrade at the BHC level would most likely to affect the lending behaviour of the BHC's bank(s) if that bank is relatively more reliant on rate-sensitive liabilities. We test this conjecture by incorporating a measure into our regression specification that captures the extent to which a bank relies on non-core funding. Specifically, we create an indicator

variable (*High Non-Core Funding*) that takes the value of one if the ratio of non-core funding to total assets is greater than the sample median value, and zero otherwise. Results from this test are presented in Table 5-7.

We use the fully-specified version of our regression model to test the association between credit rating changes and bank lending conditioned on non-core funding reliance. Again, we find a positive and statistically significant relation between BHC rating upgrades and loan denial. We do not find evidence that downgrades are related to loan denial, on average. Consistent with the results of prior studies examining the association between credit quality and costs of capital, we find that the estimate on the interaction between *Downgrade* and *High Non-Core Funding* is statistically significant. Loan denial increase for banks owned by BHCs are heavily reliant on non-core funding after a credit rating downgrade. So, although we do not find evidence supporting a contraction in credit resulting from higher costs of funding on average. We do find that denial increase subsequent to credit rating downgrades for banks relatively more reliant on non-core funding, consistent with the "loan contraction" hypothesis.

Table 5.7: Non-core Funding Reliance, Credit Rating Changes, and Bank Lending

This table reports the results of ordinary-least-squares testing on the relation between BHC credit rating changes, mortgage loan denial at the loan level, and bank-level non-core funding reliance. *Denial* is an indicator variable that takes the value of one if the loan application is denied, and zero otherwise. *Upgrade* and *Downgrade* are indicator variables that take the value of one if the bank is upgraded or downgraded in the year prior to the year of the loan application, respectively, and zero otherwise. *High Non-Core Funding* is an indicator variable that takes the value of one if the ratio of non-core funding to total assets is greater than the yearly sample median value, and zero otherwise. Formal variable definitions are provided in Appendix 5A. Fixed effects are included as denoted by the table. All specifications compute robust standard errors clustered at the bank level. *t*-statistics are reported in the parentheses below the coefficient estimates. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable = Denial (0,1)	
	(1)	(2)
Upgrade	0.0064	0.0204**
	(0.74)	(2.61)
Downgrade	-0.0122	-0.0125
	(-0.94)	(-0.72)
LTI ratio	0.0068**	0.0077**
	(2.03)	(2.24)
High non-core funding	0.0031	0.0025
	(0.26)	(0.16)
Upgrade*High non-core funding	0.0265	-0.0025
	(1.26)	(-0.27)
Downgrade*High non-core funding	0.0475*	0.0657***
	(1.89)	(2.71)
Male	-0.0198***	-0.0196***
	(-3.96)	(-3.92)
Hispanic	0.0934***	0.0939***
	(7.81)	(7.89)
Asian	-0.0324***	-0.0327***
	(-3.93)	(-4.14)
White	-0.0664***	-0.0673***
	(-11.44)	(-13.52)
Black	0.0655***	0.0653***
	(5.42)	(5.80)
Ln(Applications)		-0.0301***
		(-5.04)
Bank size		-0.0170
		(-0.90)
ROA		4.4326***
		(3.30)
Income diversification		-0.0386
		(-0.34)
Leverage		2.0103**
		(2.23)
Constant	0.2292***	-1.1456*
	(15.37)	(-1.68)
Bank x County FEs	Yes	Yes
County x Year FEs	Yes	Yes
Observations	9,953,461	9,931,449
Adj R-squared	0.160	0.161

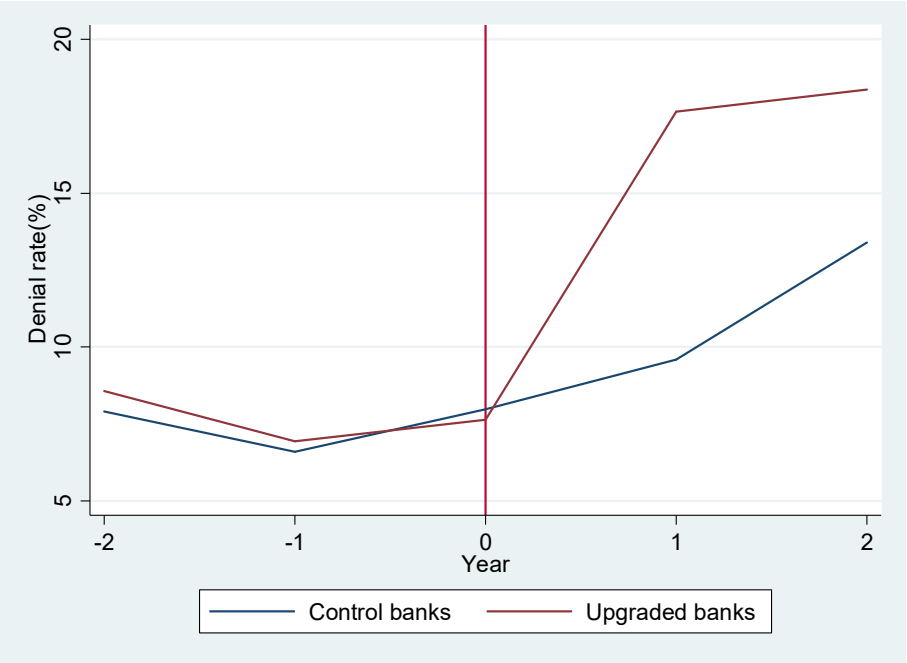
5.5.4. The effects of bank rating upgrades – pre-event trend

A critique we face in examining changes in loan denial rates subsequent to a BHC credit rating upgrade is that of a pre-selection issue. For example, an argument could be levied that the credit rating upgrade itself is the result of prior decisions made by the BHC to curb risky lending. Thus, the credit rating upgrade simply reflects the contraction in lending and, therefore, the increases in post upgrade denial rates are just an extension of the BHC's pre-rating change lending strategies. We recognize this as a potential concern and seek to address the issue in this section. To address this concern, we investigate the trends in loan denial rates pre-upgrade for the credit rating upgrade BHCs in our sample relative to a propensity matched control group. In order to ensure that our differences-in-differences analysis is valid, we need to ensure that the parallel trends assumption is satisfied. Specifically, finding a similar pre-event trend in loan denial rates for both the treatment group (BHCs that experience a rating upgrade) and the control group (propensity-matched BHC that do not experience an upgrade) would provide evidence of validity. We follow Roberts and Whited (2013) and Chu, Ma, and Zhao (2019) to conduct diagnostic checks of the pre-trend in mortgage denial rate.

The parallel trends assumption is not directly testable in a statistical sense. So, to investigate the differences in pre-rating upgrade denial rates, we propensity match the sample of credit rating upgrade BHCs to a control group of credit rated BHCs that do not experience a rating upgrade using a one-to-one match on pre-upgrade rating and size. We then plot the loan denial rates for our treatment and control BHCs surrounding the year of the credit rating upgrade. Plots of the trends in loan denial rates around the rating upgrade event are presented in Figure 5.4. Loan denial rates are similar for both the treatment group and control group prior to the credit rating upgrade but differ after the upgrade. The denial rates for the BHCs in our control sample show some increase after the upgrade event, but the increase is markedly less relative to the increase for the BHCs experiencing the upgrade. The similarities in denial rates prior to the upgrade event combined with the notable differences after the event suggest that the parallel assumption in our differences-in-differences tests is likely satisfied.

Figure 5.4: Pre-trend assumptions of bank rating upgrades

This figure presents the denial rates of mortgage applications for upgrade banks (treatment groups) and control banks (control groups) around the bank upgrades. Denial rates of a bank are calculated by the ratios of amount of mortgages denied by that bank over the total amount of mortgages applied to in a given year.



5.5.5. Bank Ratings, Credit Rating Changes, and Bank Lending

In this section, we investigate the extent to which the denial in loan denial subsequent to a credit rating upgrade at the BHC level differ as a function of the BHCs rating level after the upgrade. Our prior results suggest that BHCs move to tighten lending standards at their bank(s) after the upgrade. We view this as evidence consistent with BHCs moving to protect, or investing in, their reputation after the upgrade. In this section we explore the extent to which the marginal benefits to reputation protection differ for BHCs depending on their credit rating level after to the rating upgrade. For example, a BHC moving from a rating of AA to AA+ may not see the need to invest as heavily in protecting its improved reputation as a BHC moving from a rating of BB- to BB. If the marginal benefits to additional investments in reputational protection diminish as a function of the BHC's rating level (consistent with prior literature), then we would expect to see smaller increases in loan denial for banks held by BHCs with higher post-upgrade ratings. Consistent with this conjecture and with our prior

results, we would expect the impact of a credit rating change on denial to be less pronounced for BHCs with higher post-upgrade ratings if the rating upgrade is exogenous to the increase of mortgage denial activities. This result would be due to the fact that the marginal benefit of a credit rating upgrade is reduced for BHCs with a relatively higher rating. To test this conjecture, we implement an extended specification of equation (1) adding an interaction term between *Rating* and *Downgrade*/*Upgrade* as follows:

$$Denial_{ijkt} = \alpha_j + \alpha_{kt} + \beta_1 Upgrade_j + \beta_2 Downgrade_j + \beta_3 Upgrade_j * Rating_{jt} + \beta_4 Downgrade_j * Rating_{jt} + \beta_5 LTI\ Ratio_{it} + \beta_6 Ln(County\ Applications)_{jkt} + \boldsymbol{\gamma_1 X_{it}} + \boldsymbol{\gamma_2 Z_{j,t-1}} + \boldsymbol{\gamma_3 M_{k,t-1}} + \varepsilon_{ijkt} \quad (2)$$

where *i* denotes the borrower, *j* the lender, *k* the county, and *t* the year of application. Consistent with our prior specifications, the dependent variable in our regressions specifications is *Denial* which is an indicator variable that takes a value of one if the loan application was denied, and zero otherwise. Again, *Upgrade* and *Downgrade*, are indicator variables which take a value of one if the lending bank's holding company experiences a credit rating upgrade or downgrade, respectively, in the year preceding the year of application. *Rating* is the S&P long-term issuer ratings mapped into twenty-two numerical categories after the credit rating change.[25] We are primarily interested in the coefficient estimates on the interaction terms between *Downgrade* and *Upgrade* and *Rating*. We also include various fixed effects, as denoted by Table 8, to account for variation in our dependent variable which may be the result of time, bank, or county characteristics. All specifications compute heteroskedasticity robust, clustered standard errors by bank to account for the correlation of residuals within banks.

The results of these tests are presented in the Table 5-8. The coefficient estimates on *Upgrade* are positive and statistically significant in both specifications consistent with our prior results. Coefficient estimates on the interaction term between *Upgrade* and *Rating* are negative and statistically significant. The negative coefficient estimates on the interaction terms suggests that the marginal benefits of additional investments in reputational considerations are reduced for BHCs with higher post-upgrade ratings. We do not find a

[25] In untabulated results, we use the BHC rating prior to the rating upgrade instead of the rating after the upgrade and find qualitatively similar results.

statistically significant association between credit rating downgrades and loan denial on average, or when conditioned on the post-downgrade rating level.

Table 5.8: Bank Ratings, Credit Rating Changes and Bank Lending

This table reports the results of ordinary-least-squares testing on the relation between BHC credit rating changes and mortgage loan denial at the loan level. *Denial* is an indicator variable that takes the value of one if the loan application is denied, and zero otherwise. *Upgrade* and *Downgrade* are indicator variables that take the value of one if the bank is upgraded or downgraded in the year prior to the year of the loan application, respectively, and zero otherwise. Rating is S&P long-term foreign currency issuer ratings mapped into twenty-two numerical categories (Bloomberg) (Adelino & Ferreira, 2016). Formal variable definitions are provided in Appendix 5A. Fixed effects are included as denoted by the table. All specifications compute robust standard errors clustered at the bank level. t-statistics are reported in the parentheses below the coefficient estimates. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable = Denial (0,1)	
	(1)	(2)
Upgrade	0.2061*	0.2250***
	(1.93)	(2.93)
Downgrade	0.1730	0.1404
	(1.10)	(0.95)
Rating (t)	0.0230**	0.0227***
	(2.63)	(3.64)
Upgrade*Rating (t)	-0.0099*	-0.0110***
	(-1.75)	(-2.76)
Downgrade*Rating (t)	-0.0079	-0.0066
	(-0.92)	(-0.81)
LTI ratio	0.0081*	0.0078**
	(1.75)	(2.23)
Ln(Applications)	-0.0191***	-0.0309***
	(-3.92)	(-5.14)
Male	-0.0246***	-0.0195***
	(-4.13)	(-3.86)
Hispanic	0.0986***	0.0937***
	(9.21)	(7.95)
Asian	-0.0307***	-0.0327***
	(-3.13)	(-4.09)
White	-0.0725***	-0.0675***
	(-13.19)	(-13.60)
Black	0.0707***	0.0650***
	(5.08)	(5.85)
Bank size	-0.0501**	-0.0354*
	(-2.63)	(-1.86)
ROA	1.8593	1.9464
	(0.96)	(1.22)
Income diversification	-0.1088	-0.0061
	(-0.90)	(-0.05)
Leverage	2.2006**	1.6054*
	(2.09)	(1.95)
HPI change	-0.0011**	
	(-2.08)	
Unemployment rate	-0.0041	
	(-0.96)	
Ln(Population)	-0.0838	
	(-0.96)	
Constant	0.0304	-0.7958
	(0.04)	(-1.06)
Year FEs	Yes	
Bank FEs	Yes	
County FEs	Yes	
Bank*County FEs		Yes
County*Year FEs		Yes
Observations	9,931,449	9,931,449
Adj R-squared	0.123	0.161

5.6. Conclusions

We document a link between credit rating changes at the BHC level and bank lending. Our results indicate that BHC credit rating upgrades lead to higher loan denial rates at the bank level in the year subsequent to the upgrade. Additionally, we find that the propensity for banks to deny loan application requests for risky loans increases subsequent to a credit rating upgrade by its BHC. We view these results as evidence consistent with BHCs taking active steps to preserve their recently improved reputation. Further, we do not find evidence that BHC level credit rating downgrades lead to changes in bank-level, mortgage loan denial rates subsequent to the downgrade, on average.

Our results indicate a link between BHC credit rating changes and bank lending. We then examine competition as a factor that may influence the association. We find that mortgage denials increase subsequent to a credit rating upgrade, on average, but less so for banks operating in a competitive market. Competition seems to mitigate the ability, or willingness, of BHCs to invest in reputation protection subsequent to a credit rating upgrade. Additionally, we perform various supplemental analyses to better study the link. We find: 1) that our main results hold when we remove loan applications originating in the same state as the state of domicile for the BHC; 2) that banks are not moving to other loan classes, on average, following the rating change; and, 3) that banks with the most rate-sensitive liabilities increase denial rates after a rating downgrade consistent with the "loan contraction" hypothesis, i.e., that BHCs act to prevent further damage to their credit rating after the downgrade by restricting lending.

Banks offer an efficient means of intermediating between the suppliers of capital and the users of capital enabling real economic growth. It is tantamount that bankers, regulators, and societies at large better understand the factors that affect the efficacy of banks in the intermediation process. Changes at the bank holding company (BHC) level can affect local banks and engender real consequences for the local economy (Ashcraft, 2005). Our study contributes to the literature on the factors that affect banks in the process of intermediation by identifying one such factor, i.e., credit rating changes at the BHC level.

Chapter 6

Chapter 6: Conclusion

6.1. Introduction

This chapter provides a summary and conclusion of the whole thesis, which studies the executive compensation and financing decision making in the banking industry. In particular, Chapter 3 examines the reasons why bank CEOs sacrificed their bonuses during the recent financial crisis to address the question whether or not these CEOs did so because of the government or public pressure and critics on reducing CEO's compensation in the long run. The findings confirm the effects of internal and external pressures. Chapter 4 examines the effects of incentives embedded in CEO cash bonus on bank mortgage lending activities using the terrorist attacks and the change in accounting policy, i.e. FAS 123R as the quasi-natural experiments, and confirms the reduction of risk-taking incentives as a result of an increase in the cash bonus and cash bonus compensation structure is not a cause to the housing market collapse 2008-2009. Chapter 5 focuses on the relationship between changes of bank credit ratings and mortgage lending supply and suggest that BHCs move to protect their improved rating after the upgrade at the expense of the supply of local credit. The findings confirm the asymmetric effects of rating changes and shed light on one factor of bank intermediation process, i.e. credit rating changes at the BHC level.

The chapters are organised as below. Section 6.2 starts with the summary of findings and contributions of central empirical studies in chapter 3, 4 and 5, then followed by the discussion of policy implications and recommendations in Section 6.3 as well as research limitation in Section 6.4. Finally, Section 6.5 provides some avenue for future research in this area.

6.2. Summary of findings and contributions

Given the motivations highlighted for the thesis, the criticism over high executive compensation and the attention to incentives embedded in the compensation contracts as well as the pivotal role of banks discussed in the background and theoretical framework section, studying the decision-making at the senior level in the banking sector is vital. Thus, this thesis contributes to decision-making in banking research by identifying to

what extent bank executives make decisions under various exogenous shocks. The remaining findings and contributions of the thesis are presented by organised into three categories which are based on the three main empirical chapters as follow.

The first chapter contributes to several strands of literature. First, our results suggest that the government or public pressure and critics on reducing CEO's compensation does not have a material impact on CEOs' long-term compensation since bonus forgoing during certain periods tends to be short term. These results confirm the views that CEO pay is justifiable to their talents can be mainly explained by the market capitalisation of their firms (Gabaix and Landier, 2009) and has not risen faster than other highly-paid professions (Kaplan and Rauh, 2010). It is also consistent with the view that "making CEO pay a political issue should be stopped" (Edmans, 2016). Second, our findings extend the research on one-dollar CEO salary (Loureiro, Makhija, & Zhang, 2020; and Hamm, Jung, & Wang, 2015) and help explain why CEOs forgo financial rewards. Hamm et al. (2015) find that CEOs with higher ownership and worked at firms with depressed stocks, employee tension, and headquartered on the Silicon Valley area are more likely to take $1 salary to lessen the pressure of stakeholders when their firms are underperformed, and adopting $1 salary does not send a signal of the improvement in subsequent stock returns. Loureiro et al. (2020) focus on the consequences of $1 CEO salary on CEO compensation and firm performance. They show that $1 CEOs, compared to their peers, receive higher total compensation and their firms generate lower stock market returns after $1 salary adoption. The impact on total compensation is lessened by financial restructuring and CEO entrenchment and increased by CEO overconfidence. Our study differs from these studies by focusing a specific period of particular political and economic tension (the 2007-2009 financial crisis) and in an important industry (banking), which has strategic implications on the overall macroeconomy, and thus has received great attention from the public and legislators during the financial crisis (Fahlenbrach & Stulz, 2011). We find that CEOs are more likely to forgo bonus when facing higher pressure, and their banks' subsequent performance do not improve. Moreover, the pressure does not seem to be derived from stock performance, but from internal and external constituents (e.g., the political costs, and corporate information environment as well as CEOs themselves). Our findings further suggest that forgoing decision during the financial crisis is a short-term decision, rather than a ruse to camouflage the public's attention to CEOs' compensation as found in Loureiro et al. (2020). In addition, rather than salaries which do not vary with the performance of the firm or the executive, we focus on bonus, which is performance-based. Focusing on bonus

is also more economically significant than on salaries because the average ratio of cash bonus over salary paid for 2006 performance of the 98 U.S. large banks in our sample is 4.26 (Fahlenbrach & Stulz, 2011). According to prior accounting research, the bonus also plays an essential role in managerial decisions (Healy, 1985; Holthausen, Larcker, & Sloan, 1995). Finally, this study offers some empirical evidence on the radical self-sacrificial leadership behaviour (Choi & Mai-Dalton, 1998) when the leaders give up or postpone their legitimate share of organisational rewards to build trust, show their loyalty and dedication to the firms (Conger, 1989; House & Shamir, 1993; Yukl, 1994). We find that the internally promoted CEOs are more likely to forgo their bonus and they are less likely to exit, demonstrating their loyalty to the banks. These findings are consistent with the view that CEOs' behaviours are affected by their working environment, their position, and their personal characteristics (Busenbark, Krause, Boivie, & Graffin, 2016). Taken together, these results suggest that the bonus-forgoing decision is likely a temporary bank decision, has little economic impact on bank's performance, shed light to the debate on CEO compensation, and support shareholder value view.

Despite the prevalence of cash bonus, there is not much empirical evidence on the relevance of cash bonus and bank risk-taking. By exploiting the exogenous shocks, the second empirical study, enable to circumvent the frequently encountered endogeneity issues between compensation and decision-making in banks, contributes to non-equity incentives embedded in cash bonus and risk-taking literature in several interrelated ways. First, it augments the findings of previous studies on the negative association between CEO bonus and bank risk-taking, and this is the first study to examine how incentives embedded in CEO cash bonus affect bank risk-taking at loan level rather than those aggregated at the bank level, thus capturing the ex-ante risk-taking rather than ex-post risk-taking incentives. Second, it suggests that cash bonuses did not contribute to the risky retail lending in banks prior to the 2008-2009 housing market downturn.

There is not much known about the implications of credit ratings on bank financing decision while banks offer an efficient means of intermediating between the suppliers of capital and the users of capital enabling real economic growth. It is worth to understand better the factors that affect the efficacy of banks in the intermediation process as well as the effects of credit rating changes, especially the bank upgrades. The third empirical study, therefore, contributes to the debate and understanding of the "specialness" role of banks and how banks work as financial intermediation by identifying credit rating changes at the BHC level as one factor which influences the process of intermediation.

The findings suggest that BHC credit rating upgrades lead to higher loan denial at the bank-loan level in the year subsequent to the upgrade, as well as the lack of movement to other asset classes, and the increased focus on conforming loans, consistent with the notion that BHCs taking active steps to preserve their recently improved reputation and when pressured by competitive forces to a lesser degree, BHCs are free to invest in reputational considerations actively. Collectively, the findings suggest that BHCs and their banks focus on reputational considerations when cost-effective (i.e., after an upgrade) and cost considerations when mandated (i.e., after a downgrade when the bank is relatively more reliant on non-core funding) and confirm the asymmetric effects of credit rating changes.

6.3. Research limitations

Based on the three empirical chapters, the constraints of this thesis are presented as follows:

First, the limitation is linked to the standard event study methodology in the first empirical study. Although this methodology has been widely used in the empirical studies, it is noticeable that the method assumes that there is no possibility of information leakage surrounding the event and that the event occurs completely unexpectedly by investors. In reality, this may not always be the case, for example, the bonus-forgoing decision may not be completely surprised to the market investors prior to the announcements, as CEO decisions are rarely kept confidential or in this study, in case I cannot find the announcement dates from media, I use the dates of proxy statements as these are the first public of forgoing decisions (Agrawal and Mandelker 1990). However, these decisions may be known by the investors before these dates. Thus, the leakage of information could weaken the statistical significance of some estimation coefficients.

Second, the limitation comes from data limitation. Although the dataset for the first study allows me to conduct a comprehensive analysis, I focus only on nearly 100 important banks following Fahlenbrach & Stulz (2011) in the crisis period. Because the dataset does not cover the non-crisis period and not all of the banks in the industry, my contributions may not be easily generalised for all banks, especially small banks and non-crisis period.

Last but not least, this thesis only concentrates on the CEOs in the public banks rather than all of the members of top management teams at both private and public banks. Thus, my contributions may be different in terms of top management team decisions and different characteristics between the private banks and public banks. For example, in this thesis, the findings support for the shareholder view; however, given the different characteristics of private banks, the future work may support for the rent extraction view.

6.4. Avenue for future research

Given the research limitations discussed above and exogenous shocks employed, this thesis suggests some possible fruitful avenue for future research in bank corporate governance such as compensation and executive making-decision. For instance, the first empirical study concentrates on the bonus-forgoing decision in the banking sector during the financial crisis, the future work can extend the sample period and all the sectors to have a full picture. In addition, this thesis only focuses on CEOs in public banks. However, future studies can focus on private banks to look at whether and how the difference in compensation between public and private banks which may represent for rent extraction. In addition, future work can look at the total pay at the top management team, i.e. five highest-paid executives and different hierarchy within a given bank rather than just CEO to examine the different incentives across top management team and bank hierarchy.

Future studies can also exploit how exogenous shocks, i.e. terrorist attacks, impact on the behaviour of banks/firms. Terrorism is an important topic and attracts a lot of attention because the increasing wave of terrorist attacks around the globe, in both continents the United States and Western Europe in the recent years poses a threat to the society in general and organisations in specific. Specifically, there are more than 190,000 terrorist attacks worldwide from 1970, according to the Global Terrorism Database (GTD). The terrorist attacks adversely influence on the performance of the global financial market and the macroeconomy as well as organisations. According to the survey on public opinion, “half of the US population are worried about terrorism” and “more than a third in the US say they are less willing to do certain activities because of terrorism”. Additionally, the 19th Annual Global CEO Survey of Price Waterhouse Coopers strongly emphasises that “geopolitical uncertainty (exacerbated by regional conflicts and increased terrorism attacks) is a top concern for nearly threequarters of

CEOs". Taken together, it is worth to investigate the effects of terrorist attacks on decision making of firm(bank) executives.

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Appendix

Appendix 3A: Sample U.S. Banks and Their Bonus-forgoing CEOs

No.	Bank Name	CEO Name	Year(s)
1	ASSOCIATED BANC-CORP	Paul S. Beideman	2008
2	BANK OF AMERICA CORP	Kenneth (Ken) Doyle Lewis	2008-09
3	BEAR STEARNS COS INC (De-listed 06/2008)	James (Jimmy) Eliot Cayne	2007
4	CENTRAL PACIFIC FINANCIAL CORP	Clinton (Clint) L Arnoldus	2007
5	CENTRAL PACIFIC FINANCIAL CORP	Ronald K Migita	2009
6	CITIGROUP INC	Doctor Vikram Shankar Pandit	2008-09
7	COMERICA INC	Ralph W Babb Jr	2008
8	FIRST COMMONWEALTH FINANCIAL CORP PA	John J Dolan	2008-09
9	GLACIER BANCORP INC	Michael (Mick) J Blodnick	2007-09
10	GOLDMAN SACHS GROUP INC	Lloyd Craig Blankfein	2008-09
11	IRWIN FINANCIAL CORP (De-listed 09/2009)	William (Will) Irwin Miller	2007
12	JPMORGAN CHASE & CO	James (Jamie) L Dimon	2008
13	M&T BANK CORP	Robert (Bob) G Wilmers	2008
14	MERRILL LYNCH & CO INC (De-listed 01/2009)	John Alexander Thain	2008
15	MORGAN STANLEY (Morgan Stanley Dean Witter & Co prior to 07/2002)	John J Mack	2007-09
16	NORTHERN TRUST CORP	Frederick (Rick) H Waddell	2008
17	SLM CORP (SALLIE MAE) (USA Education prior to 05/2002)	Albert (Al) L Lord	2008
18	US BANCORP (First Bank System Inc prior to 08/1997)	Richard K Davis	2008
19	WASHINGTON MUTUAL INC (De-listed 09/2008)	Kerry K Killinger	2007
20	WEBSTER FINANCIAL CORP	James (Jim) C Smith	2008
21	WINTRUST FINANCIAL CORPORATION	Edward (Ed) Joseph Wehmer	2007-08
22	ZIONS BANCORP	Harris H Simmons	2007-08

Note: This table lists the U.S. banks in our sample whose CEOs forwent bonus during the financial crisis (2007-2009). The names and the years during which bonus was forgone are reported.

Appendix 3B: Selected Proxy Statement Disclosures of CEOs Forgoing Bonus

No.	Bank Name	CEO Name	Year	Proxy Statement Disclosure
1	ASSOCIATED BANC-CORP	Paul S. Beideman	2008	Mr. Beideman recommended to the Committee that the Committee specifically consider whether to exercise its discretion to not award him a cash incentive bonus under the PIP for 2008, even though Associated satisfied the relevant performance criteria. The Committee exercised its discretion not to pay the CEO the cash incentive bonus for 2008.
2	BANK OF AMERICA CORP	Kenneth (Ken) Doyle Lewis	2008	Mr. Lewis recommended that no year-end compensation be paid to him or any other executive officer.
3	CITIGROUP INC	Doctor Vikram Shankar Pandit	2009	Based on Mr. Pandit's performance against the company's strategic priorities, the committee determined that Mr. Pandit merited consideration for an incentive award for 2009; however, based on Mr. Pandit's commitment, the committee agreed to award him no incentive compensation for 2009.
4	GLACIER BANCORP INC	Michael (Mick) J Blodnick	2007	Committee recommended a bonus in excess of $150,000, but Mr. Blodnick declined to accept a bonus in a higher amount. For 2007, we awarded a bonus to our Chief Executive Officer of $150,000, or approximately 48% of his base salary.

Note: This table presents examples of proxy statement disclosures on CEOs forgoing bonus during the financial crisis.

Appendix 3C: Variable Definition and Data Source (in Parentheses)

Variable	Definition
Forgo	A dummy variable that takes the value of one if a CEO gave up her/his bonus in a given fiscal year t, and zero otherwise (Proxy statements).
TARP	A dummy variable that takes the value of one if a bank received the TARP fund in a given fiscal year t, and zero otherwise (U.S. Department of the Treasury).
Bank characteristics	
Total assets	Total assets in millions of US dollars (Compustat).
Bank size	Natural logarithm of the total assets in millions of US dollars (Compustat).
Tobin's Q	Ratio of market value of assets to book value of assets. The market value of total assets is computed as the book value of total assets plus market capitalization minus book value of equity. The market capitalization is measured as common shares outstanding times the fiscal year closing price (Compustat).
Market-to-book ratio	Market value of equity over book value of equity (Compustat/CRSP).
Leverage	Ratio of book total assets to stockholder's equity (Compustat).
Diversification%	The share of non-interest income in total operating income (Compustat).
Board governance	
Ln (Audit committee size)	Natural logarithm of the number of directors sitting on the audit committee (BoardEx).
Expertise	Refers to the audit committee financial expertise, measured as the proportion of the NEDs with related functional experience such as a public accountant, auditor, principal or chief financial officer, controller, or principal or chief accounting officer sitting on the audit committee (BoardEx).
Ln (Board size)	Natural logarithm of the number of directors sitting on the board (BoardEx).
Audit committee independence	The proportion of independent non-executive directors on audit committee (BoardEx) where 'independent directors' are non–

	executive directors (NEDs), i.e. not full-time employees (Sun & Liu, 2014).
CEO characteristics	
Inside appointed	A dummy variable that takes the value of one if a CEO appointed from inside the bank, i.e. the year when a CEO joining the bank and that when he/she promoted to be a CEO is the same, and zero otherwise (BoardEx).
Ln (Directorship experience+1)	Natural logarithm of the total number of prior directorships that CEOs served on quoted boards plus one (BoardEx).
Duality	A dummy variable that takes the value of one if a CEO hold the chairman position, and zero otherwise (BoardEx).
Ln(Tenure)	Natural logarithm of the number of years the CEO has been in role (BoardEx).
CEO ownership	The percentage of total share owned by CEO as reported in given fiscal year t (BoardEx).
Ivy League	A dummy variable that takes the value of one if a CEO graduated from an Ivy League institution (Brown University, Columbia University, Cornell University, Dartmouth College, Harvard University, Princeton University, University of Pennsylvania, and Yale University) at any academic level, and zero otherwise (BoardEx).
Ln (Excess $500K)	The natural logarithm of the total compensation amount excess of $500K, and zero otherwise (WRDS-Execucomp)
Macroeconomics	
Ln(GDP)	Natural logarithm of GDP of the states where the bank presents (U.S. Department of Commerce - Bureau of Economic Analysis)
Subsequent tests	
Total compensation	Total direct compensation (Execucomp)
Bonus	Total bonus and non-equity incentives (Execucomp)
Returns	Annual buy-and-hold stock returns (CRSP).
Returns on Assets (ROA)	Ratio of net income to total assets (Compustat).
Returns on Equity (ROE)	Ratio of net income to stockholder’s equity (Compustat).

Subsequent tests (cont'd)

Volatility	Annualized standard deviation of stock monthly returns (CRSP).
SD(ROA)	Standard deviation of Returns on Assets, rolling over 3 years (Compustat).
SD(ROE)	Standard deviation of Returns on Equity, rolling over 3 years (Compustat).
Loan loss provisions/Assets	Loan loss provisions over total assets (Compustat).
Ln(Z-score)	Natural logarithm of Z-score where Z-score is the average bank return on assets plus bank equity to assets ratio, scaled by the standard deviation of return on assets rolling over 3 years (Compustat).

Appendix 3D: Robustness test

This table reports the marginal effects estimated at the mean for continuous variables and for a change in an indicator variable from zero to one for indicator variables from logistic regressions of the bonus-forgoing decision on the costs of non-forgoing channel: *Bank size, Ln(Audit committee size), and Inside Appointed* and opportunism indicators: *Tobin Q, Return on Assets (ROA), and Return on Equity (ROE)*. *Bank size* is the natural logarithm of the total assets in millions of dollars, lagged at time year (t-1), *Ln(Audit committee size)* are the natural logarithm of the number of directors sitting on audit committee. *Inside appointed* is a dummy variable that takes the value of one if a CEO is appointed from inside the bank, i.e. the year when a CEO joins the bank and that when he/she is promoted to be a CEO is the same, and zero otherwise. *Tobin Q* is defined by the ratio of market value of assets to book value of assets. The market value of total assets is computed as the book value of total assets plus market capitalization minus book value of equity, and the market capitalization is measured as common shares outstanding times the fiscal year closing price. *ROA and ROE* are the ratio of net income to total assets, and equity, respectively. The sample period is 2007-2009. All continuous variables are winsorized at the 1st and 99th percentile levels. Robust standard errors clustered by banks. t-statistics are shown in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. Variable definitions are presented in the Appendix 3C.

	Prob (Forgo=1)		
	(1)	(2)	(3)
Bank size	0.0639***	0.0636***	0.0672***
	(3.80)	(3.80)	(3.88)
Ln (Audit committee size)	0.3077***	0.3078***	0.3138***
	(3.07)	(3.11)	(3.14)
Inside appointed	0.0965*	0.0957*	0.0908
	(1.79)	(1.75)	(1.58)
Tobin Q			0.2642
			(0.77)
ROA		0.5375	
		(0.31)	
ROE	0.0307		
	(0.22)		
Expertise	0.1046	0.1060	0.1166
	(0.67)	(0.68)	(0.72)
Ln (Board size)	-0.1533	-0.1541	-0.1599
	(-1.28)	(-1.28)	(-1.29)
Ln (Tenure)	0.0329	0.0329	0.0335
	(1.36)	(1.35)	(1.32)
CEO ownership	0.0003	0.0003	0.0012
	(0.05)	(0.05)	(0.19)
Duality	-0.0573	-0.0572	-0.0562
	(-1.21)	(-1.22)	(-1.20)
Ln (Directorship experience+1)	0.0415	0.0421	0.0476
	(0.83)	(0.85)	(0.95)
Ln (Excess $500K)	-0.0135	-0.0134	-0.0135
	(-1.33)	(-1.33)	(-1.35)
Ivy League	-0.0260	-0.0259	-0.0257
	(-0.46)	(-0.46)	(-0.45)
Leverage	0.2997	0.3447	0.2936
	(0.37)	(0.43)	(0.39)
Diversification ratio	-0.2468	-0.2452	-0.2578
	(-1.30)	(-1.30)	(-1.47)
Ln(GDP)	-0.0426	-0.0427	-0.0422
	(-1.55)	(-1.55)	(-1.53)
Year FEs	Yes	Yes	Yes
Observations	224	224	224

Appendix 4: Variable Definitions

Dependent variable	**Definition**
Denial	A dummy variable, equal to 1 if the mortgage application is denied, and 0 otherwise
Loan characteristics	
Loan Amount	The amount requested in the application ($'000)
Applicant Income	The annual gross income of the applicant ($'000)
Loan-to-income ratio (LTI)	The ratio of amount of loan to income of the mortgage applicant
Risky loan	A dummy variable, equal to 1 if the LTI ratio is greater than 3, and 0 otherwise
Male	A dummy variable, equal to 1 if the applicant is male, and 0 otherwise
White	A dummy variable, equal to 1 if the applicant is white, and 0 otherwise
Black	A dummy variable, equal to 1 if the applicant is black, and 0 otherwise
Asian	A dummy variable, equal to 1 if the applicant is Asian, and 0 otherwise
Hispanic	A dummy variable, equal to 1 if the applicant is Hispanic, and 0 otherwise
Bank and CEO characteristics	
Bank size	Natural logarithm of the total assets
Attacks	A time-variant indicator variable that takes the value 1 if a bank's headquarters were within 100 miles of the attack during and after the attack, and 0 for the treatment banks before the attack and all other banks (Dai et al., 2020)
ROA	Ratio of net income to total assets

Deposit/Assets	Bank deposits divided by total assets
Income diversification	Ratio of noninterest income to the sum of interest income and noninterest income
Leverage	Ratio of total liabilities to total assets
CEO's age	Age of a CEO
Ln(Age)	Natural logarithm of CEO's age
Compensation characteristics	
Cash bonus	Total cash bonus (bonus + nonequity incentives) ($'000)
Total compensation	Total compensation including salary, bonus, restricted stock, stock option, and other ($'000) (TDC1)
RelBonus (Cashbonus_p)	Ratio of cash bonus to total compensation
Salary_p	Ratio of salary to total compensation
Stocks_p	Ratio of stock value to total compensation
Options_p	Ratio of option value to total compensation
Others_p	Ratio of other compensation to total compensation
Delta	Dollar change in wealth associated with a 1% change in the firm's stock price (in $000s) (pay-performance sensitivity)
Vega	Dollar change in wealth associated with a 0.01 change in the standard deviation of the firm's returns (risk-taking incentives)

Appendix 5A: Variable Definitions

Variable	Definition
Loan/Borrower Characteristics	
Denial	An indicator variable which takes the value of one if the loan application is denied, and zero otherwise.
LTI ratio	The ratio of the requested loan principal to the gross annual income of the applicant.
Risky loan	An indicator variable which takes a value of one if LTI ratio is greater than three, and zero otherwise.
Applicant income	The gross annual income of the loan applicant (in thousands of dollars).
Amount of loan	The principal amount of the requested loan (in thousands of dollars).
Male	An indicator variable which takes the value of one if the loan applicant identifies as male, and zero otherwise.
Hispanic	An indicator variable which takes the value of one if the loan applicant identifies as Hispanic, and zero otherwise.
Asian	An indicator variable which takes the value of one if the loan applicant identifies as Asian, and zero otherwise.
White	An indicator variable which takes the value of one if the loan applicant identifies as White, and zero otherwise.
Black	An indicator variable which takes the value of one if the loan applicant identifies as Black, and zero otherwise.
Bank Characteristics	
Upgrade	An indicator variable which takes the value of one if the lending bank has a credit rating upgrade in the year prior to the loan application, and zero otherwise.
Downgrade	An indicator variable which takes the value of one if the lending bank has a credit rating downgrade in the year prior to the loan application, and zero otherwise.

Competition	A competition index based on the interstate branching restrictiveness index (state-level R&S Index) following Rice and Strahan (2010). The state-level R&S Index is the sum of various restrictions and ranges from zero (deregulated, most open toward interstate entry and competition) to four (highly regulated, most restrictive toward interstate entry and competition) based on the deregulation changes in a state. The state-level R&S Index takes a value of four for all years before the state implements interstate bank branching deregulation. We define a variable, Competition, as five minus the R&S Index such that higher values of Competition represent more competitive markets.
Bank size	The natural log of the bank's total assets in thousands
ROA	The ratio of the bank's net income to its total assets.
Non-Interest Income	The ratio of the bank's noninterest income to the sum of interest income and noninterest income.
Leverage	The ratio of a bank's total liabilities to total assets.
Non-Core Funding	The ratio of one minus core funding to total assets.
Non-Conforming Loans	An indicator variable which takes the value of one if the loan principal exceeds the conforming loan limit set in order for loans to be sold to GSEs, and zero otherwise.
Ln(Applications)	The natural log of the total number of loan applications per bank per year in a given county.
County-Level Characteristics	
County HPI Change	The year-over-year change in the county-level home price index.
County Unemployment	The county unemployment rate in a given year as reported by the Bureau of Labor and Statistics.
Ln(County Population)	The natural log of the population of a given county.

Appendix 5B: Correlation matrix

This table reports Pearson pairwise correlation coefficients for all independent variables used in the regression models. Variable definitions are presented in the Appendix 5A. All continuous variables are winsorized at the 1st and 99th percentile levels. The coefficients in bold with the symbol *, **, and *** denote significance at the 10%, 5% and 1% level, respectively.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1)	LTI ratio																				
(2)	Risky loan	0.77***																			
(3)	Rating	0.07***	0.06***																		
(4)	Lag rating	0.08***	0.07***	0.91***																	
(5)	Upgrade	0.07***	0.05***	0.35***	0.43***																
(6)	Downgrade	0.04***	0.03***	-0.04***	0.05***	-0.15***															
(7)	Competition	0.02***	0.02***	0.01***	0	0.02***	0.01***														
(8)	High Non-Core Funding	0.01***	0.03***	0.05***	0.08***	-0.10***	0.06***	0.03***													
(9)	Ln(application_county)	0.17***	0.15***	0.28***	0.26***	0.06***	-0.03***	-0.05***	0.14***												
(10)	Male	-0.05***	-0.05***	-0.01***	-0.01***	0.00***	-0.00***	-0.02***	-0.03***	-0.02***											
(11)	Hispanic	0.08***	0.08***	0.06***	0.06***	0.02***	-0.02***	-0.03***	0.09***	0.17***	0.02***										
(12)	Asian	0.09***	0.09***	0.04***	0.06***	0.02***	0.06***	-0.01***	0.06***	0.15***	0.01***	-0.06***									
(13)	White	-0.04***	-0.05***	0.00***	-0.00***	0.03***	-0.01***	0.00***	-0.08***	-0.12***	0.22***	0.08***	-0.42***								
(14)	Black	0.02***	0.02***	-0.02***	-0.03***	-0.01***	-0.04***	0.03***	0.03***	0.03***	-0.08***	-0.06***	-0.07***	-0.44***							
(15)	Bank size	0.11***	0.09***	0.67***	0.70***	0.21***	0.24***	0.07***	0.50***	0.31***	-0.03***	0.10***	0.10***	-0.06***	-0.01***						
(16)	ROA	0.01***	0.02***	0.28***	0.13***	0.14***	-0.52***	0.03***	-0.32***	0.11***	0.01***	0.03***	-0.03***	0.02***	0.01***	-0.20***					
(17)	Income diversification	0.09***	0.09***	0.32***	0.27***	0.00*	0.04***	0.10***	0.19***	0.19***	-0.01***	0.12***	0.05***	-0.01***	-0.02***	0.40***	0.19***				
(18)	Leverage	-0.10***	-0.07***	-0.02***	0.02***	-0.04***	-0.08***	-0.07***	0.37***	-0.01***	-0.00**	-0.05***	-0.01***	-0.03***	0.02***	0.04***	-0.20***	-0.09***			
(19)	County HPI change	0.02***	0.04***	-0.01***	-0.12***	-0.17***	-0.36***	-0.03***	-0.01***	0.18***	0.00***	0.06***	0.00*	-0.02***	-0.00***	-0.10***	0.35***	0.24***	0.08***		
(20)	County Unemployment Rate	0.05***	0.03***	-0.10***	0.01***	-0.04***	0.53***	-0.04***	0.05***	-0.05***	0.00**	0.02***	0.05***	-0.04***	0.01***	0.15***	-0.34***	0.06***	-0.11***	-0.40***	
(21)	Ln(county population)	0.12***	0.13***	0.08***	0.10***	-0.01***	0.06***	-0.03***	0.16***	0.77***	-0.04***	0.15***	0.15***	-0.16***	0.02***	0.20***	-0.05***	0.16***	0.03***	0.07***	0.07***

Appendix 5C: S&P long-term foreign currency rating scale transformation

This table presents the S&P long-term foreign currency issuer ratings mapped into twenty-two numerical categories (Bloomberg).

S&P Ratings	Rating scale transformation
AAA	22
AA+	21
AA	20
AA-	19
A+	18
A	17
A-	16
BBB+	15
BBB	14
BBB-	13
BB+	12
BB	11
BB-	10
B+	9
B	8
B-	7
CCC+	6
CCC	5
CCC-	4
CC	3
C	2
D/SD	1

Appendix 5D: Robustness test - Credit Rating Changes and Bank Lending using probit regressions

This table reports the results of the probit regressions testing on the relation between BHC credit rating changes and mortgage loan denial at the loan level. *Denial* is an indicator variable that takes the value of one if the loan application is denied, and zero otherwise. *Upgrade* and *Downgrade* are indicator variables that take the value of one if the bank is upgraded or downgraded in the year prior to the year of the loan application, respectively, and zero otherwise. Formal variable definitions are provided in Appendix 5A. Fixed effects are included as denoted by the table. All specifications compute robust standard errors clustered at the bank level. t-statistics are reported in the parentheses below the coefficient estimates. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable = Denial (0,1)			
	(1)	(2)	(3)	(4)
Upgrade	0.1049**	0.0917***	0.0963*	0.0806***
	(1.97)	(3.32)	(1.69)	(2.69)
Downgrade	0.0926	0.1205*	0.0964	0.1220*
	(1.46)	(1.81)	(1.44)	(1.78)
LTI ratio	0.0165	0.0173		
	(1.27)	(1.26)		
Risky loan			0.0757***	0.0745***
			(4.25)	(4.18)
Upgrade*Riskyloan			0.0379***	0.0482***
			(2.72)	(3.71)
Downgrade*Riskyloan			-0.0219	-0.0122
			(-0.45)	(-0.28)
Ln (Applications_County)	-0.0620**	-0.0607**	-0.0616**	-0.0603**
	(-2.57)	(-2.41)	(-2.41)	(-2.26)
Male	-0.1007***	-0.1012***	-0.0999***	-0.1004***
	(-4.67)	(-4.58)	(-4.69)	(-4.60)
Hispanic	0.4370***	0.4381***	0.4341***	0.4352***
	(10.12)	(9.85)	(10.20)	(9.93)
Asian	-0.1189***	-0.1241***	-0.1212***	-0.1264***
	(-3.40)	(-3.83)	(-3.24)	(-3.63)
White	-0.2560***	-0.2652***	-0.2549***	-0.2641***
	(-7.12)	(-8.50)	(-6.98)	(-8.31)
Black	0.2619***	0.2491***	0.2622***	0.2495***
	(4.53)	(4.90)	(4.43)	(4.79)
Bank size		-0.1124*		-0.1120*
		(-1.86)		(-1.87)
ROA		12.4162**		12.4035**
		(2.18)		(2.17)
Income diversification		-0.0822		-0.0825
		(-0.28)		(-0.28)
Leverage		9.4997***		9.5438***
		(2.58)		(2.63)
HPI change	0.0000	-0.0003	-0.0000	-0.0003
	(0.02)	(-0.09)	(-0.01)	(-0.11)
Unemployment rate	0.0452***	0.0439***	0.0453***	0.0440***
	(8.29)	(9.37)	(8.26)	(9.39)
Ln (Population)	-0.0018	-0.0006	-0.0030	-0.0019
	(-0.04)	(-0.01)	(-0.07)	(-0.04)
Constant	-1.1215***	-8.3215***	-1.0875***	-8.3333***
	(-3.02)	(-3.02)	(-2.82)	(-3.09)
Year FEs	Yes	Yes	Yes	Yes
Bank FEs	Yes	Yes	Yes	Yes
Observations	9,931,449	9,931,449	9,931,449	9,931,449