The Effect of Dealing in Securities on Lending at Commercial Banks

Dinara Bayazitova

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Approved by:

Greg Brown

Robert Bushman

Paolo Fulghieri

Matthias Kahl

Anil Shivdasani

ABSTRACT

DINARA BAYAZITOVA: The Effect of Dealing in Securities on Lending at Commercial Banks
(Under the direction of Anil Shivdasani)

This study empirically examines the effect on lending of the change in bank regulation in 1996, when commercial banks were allowed to increase their dealing in securities. It documents the decline in loan growth rates at the affected dealer banks compared to unaffected banks. In particular, affected banks restricted their supply of lending by increasing denial rates on mortgages after the change. These effects can be explained by the competition for limited funding between lending and dealing in securities in the presence of credit constraints. Also, this research demonstrates that dealer banks shift funds from lending to market-making during periods of high volatility. This occurs because of the increased demand for liquidity provision by market-makers. Consistent with this explanation, I find higher risk-adjusted gross trading returns at dealer banks at those times.

To my family.

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1.Introduction

In this thesis I consider patterns of lending behavior by conglomerate banks that combine lending with dealing in securities. I analyze how lending by this kind of banks is different from lending by other commercial banks. Proprietary trading and dealing in securities by commercial banks is a controversial topic. One of the major points of the debate is how to distinguish between these two types of trading. Many academics and industry practitioners agree that there is no clear algorithm to implement such a distinction. Even more importantly, it may be conceptually impossible, since market making can be viewed as a form of proprietary trading (Duffie, 2012). If this is taken into account, one can expect that proposed restrictions on proprietary trading will limit market making. They might also have unintended consequences in the form of reduced liquidity and increased funding costs for bond issuers (Oliver Wyman, 2011).

In addition to its effect on bank risk and liquidity in financial markets, there is another dimension to the possible consequences of trading in securities by commercial banks: it may affect bank lending. And it is this effect that is the main focus of this empirical study. It is not well understood, despite recent attention to commercial banks that engage in both lending and trading. It is very important, however, for formulating a sound regulatory policy, given that dealer banks account for a large portion of total lending in the US.

Trading in securities by commercial banks may have a negative effect on their lending. According to the bank regulatory rules, some minimum level of equity capital is required to be allocated to both issued loans and trading assets held on balance sheets. When trading and lending divisions are combined in one financial institution, they compete for a limited amount of bank equity capital. Capital is costly, however, and if the expected risk-adjusted performance of lending is lower than that of trading, it may get less capital. Because trading at commercial banks is restricted and minimum capital requirements limit the opportunities for a bank to take risk, it will choose an optimal mix of lending and trading. If expected returns are non-linear, however, an internal rather than the corner solution will be chosen.

As a way of resolving the issue of causality, I consider two exogenous shocks to dealing and examine their effects on lending at the affected banks. First, I look at the bank regulatory change of 1996 that relaxed the constraint on dealing by commercial banks. For a long time the Banking Act of 1933 (also known as the Glass-Steagall Act) prohibited commercial banks, with a few exceptions, from making markets in securities. This restriction was subsequently eroded by the Federal Reserve's reinterpretations of its wording. In 1987 commercial banks were allowed to establish so called Section 20 subsidiaries that could engage in underwriting and dealing in securities to a limited extent. In 1996 this constraint was further relaxed. It is this later change in the rule that is used as an exogenous shock to examine the effect of dealing on lending in this thesis. To eliminate the contaminating influence of other events affecting both types of banks, I perform a difference-in-difference test. I find that after the constraint on dealing was relaxed, dealer banks reduced their loan growth compared to other banks not affected by the regulatory change.

It is also important to understand what drives the decline in loan growth by dealer banks after the regulatory change: lower loan supply or decline in loan demand. To disentangle loan supply and demand effects, I estimate at the likelihood of loan applications being rejected and compare the changes in this likelihood after 1996 between dealer and other banks. To perform this test I consider mortgage loans only, because this is the only category for which such detailed data is publicly available. I find that after 1996 dealer banks were more likely to reject mortgage applications than were other banks. In other words, dealer banks tightened their mortgage loan supply after the constraint on market making was relaxed. This result holds when I repeat the analysis for each of the ten largest US states separately to form a better match between affected and unaffected banks. Finally, to provide evidence in support of the supply-side explanation, I examine changes in loan demand around the bank regulatory change. I measure loan demand by the total number of mortgage applications submitted to a bank, and show that changes in mortgage demand was no different for dealer banks compared to others.

I also examine alternative explanations for the decline in loan growth rate for dealer banks after the regulatory change. One can argue that loan demand has declined because commercial banks entered underwriting at the same time as dealing in securities. Although this could magnify the magnitude of the decline in corporate loans, it was unlikely to affect mortgages, for which I find tightening of credit supply as well.

Another concern is that banks do not hold on their balance sheets only loans they have originated, but also securitized. Therefore, the decline in growth rates for loans held on bank balance sheets might be due to an overall upward trend in securitization, which is likely to affect larger banks more than smaller ones. However, we do not find support for this explanation, since there is no difference in changes in the fraction of securitized mortgages held by dealer and non-dealer banks.

Increase in demand for dealing on capital markets during high-volatility periods is considered the second exogenous shock. Asset pricing literature suggests that at periods of high uncertainty, demand for dealing is particularly strong. There are both theoretical reasons and empirical evidence of this effect. So called flight to quality usually arises at these times, and requires market-makers to provide liquidity. Also, investors tend to increase their hedging demands at those times as well. Selling pressure is further amplified by a number of frictions discussed in the asset pricing literature. In particular, fund managers are subject to withdrawals when fund performance falls below a threshold (Vayanos, 2004). Traders liquidate holdings across different securities after trading losses (Kyle & Xiong, 2001). There is a positive relation between volatility and trading volume for different types of assets (Gallant, Rossi & Tauchen, 1992; Foster, 1995; Wang and Yau, 2000; Fleming 2003). As a result of these frictions, at periods of high uncertainty financial institutions that combine lending and dealing under one umbrella are likely to have incentives to move funds from lending to dealing.

The empirical evidence that I provide is consistent with this hypothesis. High-volatility periods are defined as the quarters when the average daily VIX was in the top 25% of quarters since the beginning of the VIX series in 1990. I find that during these periods banks have abnormally high risk-adjusted gross trading returns, suggesting that they do have incentives to move funds from lending to dealing. I also show that during periods of high volatility, growth rates in trading assets increase while loan growth rates decrease for these banks relative to others. This suggests that dealer banks do shift funds from lending to dealing at these times.

I consider and reject some alternative explanations for these findings. First, I show that the lower growth rate in loans by dealer banks during high-volatility periods is not due to the overlap between recession and high-volatility quarters, or to a higher sensitivity of these banks to recessions. Second, I show that the result cannot be explained by high reliance of these banks on financing from capital markets, which tend to dry up during periods of high volatility.

The findings of this thesis have important implications for bank regulation. Most importantly, combining lending and market-making may divert funds from lending and is likely to lower loan growth. At periods of high volatility this effect is likely to be amplified.

However, it is also possible that higher profits from market-making may compensate for abnormally high credit losses, thus supporting bank capital when recessions are accompanied by high volatility on capital markets. Banks with higher levels of capital are likely to lend more. Therefore, profits from market-making may indirectly increase lending in later periods. In other words, market-making can potentially subsidize lending through diversification of bank earnings. Although these indirect positive effects of trading on lending are possible, they are difficult to measure, and I do not provide supporting evidence in this thesis.

This thesis contributes to the literature on trading in securities by commercial banks. The majority of the earlier papers have focused on the effect of trading in securities on bank risk. Their findings are mixed because of the different methodologies and sample periods used. Studies from the 1980s find that overall commercial bank risk is lower in the presence of trading. This is an example of a classic diversification effect that arises when two types of activities are combined, and conditional on their earnings being less than perfectly correlated. Wall and Eisenbeis (1984) consider combined earnings of banks and securities firms at the industry level. White (1986) finds that banks trading in securities had higher survival rates than others during the Great Depression. Kwast (1989) finds some potential for diversification gains from limited securities activities under the Glass-Steagall Act. However, he cautions that this potential appears to be limited. Later studies find an increase in overall bank risk after the Glass-Steagall Act was repealed (Geyfman & Yeager, 2009) and for Section 20 subsidiaries using their confidential financial statements (Kwan, 1998). DeYoung and Roland (2001) analyze the reasons for higher volatility of earnings from trading than from lending. They suggest that in contrast to lending, trading has low switching costs (relationships are not as important as they are in lending) and high operating leverage (the competitive salaries of traders are a large fixed expense). None of these papers, however, considered the effect of trading on lending, the focus of this study.

The findings of this thesis are relevant for the current discussion of the so-called Volcker rule, one of the most intensely debated parts of the Dodd-Frank Wall Street Reform and Consumer Protection Act (Johnson, 2012). The Volcker rule constrains trading by commercial banks and is intended to limit risk-taking in the banking sector that is financed to a large extent through FDIC insured deposits. The Volcker rule limits proprietary trading and investments in hedge funds by commercial banks to 3% of bank capital, but allows them to trade "on behalf of customers" (to make markets). Although this rule applies only to proprietary trading and does not restrict dealing in securities, it is reasonable to argue that it might affect lending as well, because the two types of trading are difficult to distinguish.

This thesis is organized as follows. In Section 2, the data and sample construction are described. In Section 3 the effect of regulatory change on lending by dealer banks is considered. In Section 4 the incentives in lending and market-making during periods of high volatility are considered. In Section 5 the findings are summarized.

2. Data

Banks dealers are bank holding companies (BHCs) that have established so-called Section 20 subsidiaries. The list of these banks is compiled on the basis of the approval decisions for establishing Section 20 subsidiaries obtained from the Federal Reserve Bulletins. As of the end of the second quarter of 1995, 25 BHCs in US had established Section 20 subsidiaries. These banks are listed in Appendix A. The subsample of nondealers consists of 1,082 bank holding companies, including 398 public banks.

Bank financial statements data are obtained from Y-9C Reports (the Bank Holding Company Report of Income and Report of Condition) for the years from 1995 until 2008. Table 1 shows summary statistics on the major characteristics of dealer banks that are used as control variables in regressions later. Chargeoffs on loans as a percentage of total loans on bank balance sheet are used as a proxy for credit losses. The percentage of total assets financed with deposits shows the composition of funding.

Loan balances at dealer banks grew on average 1.07% per quarter in 1995–2008. The median growth rate was slightly higher at 1.23%. As of the end of the second quarter of 1995, banks with Section 20 subsidiaries had on average $81.7 billion in total assets. They had 62.3% of their assets invested in loans and 5.3% in trading assets. Credit losses were on average 0.11% of total loans. 57.3% of total assets were funded with deposits.

Data on mortgage loan applications and originations comes from the HMDA dataset. This is collected by the Federal Reserve under the provisions of the Home Mortgage Disclosure Act (HMDA), which was enacted in 1975 to monitor mortgage market access for minority and low-income borrowers. The HMDA requires all regulated financial institutions with assets above $30 million to provide information. This dataset is therefore a comprehensive source of information about mortgages. Refinancings are excluded from the sample. Among other things, the HMDA dataset contains information about the amount of loan for which each application was made, the year of application, and an indicator for the bank decision. The date when the mortgage application was made is not included. Therefore, 1995 and 1997 are included for the analysis (a year before and a year after the 1996 regulatory change). The average denial rate of mortgage applications for dealer banks in this sample period was 29%.

3. Exogenous Shock I: Regulatory Change in 1996

3.1 Bank regulation of dealing in securities in the US

Trading in securities by commercial banks is a highly controversial topic and government regulation of this issue has been different at different points in time. According to the 1933 Glass-Steagall Act, commercial banks were prohibited from underwriting and dealing in securities. Government and general municipal bonds were the exceptions to this rule. All other types of securities were considered to be bank ineligible. However, there was a loophole in the formulation of the law. According to the Glass-Steagall Act commercial banks could not "be engaged principally" in underwriting and dealing of securities. Unfortunately, the language of the law did not specify more precisely what it means "to be engaged principally". This restriction was gradually eroded in the late 1980s, when the Federal Reserve reinterpreted the meaning of "to be engaged principally". In 1987 it ruled that commercial banks could establish separate subsidiaries to underwrite and deal in securities. If revenues from underwriting and dealing in bank ineligible securities account for no more than 5% of the total revenue of the subsidiary, the subsidiary is considered to be not "engaged principally" in these activities.[1] This cutoff level was later increased to 10% in 1989 and to 25% in 1996. Bank subsidiaries engaged in underwriting and dealing in previously bank-ineligible securities were called Section 20 subsidiaries after the section of the Glass-Steagall Act that originally prohibited it, but was later reinterpreted by the Federal Reserve.

3.2 Hypothesis I: Competition between lending and dealing for funding

These regulatory changes have led to the creation of financial institutions in which lending and dealing in securities are combined. The patterns of growth and financing of both types of activity within such institutions are likely to be different from those at standalone banks.

At such financial institutions the headquarters redistribute profits as well as externally raised funds among the divisions based on their risk-adjusted performance. If expected returns adjusted for risk are larger for a dealing division than for a lending division, a bank's management will have incentives to shift funds from lending to dealing.

Hypothesis 1

If a bank holding company is financially constrained, lending and market making divisions compete for limited funding. When market-making at a bank holding company increases, its loan growth is reduced.

In principle, a bank might prefer to raise new capital to expand into dealing activities, and would not necessarily have to reduce lending. However, it is important to keep in mind that raising new capital involves transaction costs. In other words, the opportunities for banks to

[1] Although a bank can increase trading in ineligible securities at any cutoff level if it increases trading in eligible securities at the same time, it is easier to do with a higher cutoff because, for example, the supply of Treasuries is limited or because buying too many Treasuries will have an effect on price.

expand are limited. To choose an optimal growth strategy, bank management needs to evaluate the tradeoff between the expected returns and risks in dealing and the costs of raising new capital. Specific reasons for the decision might vary across banks, but there are some general arguments that apply to all of them.

Most importantly, to value bank assets, outside investors need detailed information about the assets held on the bank's balance sheet. As with nonfinancial companies, the data contained in the publically available financial statements is aggregated. More detailed additional information provided to analysts and investors during public offerings might be interpreted in various ways. Some types of bank assets are intrinsically complicated and difficult to value. Also, the rules regulating valuation of some types of bank assets are often opaque and difficult to understand. This presents challenges for commercial banks in raising external capital. Diamond (1984) argues that financial intermediation gives rise to an additional layer of agency problems and creates a need "to monitor the monitor".

Also in contrast to loans, trading assets on the balance sheets of dealer banks are marked to market. The consequences of mark-to-market accounting for trading assets is a question that was debated in the literature for a long time. With mark-to-market accounting, reporting transparency of bank shares is reduced, because marking to market for trading assets occurs at higher frequency. The reasons for this effect are discussed in Ball, Jayaraman and Shivakumar (2012). First, bank managers convey private information to uninformed investors by issuing voluntary earnings forecasts. Because gains and losses on trading assets are difficult to predict, mark-to-market accounting for trading assets makes it more difficult for bank managers to convey their private information credibly while making these forecasts. Second, uninformed investors are at a disadvantage in determining the extent to which securities' gains and losses are due to shocks to expected returns (which reverse in earnings over time) or shocks to expected cash flows, or both. Third, it is possible that managers manipulate mark-to-market gains and losses on trading securities by selectively trading in illiquid markets and influencing traded prices (Heaton et al., 2010; Milbradt, 2009). There is evidence of price manipulation at the end of period: increases in trading volumes, widening of spreads and subsequent price reversals. For example, Carhart et al. (2002) find that about 80% of mutual funds outperform the S&P 500 on the last trading day of the year, and more than 60% under-perform the next day. Gallagher et al. (2009) and Comerton-Forde and Putniņš (2011) provide evidence of price manipulations in other contexts.

Literature on the financial constraints on non-financial firms suggested a number of ways of measuring them, with investment-cash flow sensitivity being the most commonly used (Fazzari et al., 1988). Hadlock and Pierce (2010) provide a critical review of this literature, and conclude that measures based on a single firm characteristic, such as size and age, are superior predictors of financial constraint levels.

Applying this method to commercial banks, however, does not allow us to conclude that they are financially constrained, and there are reasons to argue that it might not be applicable in this context. In particular, commercial banks are financed with FDIC insured deposits and are also subject to minimum capital requirements. This distorts any decisions made by banks compared to those of non-financial firms, including rules regarding investments. Also there are a few other regulatory restrictions that impair the ability of bank holding companies to manage their capital on a consolidated basis. The Federal Reserve imposes minimum capital requirements not only on holding companies, but also on the individual subsidiaries that comprise them. It is important that the holding company is viewed as a source of strength to its subsidiaries. In other words, the holding company has an obligation to downstream capital to inadequately capitalized subsidiaries.

3.3 Exogenous shock I: The regulatory change of 1996

Although we would like to recreate the decision-making process of bank managers, given the limited level of detail in the available data, it is not feasible to reconstruct this process. However, the regulatory change described above can be viewed as an exogenous shock and used as a basis for a test.

The regulatory change of 1996 relaxed the constraint on market-making for dealer banks. It is reasonable to suggest that this encouraged a shift of growth in the affected banks from lending to dealing, from which they had previously been restricted. This was likely to lead to a decline in the lending growth rates in this group relative to other banks.

As described above, the revenue limit for Section 20 subsidiaries was changed twice after it was introduced in 1987. Although each of these regulatory changes could potentially be a basis for a test, only the last (the increase in the revenue limit from 10% to 25% proposed in July 1996) is suitable for this purpose, for the following two reasons. First, the majority of Section 20 subsidiaries were established between 1987 and 1989. Therefore, it is difficult to disentangle the effects of the 1987 and 1989 regulatory changes in revenue limit for these banks. Second, the 1996 increase was the largest of the three. Therefore, one would expect the effect of this change to be the strongest.

I test this empirical prediction using two types of data: bank financial statements in which loans are aggregated at bank holding company level, and mortgage application data collected according to the HMDA.

3.4 Changes in loan growth after the regulatory change of 1996

First, I perform difference-in-difference tests with data on the total amount of loans held on bank balance sheets. I calculate the abnormal growth rate in loans for each dealer bank as the difference between the quarterly growth in its loan balances and the median quarterly growth in loan balances in the comparison group. Two comparison groups of banks are used: all bank holding companies, and public-only bank holding companies. After calculating the abnormal growth rates in loans for dealer banks, I compare them for the periods before and after the regulatory change. To minimize the contaminating effect of other events, the sample is restricted to the time period starting four quarters before and ending four quarters after the July 1996 change in revenue limit. Banks-quarters in which acquisitions are completed are excluded from the sample.

Panel A of Table 2 shows that the average abnormal growth rate in loans for dealer banks declined in the four quarters after the regulatory change compared to the four quarters before. The magnitude of the decline in abnormal loan growth rate (-1.03%) is economically significant compared to the average growth rate of 2.5% in the total sample during this period. Analysis of medians leads to a similar conclusion: the regulatory change of July 1996 was followed by a statistically and economically significant decline in the loan growth rate. The magnitude of the median decline is large compared to the median growth rate of loans (2.2%) in the total sample during this period. This result holds if the subsample of public bank holding companies is used as a comparison group of banks, as shown in the second half of Panel A of Table 2.

To ensure that the negative abnormal growth in loans does not simply reflect changes in total assets, but represents a shift away from loans at dealer banks, I next perform a difference-in-difference test for the changes in the ratio of loans to total assets. Panel B of Table 2 shows that when measured this way, loans at dealer banks declined after the regulatory change in both means and medians.

I also conduct a regression analysis of changes in loan growth at dealer banks to ensure that the decline in means and medians is not driven by other bank characteristics. As with the univariate tests, I restrict the sample to the time period starting four quarters before and ending four quarters after the July 1996 change in the revenue limit. An indicator variable *Post 1996* is defined for four quarters after the regulatory change. An indicator variable *Dealer* is defined for the group of banks that established Section 20 subsidiaries as of June 30, 1995. The major coefficient of interest in this regression is the interaction term of these two indicator variables *Post 1996 * Dealer*.

In column 1 of Table 3 the coefficient before the interaction term *Post 1996 * Dealer* is negative and statistically significant at 5%. This suggests that even after controlling for other bank characteristics, dealer banks had a lower growth rate in loans than non-dealer banks. At the same time, the growth rate in loans in the total sample is positive, as suggested by the positive coefficient on the indicator *Post 1996*. Larger banks have on average lower growth rate in loans. As one would expect, banks with more credit losses tend to increase their loan portfolio more slowly. In column 2 I include bank fixed effect to control for any time-invariant omitted variables. The coefficient for the interaction term *Post 1996 * Dealer* remains significant at 10%, and has similar magnitude. Both magnitudes are close to the mean and median abnormal growth rates from the univariate tests. In columns 3 and 4 I repeat the regressions for a smaller subsample of public bank holding companies and get similar conclusions.

I also conduct a similar test for the regulatory change in 1989. However, I do not find a similar effect there. This could be for the reasons explained above (the majority of Section 20 subsidiaries were established between 1987 and 1989 and the magnitude of increase in the threshold in 1989 was small relative to that of 1996).

3.5 Aggregate lending implications of the regulatory change of 1996

Although we find that abnormal loan growth rates of dealer banks declined after the regulatory change of 1996 compared those of non-dealers, it is likely that borrowers rejected by dealer banks received loans from non-dealer banks competing in the same geographic region. However, this substitution may be incomplete. To estimate the net effect of the regulatory change on lending, the dollar amounts of growth in loan balances (rather than percentages) for dealer and non-dealer banks are summed up as follows:

$$\text{Aggregate Lending Change} = \sum_{i=1}^{ND}\left(\sum_{t=1}^{4}\Delta L_t^i - \sum_{t=-1}^{-4}\Delta L_t^i\right) + \sum_{j=1}^{D}\left(\sum_{t=1}^{4}\Delta L_t^j - \sum_{t=-1}^{-4}\Delta L_t^j\right)$$

where ND – the number of non-dealer banks

D – the number of dealer banks

ΔL_t^i – change in loan balances at a bank i in quarter t (in \$)

In the subsample of public banks only, the total effect of the regulatory change on lending growth is estimated to be -\$20 billion. In the sample of all bank holding companies it is \$2.5 billion. None of private banks in the sample are dealers, and showed a positive change in average growth rate in loan balances, so compensating for the negative effect at public banks. These estimates of the effect in dollar terms are not economically significant compared to the amount of total lending. In other words, when measured in dollar terms rather than in percentages, the conclusions are quite different. This might be explained by the fact that banks of different size had different growth rates in loans.

3.6 What drives reduction in loan growth: demand or supply?

Another interesting/important question is whether this change is driven by lower loan demand or tighter loan supply. As a way to disentangle these two effects I look at more detailed data on mortgage loan applications. This data makes it possible to model the probability of an application being denied by a bank, controlling for borrower, lender and geographic area characteristics. This has two purposes. First, mortgage application denial rates capture the supply side of lending, i.e. the willingness of lenders to make loans. Examining mortgage application denial rates, I can ensure that the decline in loan growth rates documented in the previous tables is not driven by a decline in demand. Second, this provides an independent robustness check of the result documented using aggregate amounts of loans from bank financial statements.

HMDA data on mortgage applications is matched to the major dataset by the name and state of banks that are included in a Bank Holding Company. Linear probability models are estimated despite the fact that the dependent variable is an indicator variable, for which a probit model seems to be more suitable following Puri, Rocholl and Steffen (2011). The major reason for using this approach is that bank fixed effect should be included in these regressions to remove the effect of time-invariant omitted variables and alleviate the endogeneity problem. However, nonlinear models suffer from an incidental parameter problem, i.e. the fixed effects and the coefficients of the other variables cannot be consistently estimated in large but narrow panels (with the number of time periods fixed and the number of groups growing infinitely).[2] In contrast, in linear models the coefficients of the main explanatory variables can be estimated consistently. The results are robust to using logit as an alternative estimation method, as described below in more detail.

Columns 1 and 2 of Panel A in Table 4 show the estimates of the linear probability models for the subsample of public banks. The sample period includes one year before and after the regulatory change of July 1996 (1995 and 1997). The dependent variable is set to one if a mortgage application was rejected by a bank and to zero if the loan was granted. The interaction term between the indicator for the Section 20 bank and the indicator for the period after the regulatory change of 1996 is positive and significant at 1% level. The denial rate of mortgage applications at these banks increased after the regulatory change. In other words, mortgage underwriting standards at these banks became stricter. This is consistent with lower loan growth rates in the tests that used data on loans from bank financial statements. The magnitude of the effect is significant not only statistically but also economically. After the regulatory change, dealer banks had a 6% higher denial rate. It is almost one quarter of the average denial rate in the sample of 29%.

In these regressions I control for a few applicant, bank and geographic area characteristics. As a measure of creditworthiness, applicant income is used. Although this is only one component of the credit scores typically used as a proxy for creditworthiness, credit score data is unfortunately prohibitively expensive. The coefficient before the logarithm of applicant income is negative and significant in all specifications. This is consistent with the intuition that higher

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[2] Neyman and Scott (1948) show that the incidental parameters (fixed effects) become inconsistent in logit models as their number increases, while the amount of information about each parameter remains fixed.

income applicants have higher chances of being approved for a mortgage loan. Banks with a higher fraction of assets financed by deposits have higher denial rates. This result might reflect the conservativeness of a bank in both lending and funding. In column 2 a number of demographic characteristics of the geographic region in which an applicant lives are added. These are considered at the county level. The signs of the coefficients for these variables are consistent with expectations; applicants living in the counties with higher than average household income have lower denial rates, while those in the counties with a higher percentage of residents educated to less than college level have higher denial rates.

Fitting a linear probability model for an indicator variable can be questioned because it can predict values that are negative or outside the range (0;1). For this reason, probit specifications are commonly used to model binary data. However, as discussed above, linear probability model has an important advantage for panel data. In contrast to a probit model, it provides consistent estimates of the main explanatory variables in models with firm fixed effects. As a robustness check of the previous result, the coefficients for probit models with and without bank fixed effects are shown in columns 3–6. The interaction terms between the dealer bank indicator and the indicator for the post-1996 period as well as control variables retain their sign and significance in all four specifications.

To get a better comparison group for the group of banks under study, I also estimate separate models for the probability of mortgage denial for the ten largest US states. Banks operating in the same state are subject to similar economic and demographic conditions, as well as the same regulation. For example, whether a mortgage is no-recourse, so that the bank does not pursue a borrower to get the difference between the amount of the mortgage and the value of the house in case of foreclosure, is determined by the laws at the state level. Specification 2 from Panel A of

Table 4 is used to fit linear probability models with bank fixed effects for each state. Panel B of Table 4 shows the estimates of the coefficients before the interaction term between the bank-dealer indicator and *Post 1996* indicator. Eight out of ten states have positive and statistically significant coefficients for this interaction term. The fact that bank-dealer denial rates did not increase in California can be explained by the fact that many Internet and high-tech companies are located there and that 1997 was a year of the Dotcom boom.

Finally, as an additional robustness check, loan level HMDA data is aggregated up to the bank level and linear regression models for bank average denial rate on mortgage applications for a given year is fit. Coefficients of this estimation are shown in Panel C of Table 4. They confirm the results obtained above for both all bank holding companies and the subsample of public ones only: dealer banks were more likely to deny mortgage applications after the 1996 regulatory change.

3.7 Which types of borrowers experience a reduction in credit availability?

It is not obvious which types of borrowers experienced most of the reduction in credit availability after the change in regulation: those who were more or less creditworthy. Less creditworthy borrowers can be charged a higher interest rate, although such loans might lead to larger expected losses. To choose the optimal mix of loans, a bank needs to evaluate the risk-return tradeoff. Borrower creditworthiness is usually measured by credit scores. However, the HMDA dataset does not include this variable. To overcome this data limitation, borrower income reported in HMDA is used.

The total sample is split into two parts: borrowers with higher and lower than the median income. Table10 shows the results of the estimation of linear probability and probit models for these two subsamples. Most importantly, the interaction term *Post 96 * Dealer* has significantly positive coefficients in both subsamples (except for the probit models without fixed effects in the subsample of high-income borrowers). This suggests that both groups of borrowers were affected by the regulatory changes. As might be expected, the magnitude of the effect was slightly greater for low-income borrowers. However, an important limitation of this analysis is that this conclusion is based on a specific measurement (income) that is only one component of the credit scores that are typically used by measure borrower creditworthiness.

3.8 Alternative explanations

It is reasonable to suggest that Section 20 banks securitized a large fraction of their loans and that the fraction of loans they securitized went up over time. Even if the amount of all originated loans was not affected, increase in the extent of securitization resulted in the reduction of the growth rate for loans held on bank balance sheets. To rule out this alternative explanation, the dynamics of securitization rates around 1996 at dealer and non-dealer banks need to be compared. HMDA mortgage loan data includes information about whether a loan was kept by a bank on its balance sheet or sold after the origination into securitization pools. An indicator for securitization is defined on the basis of this information.

Table 5 shows the estimates of linear regression models with the percentage of all granted loans being securitized or sold by the originator in a given year as a dependent variable. The sample period includes one year before and after the regulatory change of July 1996. The interaction term between the indicator for the Section 20 bank and that for the period after the regulatory change of 1996 is negative and significant at a level of 10%. This means that the securitization rate of mortgage applications at these banks did not increase but, in contrast, went down in 1997. This suggests that the lower growth rate in dealer banks after the regulatory change was not due to higher securitization rates at these banks.

4. Exogenous Shock II: Intensified Capital Market Frictions during Periods of High Uncertainty

4.1. Incentives in market-making during periods of high uncertainty

As discussed in the first part, when market-making and lending are combined in one financial institution, they compete for funding, so that such financial institutions exhibit different lending patterns than others. To study these spillover effects in a time series context, I consider periods when uncertainty about the future increases exogenously. It is reasonable to expect that capital market frictions intensify at these periods. The effect of market-making on lending may therefore be particularly pronounced because it becomes especially difficult for a bank to raise new financing on capital markets. And it is during these periods that market-making by a financial institution may have particularly pronounced effects on its lending.

However, it is important to note that intensified capital market frictions form a necessary, though not a sufficient, condition for market-making to affect lending. It is crucial that the bank headquarters have incentives to redistribute funding away from lending towards market-making. There are a number of arguments why the demand for market-making is likely to change during periods of high uncertainty, and how this change affects the incentives of the market-making division. Asset pricing literature suggests that at periods of high uncertainty on capital markets, demand for market-making is particularly strong. After negative shocks to the markets it is common to observe so called flight to quality, in which investors sell riskier assets and buy Treasuries. Market-makers are crucial in accommodating this selling pressure. Demand for liquidity provision increases at these periods, and selling pressure is further amplified by a number of frictions discussed in asset pricing literature. Traders liquidate positions across different securities after trading losses (Kyle & Xiong, 2001). When fund performance falls below a threshold, fund managers are subject to withdrawals (Vayanos, 2004). Increase in hedging demands by investors is another reason for the increase in trading volume. In addition to these mostly theoretical arguments, there are also evidence of a positive relation between volatility and trading volume in the empirical asset pricing literature. Gallant, Rossi and Tauchen (1992) show that large price movements in equity prices are followed by high volume. Fleming (2003) reports positive time series correlation between volatility and trading volume for US Treasuries, which make up the largest segment of bond markets in terms of trading activity (according to FISMA, Treasuries represent about 60% of trading volume in all bonds). Foster (1995) finds that volatility and volume in the oil futures markets are positively contemporaneously related. Wang and Yau (2000) find positive relation between volatility and trading volume for futures on S&P 500, Deutsche Mark, silver and gold.[3]

As a consequence of increased demand, return on liquidity provision increases during periods of high uncertainty. Dealers set wider bid-ask spreads to compensate for the increase in inventory risk borne by a market-maker (Ho & Stoll, 1983). Nagel (2011) shows that return from reversal strategies is higher when VIX is higher. Fleming (2003) finds a positive correlation between price volatility and bid-ask spreads in US Treasuries. Chordia, Sarkar and Subrahmanyam (2005) find that volatility is informative in predicting bid-ask spreads for stocks

[3] In addition to the findings of the previous literature in undocumented results I show that if I use our specific definition of high-volatility periods, trading volume is higher for two types of assets with long enough time series of data available (stock and exchange-traded derivatives).

and US Treasuries. Wang and Yau (2000) document a positive relation between volatility and bid-ask spread for a number of futures (S&P 500, Deutsche Mark, silver and gold).

Because the demand for liquidity provision on capital markets increases at periods of high uncertainty, shifting funds from lending to this activity is a feasible and likely strategy for dealer banks. It is important to acknowledge, however, that at these periods the risks of market-making also increase.

Hypothesis II

At the periods of high volatility dealer banks shift funds away from lending to market making because of increased demand for market making.

I describe the empirical evidence consistent with this hypothesis below. Most importantly, at the periods of high uncertainty the following holds for dealer banks: (1) higher risk-adjusted trading returns; (2) increase in trading assets; (3) decline in loan growth rate compared to non-dealers. High uncertainty periods are defined as quarters when the average daily VIX is in the top 25% for the period from the beginning of the series in 1990 until 2008. As a robustness check, I also use a 20% cutoff. The list of high-volatility quarters for 25% cutoff includes the following events:

- Asian crisis (Q7, 1997)
- LTCM (Q3 1998–Q3 1999)
- Dotcom bubble (Q3 2000–Q4 2001)
- Worldcom bankruptcy (Q3 2002–Q1 2003)
- Subprime crisis (Q1, Q3–Q4 2008)

4.2. Trading returns and trading assets of dealer banks in high uncertainty periods

To provide evidence on the second hypothesis about bank incentives switching from lending to market making during the high uncertainty periods, I compare the risk-adjusted gross trading returns of dealer banks in high- and low-volatility quarters. Two measures of trading returns are used. *Marked-to-Market Risk-Adjusted Return, %* is the ratio that has in the numerator trading revenues per $1 of trading assets (the ratio of marked-to-market trading revenues [item BHCK A220] to the amount of trading assets at the beginning of the quarter). The denominator adjusts for risk to account for the fact that dealers might be compensated by higher returns for taking more risk at the periods of high volatility. As a measure of riskiness of trading assets I use Value at Risk (VaR) [item BHCK 1651] per unit of trading assets that all banks with a trading position exceeding $1 billion or 10% of total assets are required to report. As a result, I get a measure similar to the Sharpe ratio by dividing trading revenue per $1 of trading assets by VaR per $1 of trading assets. Another measure, *Total Risk-Adjusted Return, %,* includes not only marked-to-market trading revenue, but also interest income from trading assets [BHCK 4069]. The sum of these two types of revenue per $1 of trading assets is divided by VaR per $1 of trading assets to get the second measure of trading returns. Because of the limited information provided in BHC financial statements it is possible to calculate only gross returns, which do not take into account the costs of trading (most importantly funding costs and overhead expenses).

Panel A of Table 6 shows that both measures of gross risk-adjusted trading returns at dealer banks are higher in high volatility periods than in low volatility periods. The difference in marked-to-market returns is statistically significant at 5% and economically large (mean: 1.2%, median: 0.74%) compared to the level of gross trading returns at low-volatility periods (mean: 3.51%, median: 2.45%). The results are even stronger for the second measure: the difference in total returns between high- and low-volatility periods is statistically significant at 1% level and economically large (mean: 1.42%, median: 2.27%) compared to the level of total returns at low-volatility periods (mean: 6.23%, median: 4.43%). The right side of Panel A of Table 4 shows that the result is robust to the change in cutoff for a definition of high-volatility periods, although statistical significance is weaker, perhaps because of the smaller number of observations in the high-volatility subsample. These results suggest that dealer banks do have incentives to shift funds to market-making during high-uncertainty periods because they receive higher risk-adjusted trading returns at such times.

I also examine empirically whether dealer banks shift funds to market-making. First, I consider whether dealer banks increase their trading- to total-assets ratio during high-volatility quarters. Since trading assets can be rather volatile, I use the average trading- to total-assets ratio in the previous four quarters as a benchmark for comparison. I calculate *Abnormal Trading Assets, %* as a percentage change in the ratio of trading assets to total assets relative to the bank average in the previous four quarters.

Panel B of Table 6 shows that although trading assets were growing even during low-volatility quarters, their average growth was significantly faster during high-volatility quarters. The difference is statistically significant at 1% level for both mean and median. This result also holds if the cutoff for high-volatility quarters is moved to 20% from 25%, as shown on the right side of Panel B in Table 6. This suggests that dealer banks do move funds to market-making during high-uncertainty periods.

Some trading assets are often financed with trading liabilities that include short positions on securities. Although trading liabilities reduce overall financing needs, a bank still needs to allocate equity capital for the gross amount of trading assets rather than trading assets net of liabilities. Since equity capital is the most expensive form of funding, there is therefore the greatest competition to obtain it. Consequently, in our tests focused on competition between bank divisions for equity capital, it makes sense to consider changes in total rather than net trading assets.

4.3. Lending by dealer banks during high-uncertainty periods

To study the effect of market-making on lending during periods of high volatility, I perform a difference-in-difference test for the growth rates in loans. For each quarter I calculate abnormal loan growth rates at dealer banks relative to non-dealers. I use two different comparison groups: all bank holding companies and public only bank holding companies. Then I compare abnormal loan growth rates for dealer banks at high- and low-volatility periods. Table 7 shows that abnormal growth rates of loans were lower during high-volatility quarters than in low-volatility quarters. For all loans, the difference is statistically significant at 1% level. The magnitude of the average difference (-0.55%) is economically large. It is about half of the abnormal total loan growth rate for dealer banks during low-volatility periods (-1.0%) and about one fifth of the unadjusted loan growth rate in the total sample (2.5%). Similar conclusions can be made based on medians and with public BHCs used as a comparison group. The result holds for three out of four types of loans (corporate, residential and non-residential loans) considered separately.

In Table 8 I conduct a multivariate analysis to ensure that lower loan growth rates at dealer banks in periods of high uncertainty are not driven by other bank characteristics. The major coefficient of interest is the interaction term of the indicator for high-uncertainty periods with the indicator for dealer-banks *High VIX * Dealer*. In all four specifications of Table 8, this interaction term is significantly negative at 5% level. This suggests that even after controlling for other bank characteristics, dealer banks have a lower loan growth rate relative to non-dealer banks during periods of high uncertainty. The magnitude of the effect is similar to the magnitude in the univariate tests.

The coefficients on other variables are consistent with expectations. Larger banks tend to have slower growth rates. Banks using more deposit financing and borrowing less on capital markets grow slower. Banks with higher credit losses are more conservative in lending and increase their loans more slowly.

4.4. Alternative explanations

Periods of high uncertainty are often (although not always) accompanied by recession in the real economy. For example, the LTCM crisis of 1998 did not lead to a recession in the US, although it caused a lot of turbulence on the financial markets, while high volatility in the capital markets in 2001 was accompanied by a recession. Previous literature has suggested mechanisms that can propagate financial shocks to generate recession in the real sector. One of them is the financial accelerator introduced by Bernanke and Gertler (1989) and Kiyotaki and Moore (1997). The major transmission channel in these models is the increase in agency costs of borrowing after a negative financial shock, leading to a reduction in borrower net worth or collateral. It is therefore important to ensure that lower loan growth at dealer banks during high-volatility periods is not simply driven by an overlap between high-volatility and recession quarters.

To study this question, I define an indicator variable *NBER Recession* for the quarters that the NBER identifies as periods of recession in the US. The sample period used in the paper, 1996–2008, includes two recessions: those of 2001 (from the second to the fourth quarter) and 2008 (all four quarters). I also define the interaction of this indicator with the indicator for dealer banks. Comparison of column 2 with column 1 of Table 9 shows that the decline in lending by public banks was twice as large during the recessions. However, the interaction term *High VIX * Dealer* remains negative and significant, suggesting that lower growth in loans during high-volatility periods is not driven by overlaps with recessions.

Another concern one might have regarding the findings in this thesis is that dealer banks tend to rely on borrowing from capital markets as a source of funding, and it could be this funding difficulty (rather than presence of market-making divisions) that explains the reduction in lending by dealer banks during periods of high volatility. To rule out this alternative explanation, I include the interaction of the indicator for high-volatility periods and a variable characterizing the composition of bank financing. For this purpose I define two variables: percentage of deposit financing; and percentage of non-deposit borrowings including interbank loans, REPO, commercial papers, bonds, etc. Columns 3 and 4 of Table 9 show that even after inclusion of these interaction terms, the coefficient before *High VIX * Dealer* remains significantly negative. This suggests that non-dealer banks that borrow on capital markets do not reduce their lending at times of high volatility more than other banks, and our result is not driven only by difficulties in financing at dealer-banks during high-volatility periods. However, as is discussed above, difficulty in obtaining external financing is a necessary condition for internal capital markets to have pronounced effects.

5. Conclusion

In this thesis I study the patterns of lending within financial institutions that combine mortgage lending with making markets in securities. In order to address the causality concerns, two exogenous shocks were used. In Section 3.3 it was shown that after the regulatory change of 1996 affected dealer banks reduced their lending and rejected a larger portion of mortgage applications. In Section 4.2 it was demonstrated that during periods of high uncertainty on capital markets, dealer banks have incentives to shift funds away from lending and towards market making because of the higher demand for liquidity provision at such times. The major implication of these findings is that an increase in market making at a commercial bank can reduce loan growth, and that this effect is particularly pronounced during the high volatility periods.

Appendix A. Commercial Banks – Dealers in Securities

This table shows the list of bank holding companies that had established Section 20 subsidiaries to underwrite and deal in securities as of June 30,1995.

	Bank Holding Company Name
1	Banc One Corp.
2	Bank of Boston Corp.
3	Bank South Corp.
4	BankAmerica Corp.
5	Barnett Banks, Inc.
6	Chase Manhattan Corp.
7	Chemical New York Corp.
8	Citicorp
9	CoreStates Financial Corp.
10	Dauphin Deposit Corp.
11	First Chicago Corp.
12	First Interstate Bancorp
13	First of America Bank Corp.
14	First Union Corp.
15	Fleet/Norstar Financial Group, Inc.
16	Huntington Bancshares, Inc.
17	JP Morgan & Co., Inc.
18	Key Corp
19	Mellon Bank Corp.
20	National City Corp.
21	NCNB Corp. (later NationsBank)
22	Norwest Corp.
23	PNC Financial Corp.
24	SouthTrust Banks, Inc.
25	SunTrust Banks, Inc.

Table 1. Summary Statistics for Dealer Banks.

Loan Growth Rate, % is the quarterly growth rates in bank loan balances at dealer banks in 1995–2008. All other bank characteristics are reported as of June 30, 1995. *Credit Losses, %* are charge-offs on loans expressed as a percentage of total loans on bank balance sheet.

	Mean	Median
Loan growth, %	1.07%	1.23%
Total assets, $billion	81.7	66.6
Loans, % total assets	62.3	67.1
Trading assets, % total assets	5.3	0.3
Credit losses, % total loans	0.11	0.11
Deposits, % total assets	57.3	62.3

Table 2. Loan Growth at Dealer Banks after the Regulatory Change I: Difference-in-Difference Tests.

Panel A shows abnormal quarterly growth rates in bank loan balances (in %) at dealer banks four quarters before and after the regulatory changes of July, 1996. Panel B shows abnormal quarterly growth rates in loans to total assets ratios at dealer banks four quarters before and after the regulatory changes of July, 1996. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	Obs.	Mean	Median
Panel A. Abnormal Growth in Loans, %.			
Comparison group: all BHCs			
Before the regulatory change	70	-0.37	-0.13
After the regulatory change	70	-1.40	-1.50
Difference		-1.03**	-1.37**
Comparison group: public BHCs			
Before the regulatory change	70	-0.36	-0.13
After the regulatory change	70	-1.40	-1.32
Difference		-1.04**	-1.19**
Panel B. Abnormal Growth in Loans / Total Assets, %.			
Comparison group: all BHCs			
Before the regulatory change	70	0.89	0.51
After the regulatory change	70	-0.44	-0.54
Difference		-1.34**	-1.05***
Comparison group: public BHCs			
Before the regulatory change	70	0.91	0.59
After the regulatory change	70	-0.37	-0.47
Difference		-1.28**	-1.06**

Table 3. Decline in Loan Growth at Dealer Banks after the Regulatory Change II: Regression Analysis.

This table shows estimates of the coefficients for OLS regressions with quarterly growth rates in bank loan balances (%) as dependent variables. Sample period includes four quarters before and four quarters after the regulatory change of July 1996. *Post 1996* is an indicator variable for four quarters after the regulatory change. *Dealer* is an indicator variable for banks that established Section 20 subsidiaries as of the end of the second quarter of 1995. *Credit Losses, %* are charge-offs on loans expressed as a percentage of total loans on bank balance sheet. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. p-values based on heteroskedasticity-adjusted and clustered by bank standard errors are reported in parenthesis.

	All BHCs		Public BHCs	
	(1)	(2)	(3)	(4)
Post 1996	0.51***	0.58***	0.57***	0.74***
	(0.000)	(0.000)	(0.000)	(0.000)
Post 1996 * dealer	-1.26**	-1.19*	-1.27**	-1.41**
	(0.027)	(0.076)	(0.027)	(0.021)
Log (total assets)	-0.09*	-2.04***	-0.25***	-1.78**
	(0.081)	(0.001)	(0.002)	(0.013)
Credit losses, %	-1.39***	-0.90***	-1.30***	-0.64*
	(0.000)	(0.000)	(0.001)	(0.082)
Deposits, %	-0.02**	0.03	-0.02*	-0.01
	(0.050)	(0.393)	(0.086)	(0.824)
Dealer	-0.15		0.27	
	(0.791)		(0.652)	
Fixed effect	No	Yes	No	Yes
Observations	8,892	8,892	3,146	3,146
R squared	0.021	0.334	0.031	0.367

Table 4. Mortgage Application Denial Rates at Dealer Banks after the Regulatory Change

Panel A shows estimates of the linear probability models and probit models with the dependent variable equal to one if a mortgage application is denied by a bank and to zero if the loan is granted. Panel B reports coefficients of the interaction terms for linear probability models estimated separately for ten US states with the largest population. Control variables are the same as in the specification (2) of Panel A. Sample used in panels A and B includes only public bank holding companies and covers one year before and after the regulatory change of July 1996 (1995 and 1997). Panel C shows estimates of OLS regressions with the bank average mortgage application denial rate as dependent variables. *Post 1996* is an indicator variable for 1997, the year after the regulatory change. *Dealer* is an indicator variable for banks that established Section 20 subsidiaries before 1995. *Credit Losses, %* are charge-offs on loans expressed as a percentage of total loans on bank's balance sheet. *Median Income* is the logarithm of the median household income in a county. *Education* is the percentage of population in the county with high school education. *Minorities* is the percentage of non-white population in a county. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. p-values based on heteroskedasticity-adjusted and clustered by census tract standard errors are reported in parenthesis.

Panel A. Probability of Mortgage Application Denial

	LINEAR PROBABILITY		PROBIT			
	(1)	(2)	(3)	(4)	(5)	(6)
Post 1996	0.00	0.00	0.21***	0.18***	0.03	0.03
	(0.929)	(0.973)	(0.000)	(0.000)	(0.209)	(0.266)
Dealer	-0.38	-0.39	0.21***	0.22***	0.32	0.09
	(0.876)	(0.989)	(0.000)	(0.000)	(0.337)	(0.681)
Post 1996 * dealer	0.06***	0.06***	0.15***	0.10***	0.24***	0.24***
	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)
Log (income)	-0.13***	-0.12***	-0.70***	-0.65***	-0.57***	-0.55***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log (total assets)	0.06***	0.05***	0.01	0.01	0.12	0.10
	(0.004)	(0.010)	(0.445)	(0.338)	(0.119)	(0.198)
Deposits, %	0.54***	0.53***	-1.50***	-1.41***	2.04***	2.05***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Credit losses, %	-0.09***	-0.09***	-0.52***	-0.44***	-0.29***	-0.29***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log (median income)		-0.06***		-0.24***		-0.12**
		(0.000)		(0.000)		(0.023)
Education		0.00*		0.02***		0.01***
		(0.083)		(0.000)		(0.005)
Minorities		-0.00		-0.00		0.00
		(0.734)		(0.870)		(0.456)
Fixed effect	Yes	Yes	No	No	Yes	Yes
Observations	915,982	915,982	915,982	915,982	915,719	915,719
R squared	0.238	0.239	0.155	0.164	0.222	0.223

Panel B. Probability of Mortgage Application Denial for 10 US States

	State	Post 1996 * Dealer	p-value	Observations (Number of applications)	R-squared
1	California	-0.02	(0.521)	54,413	0.090
2	Florida	0.11**	(0.018)	87,911	0.091
3	Georgia	-0.08***	(0.009)	35,595	0.460
4	Illinois	0.14***	(0.000)	19,217	0.111
5	Michigan	0.28***	(0.000)	35,096	0.207
6	New York	0.09***	(0.007)	42,075	0.198
7	North Carolina	0.09*	(0.085)	56,049	0.408
8	Ohio	0.05***	(0.000)	50,867	0.208
9	Pennsylvania	0.10***	(0.000)	41,736	0.188
10	Texas	0.12***	(0.003)	37,839	0.184

Panel C. Determinants of the Bank's Average Mortgage Application Denial Rate

	All BHCs		Public BHCs	
	(1)	(2)	(3)	(4)
Post 1996	-0.01	-0.00	0.01*	0.01**
	(0.127)	(0.497)	(0.087)	(0.036)
Dealer	0.05	0.05	0.03	0.04
	(0.102)	(0.124)	(0.224)	(0.208)
Post 1996 * Dealer	0.09***	0.09***	0.07**	0.07**
	(0.008)	(0.006)	(0.045)	(0.031)
Log(Total Assets)	0.02***	0.02***	0.03***	0.02***
	(0.000)	(0.000)	(0.000)	(0.000)
Deposits, %	0.15**	0.09*	0.21**	0.11
	(0.016)	(0.062)	(0.019)	(0.115)
Credit Losses, %	0.01	0.02*	-0.00	0.00
	(0.209)	(0.090)	(0.883)	(0.579)
Log(Av. Income)		-0.06***		-0.07***
		(0.000)		(0.000)
Fixed Effect	Yes	Yes	Yes	Yes
Observations	1,300	1,300	619	619
R squared	0.106	0.161	0.176	0.239

Table 5. Securitization Rates at Dealer Banks after the Regulatory Change

This table shows estimates of the OLS regressions with average bank securitization rates on mortgage applications as dependent variable. Securitization rate for each bank is defined as the ration of the amount of originated loans that were securitized or sold to the total amount of originated loans. Sample period includes years before and after the regulatory change (1995 and 1997). *Post 1996* is an indicator variable for 1997, the year after the regulatory change. *Dealer* is an indicator variable for banks that established Section 20 subsidiaries before 1995. *Credit Losses, %* are charge-offs on loans expressed as a percentage of total loans on bank's balance sheet. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. p-values based on heteroskedasticity-adjusted and clustered by bank standard errors are reported in parenthesis.

	All BHCs		Public BHCs	
	(1)	(2)	(3)	(4)
Post 1996	1.02	1.02	1.65	1.64
	(0.305)	(0.304)	(0.270)	(0.275)
Dealer	7.01	-0.41	5.89	1.66
	(0.181)	(0.949)	(0.272)	(0.805)
Post 1996 * Dealer	-8.80*	-9.04*	-9.43*	-9.48*
	(0.096)	(0.091)	(0.082)	(0.083)
Log(Total Assets)		1.52*		1.16
		(0.072)		(0.268)
Deposits, %		-2.12		5.39
		(0.859)		(0.678)
Credit Losses, %		1.66		5.78
		(0.614)		(0.331)
Observations	1,195	1,195	570	570
R squared	0.002	0.008	0.003	0.011

Table 6. Trading Returns and Trading Assets of Dealer Banks at High Uncertainty Periods

Panel A shows quarterly risk-adjusted marked-to-market and gross trading returns for dealer banks during high and low VIX periods in 1996–2008. *Marked-to-Market Risk-Adjusted Return,%* is trading revenues per 1$ of trading assets divided by Value at Risk (VaR) per $1 of trading assets. *Total Risk-Adjusted Return, %* is the sum of trading revenues and interest income per $1 of trading assets divided by Value at Risk (VaR) per $1 of trading assets. Panel B shows *Abnormal Trading Assets, %* which are defined as the percentage change in the ratio of trading assets to total assets relative to the bank's average of this ratio over the previous four quarters. *High VIX* is an indicator for the quarters in which average for the quarter daily VIX is in the top 25% or top 20% for the period from the beginning of the VIX series in 1990 until 2008. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	High VIX = Top 25%			High VIX = Top 20%		
	Obs.	Mean	Median	Obs.	Mean	Median
Panel A. Risk-Adjusted Gross Trading Returns						
Marked-to-Market Risk-Adjusted Returns, %						
High VIX	127	4.71	3.19	103	4.55	3.25
Low VIX	215	3.51	2.45	239	3.71	2.59
Difference		1.20**	0.74**		0.84*	0.66*
Total Risk-Adjusted Returns, %						
High VIX	127	7.64	6.70	102	7.49	6.63
Low VIX	215	6.23	4.43	240	6.44	4.77
Difference		1.42***	2.27***		1.05*	1.86**
Panel B. Abnormal Trading Assets, %						
High VIX	196	17.22	8.66	160	18.34	8.53
Low VIX	357	7.25	1.65	393	7.71	2.07
Difference		9.97***	7.01***		10.63***	6.46***

Table 7. Lending by Dealer Banks at High Uncertainty Periods: Difference-in-Difference Tests

This table shows abnormal quarterly growth rates in bank loan balances (%) at dealer banks during high and low VIX periods in 1996-2008. As a comparison group of banks all non-dealer BHCs and public non-dealer BHCs are used. *High VIX* is an indicator for the quarters in which the average for the quarter daily VIX is in the top 25% for the period from the beginning of the VIX series in 1990 until 2008. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

		All BHCs			Public BHCs		
		Obs.	Mean	Median	Obs.	Mean	Median
Total loans							
	High VIX	193	-1.55	-1.39	193	-1.60	-1.44
	Low VIX	369	-1.00	-0.93	369	-0.98	-0.87
	Difference		-0.55***	-0.46***		-0.62***	-0.57***
C&I loans							
	High VIX	204	-1.73	-1.69	204	-1.83	-1.90
	Low VIX	358	-0.91	-0.83	358	-1.15	-0.92
	Difference		-0.82**	-0.87***		-0.69**	-0.98**
Real estate loans							
	High VIX	186	-1.71	-1.69	184	-1.69	-1.63
	Low VIX	376	-0.99	-0.81	378	-0.90	-0.87
	Difference		-0.72***	-0.88***		-0.79***	-0.76***
Residential mortgages							
	High VIX	183	-0.73	-0.55	183	-0.52	-0.29
	Low VIX	379	0.11	0.15	379	0.32	0.36
	Difference		-0.84**	-0.70*		-0.84**	-0.64*
Consumer loans							
	High VIX	194	0.70	0.52	194	0.66	0.34
	Low VIX	368	-0.1	0.27	368	-0.11	0.39
	Difference		0.80*	0.24		0.77*	-0.05

Table 8. Lending by Dealer Banks at High Uncertainty Periods: Multivariate Analysis

This table shows estimates of the OLS regressions with quarterly growth rate in loan balances as dependent variable. The sample period is 1996–2008. *High VIX* is an indicator for the quarters in which average for the quarter daily VIX is in the top 25% for the period from the beginning of the VIX series in 1990 until 2008. *Dealer* is an indicator variable for banks that established Section 20 subsidiaries before 1995. *Deposits, %* are deposits expressed as a percentage of total assets. *Credit Losses, %* are charge-offs on loans expressed as a percentage of total loans on bank's balance sheet. *Tier 1 Capital, %* is the amount of Tier 1 capital scaled by risk-weighted assets. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. p-values based on heteroskedasticity-adjusted standard errors are reported in parenthesis.

	All BHCs		Public BHCs	
	(1)	(2)	(3)	(4)
High VIX	-0.30***	-0.33***	-0.19***	-0.27***
	(0.000)	(0.000)	(0.001)	(0.000)
High VIX * dealer	-0.58**	-0.60**	-0.62**	-0.68**
	(0.040)	(0.030)	(0.033)	(0.015)
Dealer	-0.50***		0.40**	
	(0.005)		(0.038)	
Log (total assets)	-0.13***	-1.82***	-0.44***	-1.86***
	(0.000)	(0.000)	(0.000)	(0.000)
Deposits, %	-0.003	-0.01**	-0.02***	-0.03***
	(0.128)	(0.014)	(0.000)	(0.000)
Credit losses, %	-1.33***	-2.09***	-2.69***	-2.71***
	(0.000)	(0.000)	(0.000)	(0.000)
Tier 1 Capital, %	-0.0004	-0.0001	-0.05***	-0.10***
	(0.285)	(0.420)	(0.000)	(0.000)
Fixed effect	No	Yes	No	Yes
Observations	72,631	72,631	18,849	18,849
R squared	0.013	0.216	0.048	0.246

Table 9. Lending by Dealer Banks: Recessions and Funding Type

This table shows estimates of the OLS regressions with quarterly growth rate in loan balances (in %) as dependent variable. The sample includes public BHCs only. The sample period is 1996–2008. *High VIX* is an indicator variable for the quarters when the level of VIX was in the top 25% for the period from the beginning of the VIX series in 1990 until 2008. *NBER Recession* is an indicator for Q2-Q4, 2001 and Q1-Q4, 2008. *Dealer* is an indicator variable for banks that established Section 20 subsidiaries as of the end of the second quarter of 1995. *Deposits, %* are deposits expressed as a percentage of total assets. *Nondeposit Borrowing, %* is the amount of non-deposit borrowing by a bank scaled by the total assets. *Credit Losses, %* are charge-offs on loans expressed as a percentage of total loans on bank's balance sheet. *Tier 1 Capital, %* is the amount of Tier 1 capital scaled by risk-weighted assets. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. p-values based on heteroskedasticity-adjusted standard errors are reported in parenthesis.

	(1)	(2)	(3)	(4)
High VIX	-0.27***	-0.17***	-0.58	-0.35***
	(0.000)	(0.006)	(0.215)	(0.000)
NBER recession		-0.35***		
		(0.000)		
High VIX * dealer	-0.68**	-0.65**	-0.57*	-0.71**
	(0.015)	(0.036)	(0.071)	(0.013)
NBER recession * dealer		-0.17		
		(0.674)		
Deposits, %	-0.03***	-0.03***	-0.03***	
	(0.000)	(0.000)	(0.000)	
High VIX * deposits			0.00	
			(0.491)	
Nondeposit borrowing, %				0.08***
				(0.000)
High VIX * nondeposit borrowing				0.01
				(0.468)
Log (total assets)	-1.86***	-1.80***	-1.87***	-1.97***
	(0.000)	(0.000)	(0.000)	(0.000)
Credit losses, %	-2.71***	-2.63***	-2.70***	-2.68***
	(0.000)	(0.000)	(0.000)	(0.000)
Tier 1 capital, %	-0.10***	-0.10***	-0.10***	-0.08***
	(0.000)	(0.000)	(0.000)	(0.000)
Fixed effects	Yes	Yes	Yes	Yes
Observations	18,849	18,849	18,849	18,767
R squared	0.246	0.247	0.246	0.253

Table 10. Which types of borrowers get reduction in credit availability?

Panel A shows estimates of the linear probability models and probit models with the dependent variable equal to one if a mortgage application is denied by a bank and to zero if the loan is granted. Sample includes only public bank holding companies and covers one year before and after the regulatory change of July 1996 (1995 and 1997). *Post 1996* is an indicator variable for 1997, the year after the regulatory change. *Dealer* is an indicator variable for banks that established Section 20 subsidiaries before 1995. *Log (Total Assets)* is the natural logarithm of the applicant's income. *Credit Losses, %* are charge-offs on loans expressed as a percentage of total loans on bank's balance sheet. *Median Income* is the logarithm of the median household income in a county. *Education* is the percentage of population in the county with high school being the highest level of education. *Minorities* is the percentage of non-white population in a county. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. p-values based on heteroskedasticity-adjusted and clustered by census tract standard errors are reported in parenthesis.

Panel A. Probability of Mortgage Application Denial (borrowers with high income)

	LINEAR PROBABILITY		PROBIT			
	(1)	(2)	(3)	(4)	(5)	(6)
Dealer	-0.15	-0.14	0.18***	0.19***	-0.13	-0.20
	(0.982)	(0.981)	(0.000)	(0.000)	(0.499)	(0.279)
Post 1996	-0.01**	-0.01**	0.12***	0.09***	-0.05	-0.05
	(0.027)	(0.023)	(0.000)	(0.000)	(0.132)	(0.130)
Post 1996 * dealer	0.04***	0.04***	-0.06	-0.08**	0.19***	0.20***
	(0.000)	(0.000)	(0.123)	(0.022)	(0.000)	(0.000)
Log (income)	-0.05***	-0.05***	-0.38***	-0.35***	-0.34***	-0.32***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log (total Assets)	0.08***	0.07***	0.04***	0.04***	0.34***	0.29***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)
Deposits, %	0.36***	0.35***	-1.19***	-1.19***	1.91***	1.89***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Credit Losses, %	-0.06***	-0.06***	-0.21***	-0.16***	-0.24***	-0.24***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(Median Income)		-0.06***		-0.22***		-0.26***
		(0.000)		(0.000)		(0.000)
Education		0.00**		0.03***		0.01***
		(0.013)		(0.000)		(0.001)
Minorities		-0.00		-0.00		-0.00
		(0.315)		(0.614)		(0.659)
Fixed effects	Yes	Yes	No	No	Yes	Yes
Observations	468,793	468,793	468,793	468,793	468,056	468,056
R squared	0.090	0.092	0.0515	0.0616	0.109	0.112

Panel B. Probability of Mortgage Application Denial (borrowers with low income)

	LINEAR PROBABILITY		PROBIT			
	(1)	(2)	(3)	(4)	(5)	(6)
Dealer	0.17	0.17	0.22***	0.22***	0.54	0.61*
	(0.999)	(0.997)	(0.000)	(0.000)	(0.105)	(0.071)
Post 1996	0.03***	0.03***	0.26***	0.24***	0.09***	0.09***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Post 1996 * dealer	0.08***	0.08***	0.26***	0.20***	0.24***	0.24***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log (income)	-0.20***	-0.20***	-0.77***	-0.72***	-0.63***	-0.62***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log (total assets)	-0.03	-0.03	-0.01	-0.00	-0.08	-0.08
	(0.289)	(0.299)	(0.405)	(0.724)	(0.271)	(0.293)
Deposits, %	0.67***	0.68***	-1.63***	-1.51***	2.16***	2.20***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Credit Losses, %	-0.06***	-0.06***	-0.71***	-0.64***	-0.22***	-0.22***
	(0.006)	(0.007)	(0.000)	(0.000)	(0.002)	(0.002)
Log(Median Income)		0.02		-0.21***		0.07
		(0.247)		(0.002)		(0.237)
Education		0.00***		0.02***		0.01***
		(0.002)		(0.000)		(0.001)
Minorities		0.00*		-0.00		0.00**
		(0.084)		(0.581)		(0.040)
Fixed effects	Yes	Yes	No	No	Yes	Yes
Observations	447,189	447,189	447,189	447,189	447,105	447,105
R squared	0.226	0.227	0.106	0.113	0.183	0.183

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