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By *Jun Duanmua, Hong Liu, Garrett A. McBrayer, Tuyet Nhung Vu*

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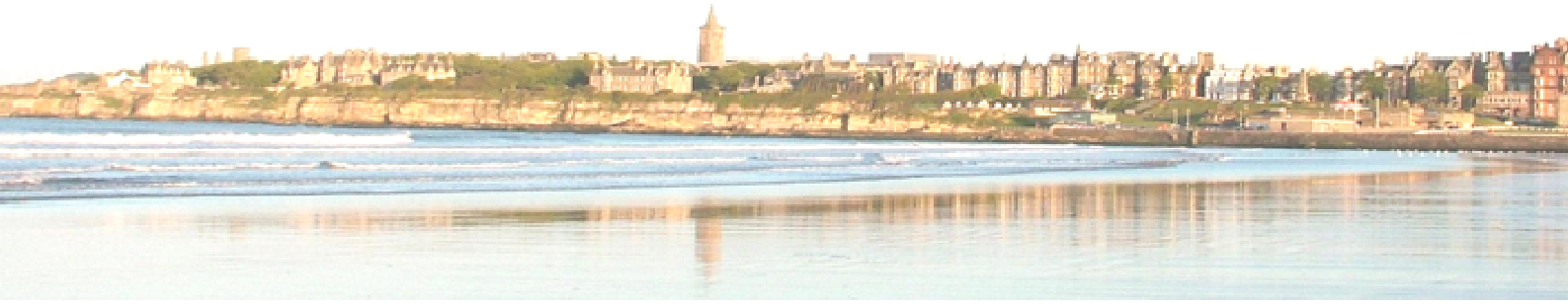

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Abstract

We study how firms change their risk-taking behavior after an exogenous credit rating upgrade. By taking advantage of the unique feature of bank holding companies, we find that subsidiary banks increase their mortgage loan denial rates after the parent's credit rating upgrade, and this increase is more pronounced for both riskier loan applications and in local markets with reduced competition. We rule out the alternative explanation that subsidiary banks move into riskier non-mortgage assets post-upgrade. Our results suggest firms change their business behavior to maintain their optimal credit rating for long-term benefits instead of exploiting the rating for short-term gains.

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1. Bank Holding Company Credit Rating Upgrade and Subsidiary Bank Mortgage Introduction

It is well documented that corporate credit ratings are endogenous to corporate strategies and firm management, e.g., capital structure (Kisgen, 2006, 2009). Research examining the association between firm credit ratings and corporate management struggles to disentangle the cause and consequence between the two. Recent studies attempt to unravel the association by exploiting exogenous variation in corporate credit ratings that results from the sovereign ceiling policies of credit rating agencies (these sovereign ceiling policies require that corporate ratings remain at or below the sovereign rating of their country of domicile). These studies find, for example, that firm investment is reduced (Almeida, Cunha, Ferreira, and Restrepo, 2017) and that banks reduce their lending supply (Adelino and Ferreira, 2016) when firms experience a downgrade in their corporate credit rating as a result of a downgrade in the sovereign rating of their country of domicile. It is unclear, however, how firm strategies change when facing an exogenous credit rating *upgrade*. In this paper, we take advantage of the unique corporate structure that exists between bank holding companies (BHCs) and their subsidiary bank(s) to explore this question.

To explore how credit rating upgrades at the BHC level might influence the credit quality of the BHC's subsidiary banks, we need to understand the structural influences that link, or isolate, the credit rating of the BHC to the credit quality, or latent rating, of the subsidiary banks. First, regulation pertinent to the BHC-subsidiary structure requires that "A bank holding company shall serve as a source of financial and managerial strength to its subsidiary banks…".[1] The holding

[1] Electronic Code of Federal Regulations 12 CFR § 225.4.

company is mandated, by federal and state regulation, to support its subsidiary bank(s). The support acts as an explicit form of credit enhancement to the subsidiary bank.

Additionally, banks are recipients of subsidies and funding options unavailable to their BHC. For example, deposit insurance and access to the Federal Reserve's discount window provide insured depository institutions with an explicit subsidy. What, then, is the net effect of the structural credit enhancement mechanisms available to banks? Kenneth and Kolatch (1999) suggest that the credit quality for a given bank should always be equal to or greater than the credit quality of the bank's holding company as indicated by their credit rating. The authors provide the following quote from Alan Greenspan to support their conjecture: "It can be considered evidence that the safety net provides the bank with a funding subsidy that is not transferred to the bank's parent holding company." That is, a subsidiary bank may enjoy government subsidies unavailable to the bank's holding company, thus reducing the funding cost sensitivity and increasing the credit availability to the bank. Given the support provided to the bank through the unique structure of the BHC-subsidiary bank relationship and the unique funding options offered to banks, it is reasonable to conclude, consistent with Kenneth and Kolatch (1999), that the credit quality of the bank must be at least that of the bank's holding company, or BHC.

The credit rating of the BHC then serves as a floor for the credit quality, or latent rating, of the subsidiary of the BHC – the effect of which will, arguably, reduce the funding costs and increase funding availability of the subsidiary bank(s) as they can now access cheaper funding. The change presents the bank with the option to adjust its lending strategies or its risk appetite in its lending policies. How, then, might observed BHC credit rating upgrades affect the subsidiary's operations? On the one hand, the bank may elect to reduce its risk exposure by funding only safer projects while maintaining its profitability. This is achieved as the bank funds fewer and less risky projects

but does so with less expensive liabilities. In this case, risk in the bank's loan portfolio is reduced with the contraction of credit. We call this the *Credit Contraction* hypothesis. On the other hand, banks are able to pursue more loan opportunities subsequent to the credit rating upgrade at their BHC because they will then have access to less expensive liabilities. In this case, marginal loan opportunities prior to the credit rating upgrade become attractive in light of the decline in funding costs post-upgrade. We call this the *Credit Expansion* hypothesis. In this case, risk in the bank's loan portfolio is increased with the expansion of credit.

A BHC credit downgrade, however, would increase the separation between the observed rating of the BHC and the latent rating of the subsidiary bank. Since the subsidiary bank's latent rating should be equal to or higher than the BHC's rating, the downgrade of the BHC's rating would not necessarily mean a contemporaneous decline in the latent rating of the subsidiary bank consequently. Hence, we may not observe an immediate change in the subsidiary bank's risk-taking behavior at least in the short run. This outcome differs from that studied in the sovereign ceiling literature. Sovereign ceiling policies mandate that the rating of a firm must not exceed the rating of its country of domicile. In our case, the credit quality, or latent rating, of the subsidiary bank may likely remain unchanged following the BHC downgrade. We nevertheless include BHC downgrades in our empirical analysis in the interest of completeness.

We quantify the impact of BHC level credit rating changes on bank lending behavior by studying the changes in mortgage lending when the BHC experiences a credit rating change relative to those whose BHCs do not. We take advantage of the rich individual level mortgage lending data in the U.S. to refer to changes in banks' risk-taking. The Home Mortgage Disclosure Act (HMDA) Loan Application Register 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 behavior subsequent to both credit rating upgrades and downgrades.

We find evidence that BHC credit rating upgrades contribute to reductions in credit origination and risk-taking in the markets served by the BHC's bank(s). Mortgage loan denial rates increase in the year subsequent to a credit rating upgrade by the bank's holding company. We interpret this as evidence consistent with the *Credit Contraction* hypothesis that the rating floor established by the BHC dictates a move towards conservatism. Additionally, we find that banks are more likely to deny riskier mortgage loans subsequent to a credit rating upgrade by their BHC. Consistent with our hypothesis, we do not find evidence that BHC level credit rating downgrades lead to changes in mortgage loan denial rates subsequent to the downgrade, on average.

An obvious concern we face in exploring these conjectures is that BHC credit ratings are likely not independent of the financial condition of their subsidiary bank(s). We recognize this challenge and attempt to address it through both structural and empirical approaches. We rely on two structural characteristics to argue that the endogeneity may not be as severe as one might initially suspect. First, we rely on the fact that the credit rated BHCs in our sample are large, money-center financial institutions. As such, they are sufficiently diversified across regional/local economies so that only macro events, correlated across several geographies, would lead to a BHC level credit ratings change emanating from a subsidiary bank(s). Second, industry-wide shifts to non-interest income and off-balance sheet products increasingly concentrate income generation responsibilities to the BHCs themselves, creating disparate incentive regimes between subsidiary banks and their holding companies wherein the revenues of the subsidiary banks are just one source of income for BHCs in an increasingly diversified revenue stream. Hence, the reverse causality effect should be significantly mitigated.

From an empirical perspective, we attempt to address the potential endogeneity issue by employing three distinct empirical approaches. First, we take advantage of our rich data to control for the bank-county and county-year fixed effects to mitigate potential cofounding effects that may correlate both the BHC rating changes and subsidiary banks' lending behavior at the bank-county and county-year levels. We find support for the *Credit Contraction* hypothesis in these analyses. Second, if the BHC's rating upgrade is a result of decreased risk-taking at the subsidiary level, i.e., a case of reverse causality, we should expect a pre-existing trend in mortgage loan denial rates before the BHC's rating upgrade. We examine this possibility by conducting diagnostic checks of the trend in mortgage denial rate on a propensity matched-sample analysis (Roberts and Whited, 2013; Chu, Li, Ma, and Zhao, 2021) and find no discernable difference in denial rates between the BHCs in our credit rating upgrade and control samples prior to the credit rating change. Third, we re-perform our analysis over a restricted sample where we drop mortgage loan applications originating in the BHC's state of domicile, minimizing the potential for within market economic conditions to affect both the BHC and its subsidiary. Our findings hold over this restricted sample.

To identify credit contraction subsequent to BHC upgrades, we conduct two additional analyses to strengthen our primary findings. First, if the new rating floor established by the BHC's credit rating upgrade leads the subsidiary bank towards more conservatism, we should observe this effect to a lesser degree if the subsidiary bank operates in a more competitive environment, because they have less room to do so. Second, we would expect that the marginal incentives to increase lending standards to reflect the BHC's rating upgrade to be less pronounced when the initial rating of the BHC is already high. We find support for both predictions. Next, we consider an alternative explanation for our main findings. It is possible that mortgage denial rates subsequent to a credit rating upgrade increase because the bank finds it more advantageous to pursue riskier non-

mortgage lending opportunities, e.g., the bank's loan composition is changed. We find no such changes.

This paper contributes to at least three strands of literature. First, this study links to the impact of credit rating change literature. The existing literature on credit rating change has thus far focused on the cost of capital (Kisgen and Strahan, 2010) and corporate decisions such as capital structure (Kisgen 2006, 2007, 2009), investment (Lemmon and Roberts, 2010; Chernenko and Sunderam, 2012), firm innovation (Griffin, Hong and Ryou, 2018), bank funding and lending (Adelino and Ferreira, 2016), bank capital structure (Wojewodzki, Boateng, and Brahma, 2020), and cost of credit (Hasan, Kim, Politsidis, and Wu, 2021). Both Adelino and Ferreira (2016) and Hasan et al. (2021) support the effects of sovereign downgrades on bank funding and lending but not those of upgrades. We contribute to this literature by investigating the bank level lending decision after an upgrade. We find evidence that BHCs and their subsidiary banks act conservatively to preserve their upgraded credit rating. This result is strongest when subsidiary banks are pressured by competitive forces to a lesser degree. Further, we find that highly rated BHCs before the upgrade have a lower marginal incentive to invest in, or protect, their reputation relative to lower rated BHCs.

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, as banks offer an efficient means of intermediating between the suppliers of capital and the users of capital, enabling real economic growth.[2] Our results contribute to our

[2] See, for example, Boyd and Gertler (1994), Stein (1998), Allen and Santomero (2001), Kayshap, Rajan, and Stein (2002), and Benston (2004), among others.

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 the lending behavior of their subsidiary bank(s).

Finally, our work is related to the relationship between BHCs and their subsidiaries that shapes their lending behavior and risk-taking. The literature has examined how internal capital markets affect lending behavior at BHCs (Houston, James, and Marcus, 1997; Campello, 2002; Begenau, Piazzesi, and Schneider, 2015; Wieland and Yang, 2020). To the best of our knowledge, this study is the first to establish the relationship between BHC upgrades and financing decisions of bank subsidiaries. Thus, we contribute to the previous literature by focusing on the drivers of risk-taking inside banking corporations, which is informative for policy makers and regulators. The evidence suggests that subsidiaries tend to reduce their risk exposure by funding only safer projects while maintaining their profitability at the previous level due to reductions in funding costs. Along this line, we also extend the literature on the drivers of bank lending channel. Our findings on credit rating upgrades at the BHC level are different from other well-known factors such as bank size (Kashyap and Stein, 1995), leverage (Bernanke, Gertler, and Gilchrist, 1999), liquidity (Kashyap and Stein, 2000), and regulatory capital constraints (Van den Heuvel 2005).

The remaining sections of this paper are organized as follows. Section 2 develops our concept and discusses the related literature. Section 3 describes our data and sample identification procedures. The results of our main empirical analyses are presented in Section 4. We discuss the results of additional analyses in Section 5. Section 6 concludes.

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 to 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 by 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 the period 1990 through 2010, the industry average ratio of non-interest income to total income for U.S. BHCs 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 1 shows that the changes in non-interest income are most notable for the largest holding companies.

[Insert Figure 1 here]

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.

[Insert Figure 2 here]

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 and 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 of 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 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.

Second, 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, to a lesser extent, 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, to an increasing extent, exogenous to the operations of a BHC's bank(s).

Finally, credit rating changes engender real economic consequences for rated issuers. Improvements (deteriorations) in 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 issuer's 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 behavior of the BHCs bank(s). Understanding how the funding costs for banks may change as 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 could be argued that this will likely not 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 in 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 behavior of its bank(s)? For rating upgrades, Durand (2011) and Watkins (2012) argue that 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 *Credit 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. 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 *Credit Contraction* hypothesis, as BHCs move to restrict lending following an upgrade in an attempt to protect their improved reputation.

As for downgrades, a BHC downgrade would increase the separation between the observed rating of the BHC and the latent rating of the subsidiary bank. Further, given that the subsidiary bank benefits from implicit and explicit protections via regulatory and governmental support, the subsidiary bank's latent rating a) should be equal to or higher than the BHC's rating; and, b) would not necessarily experience a contemporaneous decline. As such, the subsidiary bank's risk-taking behavior may not change over the short term. The credit quality, or latent rating, of the subsidiary may likely remain unchanged following the BHC downgrade. Despite the limited theoretical underpinnings, there is at least some evidence to suggest that investigating the effects of a BHC downgrade on subsidiary banks is a worthwhile endeavor. For example, 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. 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. In either case, it could be theorized that the lending of the BHC's bank(s) is affected by the credit rating downgrade of the BHC. Though we do not find the theoretical underpinnings of this argument to be highly persuasive, we do explore the possibility in the interest of completeness.

3. Data, Sample Identification, and Variable Measurement

Our credit rating change data come from Bloomberg Data Services (Bloomberg). Bloomberg maintains data on long-term issuer credit 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.

[Insert Table 1 here]

Table 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 rate 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.[3] 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. Second, 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

[3] A financial institution is required to report HMDA data if it has 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.

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.).

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. 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).

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 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; our final

sample consists of 9,953,461 applications.[4] Descriptive statistics on our final sample of mortgage applications are presented in Table 2. Formal variable definitions are provided in Appendix A.

[Insert Table 2 here]

Loan 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 2.0. We follow Chu et al. (2021) 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 loan application, 20% (8%) of the applications are reviewed by a BHC that 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 $303 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.[5]

4. Empirical Results

In this section, we evaluate the association between BHC credit rating changes and supply of mortgage lending. We test the loan application data for consistency with our various hypotheses.

[4] For robustness, we omit this restriction and test our results over the entire sample. Consistent with Gilje et al. (2016), we find that our results are qualitatively similar though statistically weaker when bank-county-year combinations with few applications are included.

[5] Non-Conforming Loan is an indicator variable that takes the value of one if the loan application is for a non-conforming loan (jumbo loan) whose loan principal is above the loan limit for one-unit single-family set by the FHFA. https://www.fhfa.gov/DataTools/Downloads/Pages/Conforming-Loan-Limits.aspx

Section 4.A presents our main results. Section 4.B examines the effects of competition as a mitigating factor on the association.

4.A. 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 with many fixed effects (Ai and Norton, 2003). Therefore, we follow the recent literature examining loan approvals and use linear models for our regression testing **(**Duchin and Sosyura, 2014; Chu et al., 2021).[6] The general OLS specification we use is given by the following:

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

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

[6] 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 3.

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 et al., 2021). We include various fixed effects, as denoted by Table 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 include county and 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 and 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 3.[7] All specifications compute heteroskedasticity robust, clustered standard errors by banks to account for the correlation of residuals within banks.

[Insert Table 3 here]

Columns (1) and (2) of Table 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 after controlling for other factors. The results in Columns (1) and (2) indicate an increase in loan denial rates in the year following a BHC credit rating upgrade.

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

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

4.B. 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 the extant literature and more concerned with the underlying assumptions. Specifically, we seek to exploit the assumption that banks operate as profit maximizers subjected to the forces of competition. If, for example, bank

managers are able to extract greater rents, then we assume that they will likely 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.

[Insert Table 4 here]

Table 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 statistically insignificant. As for the effects of competition as an influencing factor, estimates on the interaction between *Upgrade* and *Competition* are negative and statistically significant. The negative estimates suggest that increased competition reduces the ability, or willingness, of banks to invest in protecting their reputation.[8]

5. Additional Analyses

In this section, we conduct various robustness tests and explore alternate explanations for our findings. In section 5.A 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.B 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.C to explore, more directly, the effects of costs of funding resulting from a rating change. In section 5.D we explore the trends in loan denial rates before the credit rating change. Finally, in section 5.E we investigate the effects of credit rating changes on loan denial rates conditioned on the pre-rating level of the BHC.

5.A. 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 is 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-center BHCs) combined with the shifting nature of the banking industry (i.e., to fee-generating, non-interest income activities originating from fewer, more central offices) significantly alleviates this concern. As it relates to the scope of the BHCs in

[8] 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.

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 significantly 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 previously presented, 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, and 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.

[Insert Table 5 here]

Again, coefficient estimates on *Upgrade* are positive and statistically significant in both specifications. We do not find a relation between *Downgrade* and loan denial rates. Additionally, we find that loan denial rates increase 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).

5.B. Asset Substitution Subsequent to Credit Rating Changes

An alternate 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 alternate loan opportunities. 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. Second, we address this concern 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: 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 6.

[Insert Table 6 here]

For credit rating upgrades, we find no significant association between *Upgrade* and any of the other asset categories. This result is interesting given there does not seem to be movement into other asset classes after an upgrade, on average. Consistent with our prior results, we do not find a discernable shift in asset composition subsequent to credit rating downgrades.

5.C. 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 interesting as it implies either a) that 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 affect the lending behavior 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 7.

[Insert Table 7 here]

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 rates. We do not find evidence that downgrades are related to loan denial rates, 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 rates increase for banks owned by BHCs that 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 rates increase subsequent to credit rating downgrades for banks relatively more reliant on non-core funding.

5.D. Exploring the Possibility of a Pre-Selection Concern

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 in 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 et al. (2021) to conduct diagnostic checks of the pre-trend in mortgage denial rate.

[Insert Figure 3 here]

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 3. 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 a marginal increase after the upgrade event, but the increase is markedly lower 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.

5.E. Initial BHC Credit Rating Level, Credit Rating Changes, and Bank Lending

In this section, we investigate the extent to which the denial in loan denial rates 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 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 rates 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 rates 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 the BHC's S&P long-term credit rating after the rating change (*Rating*) and *Downgrade*/*Upgrade*.[9] We are primarily interested in the coefficient estimates on the interaction terms between *Rating* and *Downgrade/Upgrade*. Again, we include various fixed effects, as denoted by Table 8, to account for variation in our dependent variable, and compute heteroskedasticity robust, clustered standard errors by bank to account for the correlation of residuals within banks.

[Insert Table 8 here]

The results of these tests are presented in Table 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 statistically significant association between credit rating downgrades and loan denial rates on average, or when conditioned on the post-downgrade rating level.

6. Conclusion

[9] 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.

We document a link between credit rating upgrades at the BHC level and bank lending. Our results indicate that BHC credit rating upgrades lead to higher loan denial rates in the year subsequent to the upgrade. Additionally, we find that the propensity to deny loan application requests for risky loans increases subsequent to a BHC credit rating upgrade. 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 mortgage loan denial rates subsequent to the downgrade, on average.

Our results indicate a link between BHC credit rating upgrades and credit origination. 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 those 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; 3) that, though most of the results occur subsequent to a credit rating upgrade, banks with the most rate-sensitive liabilities increase denial rates after a rating downgrade; and, 4) that the effect of a credit rating upgrade on lending is less pronounced for higher rated BHCs.

It is tantamount that bankers, regulators, and societies at large better understand the factors that affect the efficacy of banks in the intermediation process. Banks offer an efficient means of intermediating between the suppliers of capital and the users of capital, enabling real economic growth. 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 upgrades at the BHC level.

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Figure 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 2010. The ratio of non-interest income to total income is defined as the ratio of the BHC's non-interest income (BHCK4079) to the sum of interest income (BHCK4107) and non-interest 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.

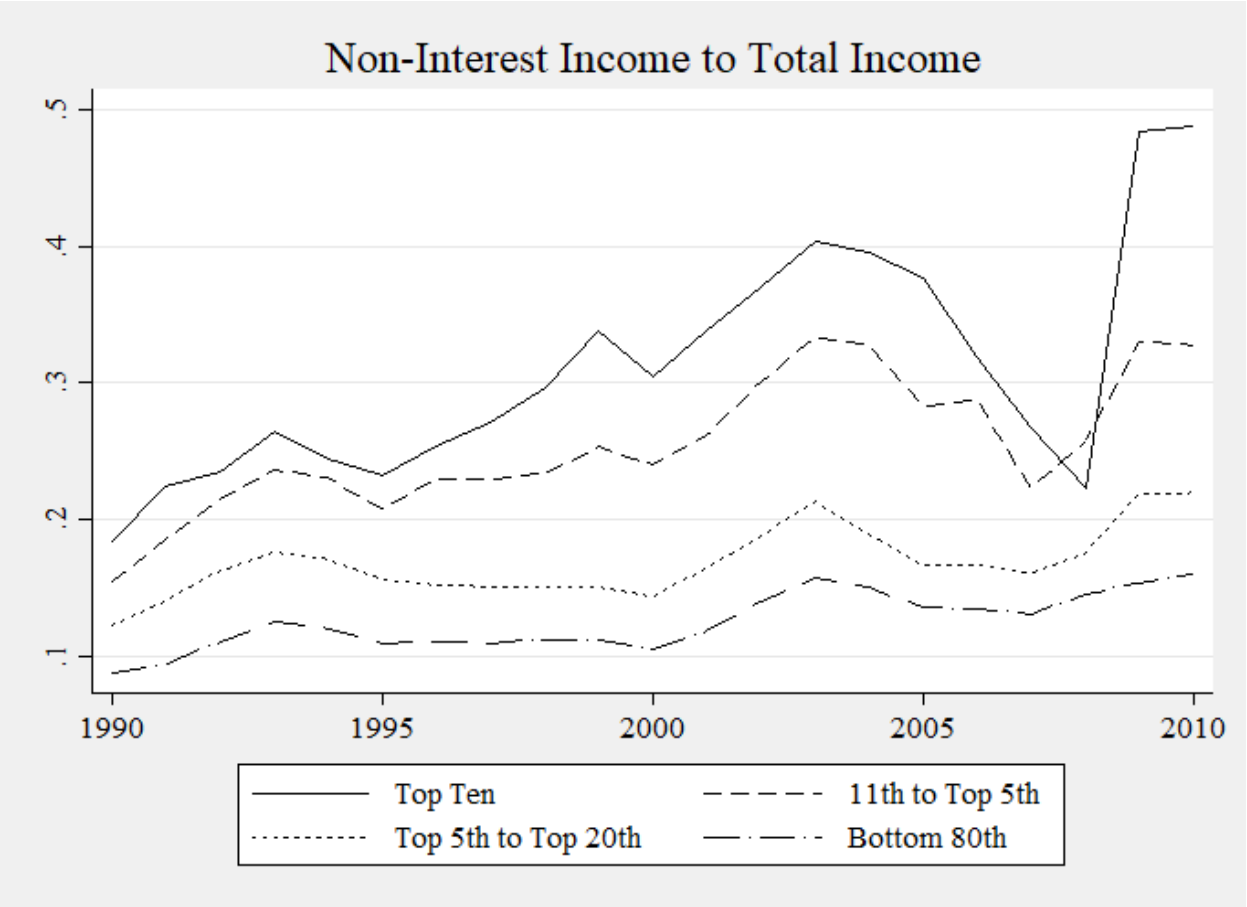

Figure 2: Off-Balance Sheet to Total Assets

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 2010. 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 BHC's 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.

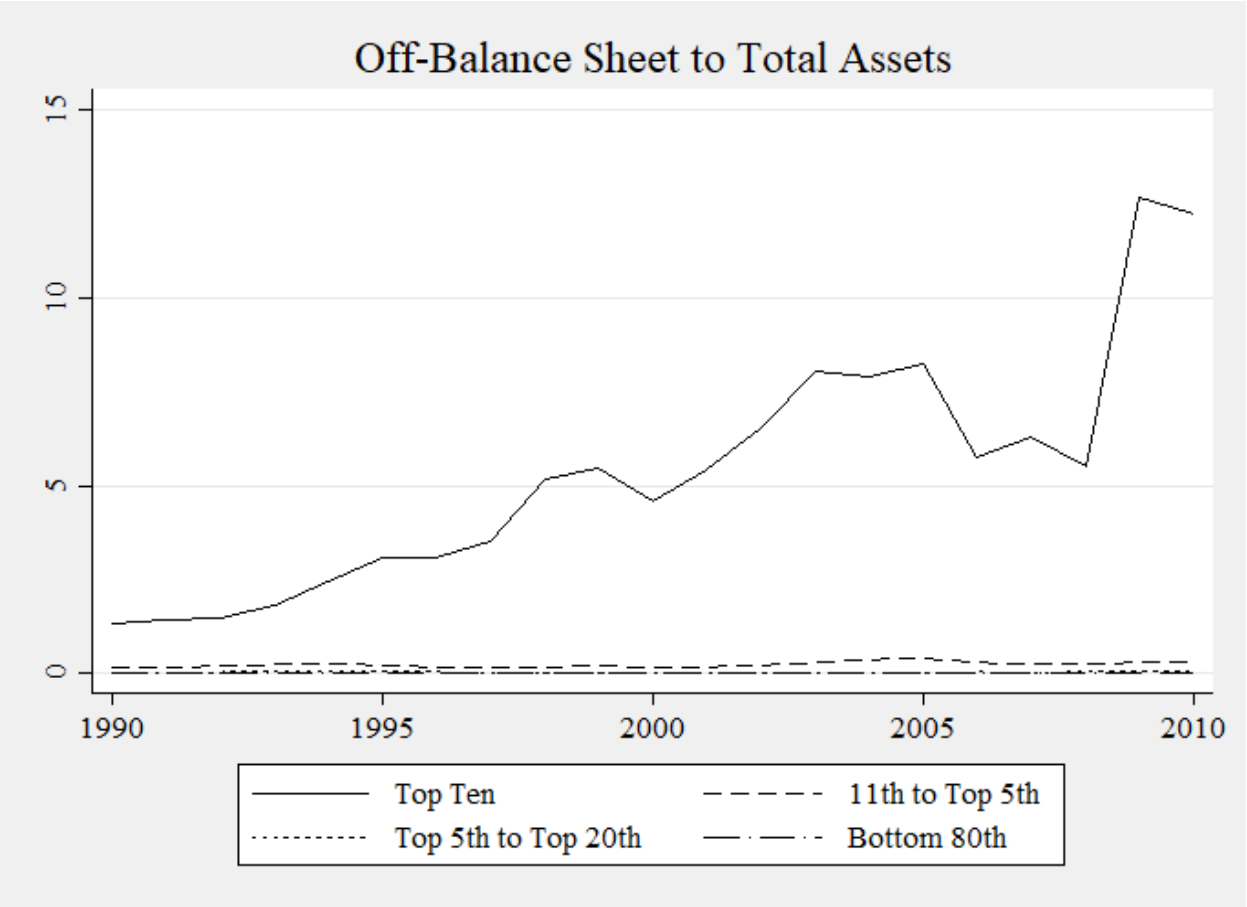

Figure 3: Pre-trend Assumptions of BHC rating upgrades

This figure presents the denial rates of mortgage applications for BHCs experiencing a credit rating upgrade relative to a control group of BHCs that do not experience a rating upgrade. We 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. Denial rates are calculated as the ratio of the denied loan applications in a given year scaled by the total loan application in the same year.

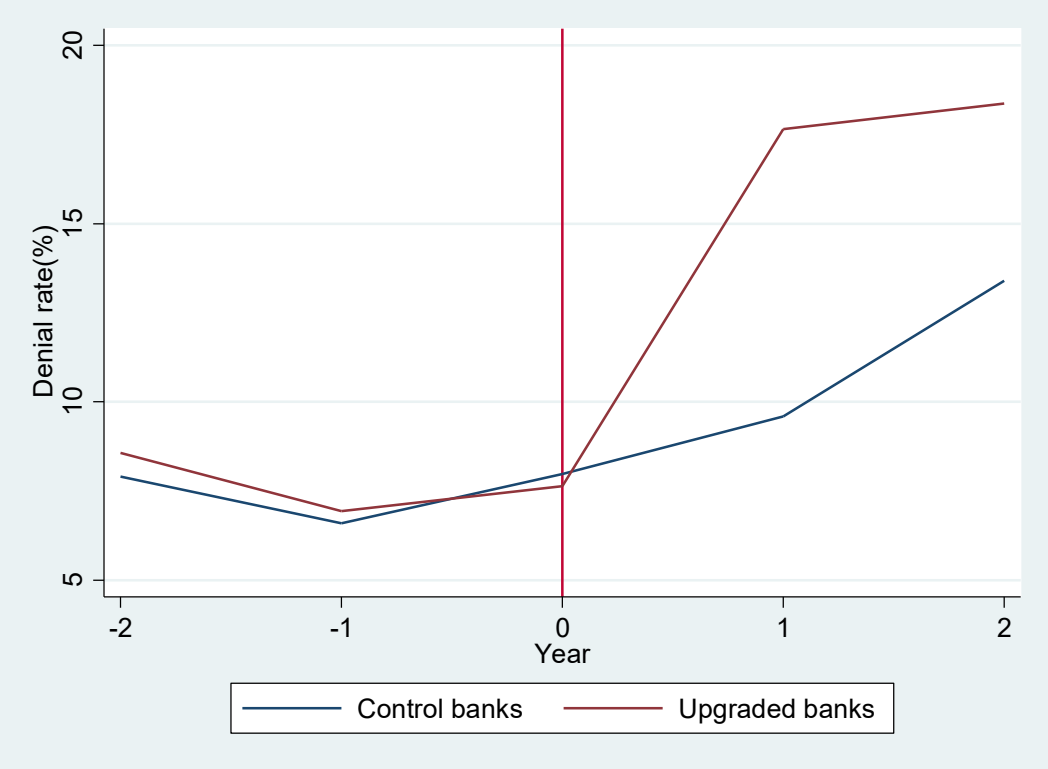

Table 1: Distribution of Credit Rating Changes

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 A.

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 2: Descriptive Statistics

The table reports descriptive statistics on the loan, applicant, bank, and county-level characteristics for the observations in our 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; and 3) the application must meet the requirements to be defined as a conventional loan. Variable definitions are provided in Appendix A.

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	105.40	103.60	75.00	15.00	680.00	9,953,461
Amount of loan	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 (County 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 (County Population)	13.04	1.37	13.16	9.58	16.09	9,953,461

Table 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 A. 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*Risky Loan			0.0093***	0.0059*
			(3.15)	(1.86)
Downgrade*Risky Loan			-0.0016	-0.0022
			(-0.17)	(-0.23)
Ln (County Applications)	-0.0190***	-0.0305***	-0.0185***	-0.0293***
	(-3.85)	(-5.13)	(-3.45)	(-5.01)
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 (County 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)
Applicant controls	Yes	Yes	Yes	Yes
Year Fes	Yes		Yes	
BHC Fes	Yes		Yes	
County Fes	Yes		Yes	
BHC*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

Table 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 A. 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)
Ln(County Applications)		-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)
Applicant controls	Yes	Yes
BHC 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

Table 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 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 A. 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*Risky Loan		0.0064*
		(1.74)
Downgrade*Risky Loan		-0.0019
		(-0.16)
Ln(County Applications)	-0.0317***	-0.0302***
	(-3.93)	(-3.81)
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)
Applicant controls	Yes	Yes
BHC*County FEs	Yes	Yes
County*Year FEs	Yes	Yes
Observations	8,188,632	8,188,632
Adj R-squared	0.167	0.167

Table 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 A. 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	Total Loans	Real Estate Loans	C&I Loans	Ag. Loans	Other Loans
Upgrade	-0.0001	-0.0101	-0.0012	-0.0002	0.0110
	(-0.01)	(-1.33)	(-0.32)	(-0.52)	(1.64)
Downgrade	-0.0024	-0.0043	-0.0005	0.0000	0.0024
	(-0.32)	(-0.72)	(-0.15)	(0.00)	(0.40)
Constant	0.0109	-0.0734	0.1336	0.0506***	-0.1230
	(0.05)	(-0.37)	(1.09)	(3.13)	(-0.60)
Bank controls	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes
Bank FEs	Yes	Yes	Yes	Yes	Yes
Observations	2,421	2,421	2,421	2,421	2,421
Adj. R^2	0.745	0.850	0.823	0.848	0.739

Table 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 A. 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)
Upgrade	0.0204**
	(2.61)
Downgrade	-0.0125
	(-0.72)
LTI Ratio	0.0077**
	(2.24)
High Non-Core Funding	0.0025
	(0.16)
Upgrade* High Non-Core Funding	-0.0025
	(-0.27)
Downgrade* High Non-Core Funding	0.0657***
	(2.71)
Ln(County 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	-1.1456*
	(-1.68)
Applicant controls	Yes
BHC x County FEs	Yes
County x Year FEs	Yes
Observations	9,931,449
Adj R-squared	0.161

Table 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 the S&P long-term issuer ratings mapped into twenty-two numerical categories (Bloomberg) (Adelino & Ferreira, 2016). Formal variable definitions are provided in Appendix A. 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(County Applications)	-0.0191***	-0.0309***
	(-3.92)	(-5.14)
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(County Population)	-0.0838	
	(-0.96)	
Constant	0.0304	-0.7958
	(0.04)	(-1.06)
Applicant controls	Yes	Yes
Year FEs	Yes	
BHC FEs	Yes	
County FEs	Yes	
BHC*County FEs		Yes
County*Year FEs		Yes
Observations	9,931,449	9,931,449
Adj R-squared	0.123	0.161

Appendix A: 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.
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 non-interest income to the sum of interest income and non-interest 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(County 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 B: Correlation matrix

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

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1)	LTI ratio																
(2)	Risky loan	0.77***															
(3)	Upgrade	0.07***	0.05***														
(4)	Downgrade	0.04***	0.03***	-0.15***													
(5)	Ln(application_county)	0.17***	0.15***	0.06***	-0.03***												
(6)	Male	-0.05***	-0.05***	0.00***	-0.00***	-0.02***											
(7)	Hispanic	0.08***	0.08***	0.02***	-0.02***	0.17***	0.02***										
(8)	Asian	0.09***	0.09***	0.02***	0.06***	0.15***	0.01***	-0.06***									
(9)	White	-0.04***	-0.05***	0.03***	-0.01***	-0.12***	0.22***	0.08***	-0.42***								
(10)	Black	0.02***	0.02***	-0.01***	-0.04***	0.03***	-0.08***	-0.06***	-0.07***	-0.44***							
(11)	Bank size	0.11***	0.09***	0.21***	0.24***	0.31***	-0.03***	0.10***	0.10***	-0.06***	-0.01***						
(12)	ROA	0.01***	0.02***	0.14***	-0.52***	0.11***	0.01***	0.03***	-0.03***	0.02***	0.01***	-0.20***					
(13)	Income diversification	0.09***	0.09***	0.00*	0.04***	0.19***	-0.01***	0.12***	0.05***	-0.01***	-0.02***	0.40***	0.19***				
(14)	Leverage	-0.10***	-0.07***	-0.04***	-0.08***	-0.01***	-0.00**	-0.05***	-0.01***	-0.03***	0.02***	0.04***	-0.20***	-0.09***			
(15)	County HPI change	0.02***	0.04***	-0.17***	-0.36***	0.18***	0.00***	0.06***	0.00*	-0.02***	-0.00***	-0.10***	0.35***	0.24***	0.08***		
(16)	County Unemployment Rate	0.05***	0.03***	-0.04***	0.53***	-0.05***	0.00**	0.02***	0.05***	-0.04***	0.01***	0.15***	-0.34***	0.06***	-0.11***	-0.40***	
(17)	Ln(county population)	0.12***	0.13***	-0.01***	0.06***	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 C: Robustness test – Credit Rating Changes and Bank Lending using probit regressions

This table reports the results of 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 A. 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*Risky Loan			0.0379***	0.0482***
			(2.72)	(3.71)
Downgrade*Risky Loan			-0.0219	-0.0122
			(-0.45)	(-0.28)
Ln (County Applications)	-0.0620**	-0.0607**	-0.0616**	-0.0603**
	(-2.57)	(-2.41)	(-2.41)	(-2.26)
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 (County 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)
Applicant controls	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes
BHC Fes	Yes	Yes	Yes	Yes
Observations	9,931,449	9,931,449	9,931,449	9,931,449

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