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The Real Consequences of Bank Mortgage Lending Standards

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Abstract

Bank loan underwriting standards are key determinants of credit availability. To better understand what happens when bank loan officers change standards, we match responses from the Federal Reserve's Senior Loan Officer Opinion Survey (SLOOS) with mortgage application information from the Home Mortgage Disclosure Act (HMDA) over the period from 1990 to 2013. HMDA data contain both accepted and denied applications, allowing us to observe changes in denial rates when loan officers report changing standards. Reports of tightened standards are associated with an increase of about 1 percentage point in denial rates (conditioning on changes in macroeconomic conditions and borrower credit quality), implying a reduction in aggregate mortgage credit of about $690 million per quarter. Reports of easing standards, though less frequent over that period, are associated with a 1 percentage point decline in denial rates. Denial rate changes are larger for banks that hold most of their mortgages on portfolio (rather than securitizing them). Tighter standards are associated with about 16 percent fewer high interest rate loans (a proxy for riskier loans). Applications rise at banks that report strengthening demand for mortgage loans. Metropolitan statistical areas (MSAs) that have more exposure to SLOOS banks that have tightened standards have much lower delinquency rates two years following the tightening—suggesting that standards are an important determinant of the credit quality of bank loan portfolios. House prices also fall in MSAs that have exposure to SLOOS banks that report tightening.

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1 Introduction

Researchers have long examined the extent to which commercial banks are a source of and propagation mechanism for macroeconomic shocks.[1] Recently, this topic has become particularly important, as excessively easy underwriting standards on residential real estate loans have been implicated as a major cause of the financial crisis. Understanding how bank loan underwriting standards affect real outcomes in loan markets and the macroeconomy more broadly is thus of considerable interest.

One source of information on bank loan underwriting policies is the Federal Reserve's quarterly Senior Loan Officer Opinion Survey (SLOOS). The survey, which has been conducted since the 1960s and has consistent questions available since the early 1990s, asks bank loan officers to indicate how they have changed underwriting standards and terms on major types of business and household loans. This paper is the first to match the (confidential) individual bank responses from the SLOOS with mortgage application information from the Home Mortgage Disclosure Act (HMDA). HMDA data contain information on applications that were denied as well as those that were accepted; thus, we can observe changes in denial rates—an important margin by which changes in credit standards can have an effect on potential borrowers. We can also observe changes in the amounts for approved loans and match those to reports on changes in loan terms. We match the data over a period from 1990 until 2013, yielding about 4,600 bank-quarter observations. Other authors (for example, Lown and Morgan (2006) and Bassett et al. (2014)) have found that SLOOS responses have predictive power for macroeconomic activity. By establishing what happens in the mortgage market when SLOOS respondents report having changed standards or terms, we provide quantitative estimates of how changes in standards contribute to changes in the macroeconomy.

Estimating the relationship between standards and these outcome variables is confounded

[1] See, for example, King (1986), Bernanke and Blinder (1988), Romer and Romer (1990), Bernanke and Lown (1991), Gertler and Gilchrist (1993), Kashyap and Stein (1994, 2000), Peek and Rosengren (1995a,b, 2000), Driscoll (2004), Ashcraft (2005), and Gilchrist and Zakrajšek (2012).

by two endogeneity problems. First, potential applicants may choose to not apply when they perceive that lending standards have tightened. This may be why denial rates are not highly countercyclical. Second, the pool of potential applicants for a specific bank may change in credit quality due to changes in standards by other banks or to changes in local or macroeconomic factors.

We address these problems in two ways. First, we include both national and local measures of macroeconomic conditions. Second, we include characteristics of the borrower pool to control for changes in credit quality.

We find that a loan officer's report of tightening standards is associated with an increase of about 1 percentage point in that bank's mortgage loan denial rate. This corresponds to an aggregate reduction in mortgage credit from banks of about $690 million per quarter just through the direct channel of denial rates. Reports of easing standards, though less frequent over our sample period, are associated with a 1 percentage point decline in denial rates.

Because securitization reduces the screening incentives of originators, we test if securitization changes the relationship between changes in standards and denial rates. We find that the effects on denial rates are larger at banks that hold their loans on portfolio, rather than securitizing them. This is consistent with this reduced screening incentive.

We also test the effects on the dollars of mortgage credit extended. We estimate that mortgage credit falls by about 5 percent when standards tighten and rises by about 4 percent when demand for such credit strengthens.

Because we expect standards to have a greater effect on marginal borrowers, we separately test the effect of changes in standards on that population. In particular, we analyze high interest rate loans—a proxy for subprime and other nontraditional mortgages. We find that such loans fall significantly, about 16 percent, when SLOOS banks report tightening.

With regard to questions on changes in demand, applications at SLOOS banks rise when the latter report increases in demand. In contrast, reports of changes in demand have a much smaller or insignificant relationship with denial rates. Similarly, changes in standards

have little effect on the volume of applications.

We look at the relationship between changes in standards and loan performance. We find that MSAs that have more exposure to SLOOS banks that tightened standards have much lower delinquency rates two years following the tightening. This suggests that when banks tighten standards they are successful in not extending credit to borrowers who will have trouble repaying their debts. It also suggests that SLOOS credit standards are a leading indicator of financial industry vulnerability to shocks.

Finally, we look at the impact of bank lending standards on local housing markets. We find that, in MSAs with more exposure to SLOOS banks that have tightened standards, house prices decline—as one would expect from the decline in approved mortgages in such areas.

The rest of the paper proceeds as follows: the next section reviews related literature; section 3 provides details on the data and empirical strategy; section 4 provides results; and section 5 concludes.

2 Related Literature

Although the Federal Reserve has conducted the SLOOS since 1966, much of the research on the behavior of loan officers is comparatively recent, in part because it is only since 1990 that the survey has consistently asked about changes in lending policies across credit products. Schreft and Owens (1991) provides a history of the early SLOOS and the general methodology that persists to the present. One line of research has used this data to explore bank-loan officer agency problems. Udell (1989) shows that loan review serves to reduce these problems. Stein (2002) argues that agency problems in part depend on the degree to which the loan relies on soft information. This is in agreement with the empirical findings of Berger et al. (2005), Liberti and Mian (2009), and Agarwal and Hauswald (2010). Heider and Inderst (2012) develop an optimal contracting model for loan officers. Agarwal and

Ben-David (1991), Berg et al. (2013), Berg et al. (2014) and Cole et al. (2013) examine loan officers' incentives, the latter using a laboratory experiment. Wang (2015) estimates that heterogeneity in risk preferences, screening ability, and belief about screening ability by loan officers appear to distort loan officer behavior.

A smaller body of work has looked at the macroeconomic impact of loan officer behavior by using the SLOOS, including Lown et al. (2000), Lown and Morgan (2006), Cunningham (2006), and Bassett et al. (2014). That literature generally finds that changes in SLOOS standards have predictive power for subsequent movements in both banking variables such as loans and macroeconomic variables such as GDP. However, in principle, this could be because loan officers are well-informed or because they have a significant impact given the critical role of banks in the economy.

Our paper is most closely related to Bassett et al. (2014) and Cunningham (2006) which try to distinguish these informational and causal channels. Bassett et al. (2014) exploit bank level shifts in the supply of business loans to confirm that "adjusted changes in banks' lending standards capture shifts in business loan supply." Cunningham (2006) finds that growth in aggregate real estate loans is not well predicted by SLOOS standards responses. This suggests that loan officers responding to the survey are simply commenting on market conditions rather than signaling changes in their own credit decisions. Our results contrast sharply with Cunningham (2006). We find that standards and demand measures both have a statistically and economically important effect on credit extension. In fact, the effects of changes in standards are larger than those from changes in demand. One key reason for the different results is we can match bank responses to bank changes in credit, which gives us much greater statistical power and additionally allows for inter-bank effects. The two earlier papers use "net percentage of respondents reporting tightening standards," a measure that treats all banks as changing standards identically. This is a problem if, for example, in a two-bank market one eases and the other tightens standards. The net percentage in this market is zero, but overall credit may increase as the easing lender attracts new borrowers

as well as cast-off applicants from the tightening lender.

Also closely related to our work is Del Giovane et al. (2011) which uses data from the Eurosystem Bank Lending Survey to study supply and demand shifts in lending to enterprises in Italy. However, they cannot externally validate that the survey responses are actually shifts in supply and demand. In contrast, because we can study mortgage applications distinctly from approved mortgage quantities, we validate that change in demand does drive applications and can be treated as a shift in the demand curve.

3 Data and Empirical Strategy

3.1 Data

3.1.1 The Senior Loan Officer Opinion Survey (SLOOS)

The Federal Reserve's Senior Loan Officer Opinion Survey on Bank Lending Practices has polled banks about changes in their lending standards for major categories of loans to households and businesses since 1990:Q2 and about changes in demand for those loan categories since 1990:Q3. The survey is usually conducted quarterly by the Federal Reserve Board, and for the majority of our sample, nearly 60 U.S. commercial banks participate in each survey.[2] The survey panel of domestic banks spans all Federal Reserve Districts, while balancing the need to keep it heavily weighted toward large banks. The primary cause of sample attrition is the acquisition of a respondent bank by another bank that already participates in the survey. Thus, nonresponse selection bias in the respondents is likely to be limited.

Banks are asked to report whether they have changed their standards during the survey

[2]While the survey has been conducted since 1966, questions have been consistently asked only since 1990. However, the demand question was not asked in 1991:Q2. Up to 24 U.S. branches and agencies of foreign banks also participate in the survey, though they do not answer questions about residential real estate loans, as such loans are generally not a large part of their business. The survey is voluntary, but banks that are asked to participate in the survey almost always agree to do so. In 2012, the domestic panel (covering all Federal Reserve Districts) was expanded to allow up to 80 banks and represented about 70 percent of total assets at domestically chartered institutions. For more information on the survey, see www.federalreserve.gov/boarddocs/SnLoanSurvey.

period (i.e., over the previous three months) on seven categories of core loans: commercial and industrial, commercial real estate, residential mortgages to purchase homes, home equity lines of credit, credit cards, auto, and consumer loans other than credit cards or auto loans. They also are asked about changes in demand for these categories. For this paper, we use only answers about residential mortgage loans because no comparable application data exist for any of these other categories.[3]

The question about changes in standards is,

> "Over the past three months, how have your bank's credit standards for approving applications from individuals for mortgage loans to purchase homes changed?"[4]

Similarly, the question about changes in demand is,

> "Apart from normal seasonal variation, how has demand for mortgages to purchase homes changed over the past three months? (Please consider only applications for new originations as opposed to applications for refinancing of existing mortgages.)"[5]

Banks are asked to answer both questions using a five-point scale. In the case of standards, the scale is: 1="eased considerably"; 2="eased somewhat"; 3="about unchanged"; 4="tightened somewhat"; and 5="tightened considerably." For demand, "eased" and "tightened" are replaced with "strengthened" and "weakened," respectively.

As banks historically have been extremely unlikely to characterize their changes in standards or demand as having changed "considerably," we use only two classifications for those

[3]Starting with the April 2007 survey, the respondents were asked about changes in standards and demand on residential mortgages by type of mortgage product (prime, nontraditional, or subprime). In constructing our series, we combine responses across mortgage types as follows. We code each of the three loan types as -1, 0, or 1, for easing, unchanged, or tightening, respectively. We sum across loan types. If the sum is ≤ -1, then aggregate series $= -1$. If the sum is zero, then we code the aggregate series as $= 0$. If the sum is ≥ 1, then the aggregate series $= 1$.

[4]See, for example, question 24 of the Senior Loan Officer Opinion Survey on Bank Lending Practices, April 2016 Edition, https://www.federalreserve.gov/boarddocs/snloansurvey/201605/table1.htm, accessed on 5/3/2016.

[5]Ibid, Question 25. The order and numbering of the questions changes from survey to survey but the text does not.

variables, rather than the five possible answers available to survey respondents: a dummy variable for whether standards have eased considerably or somewhat; and a dummy variable for whether they have tightened considerably or somewhat (and similarly for demand).

Figure 1 plots two summary measures of changes in standards and demand over the sample period. For the change in standards series (top panel), the bars show the fraction of respondents reporting they have tightened standards (blue bars) as well as the fraction reporting that they have eased standards (red bars). For the change in demand series (bottom panel), the bars show the fraction of respondents reporting they have seen stronger demand (blue bars) and the fraction reporting that they have seen weaker demand (red bars). The resulting series match prevailing narrative accounts of the period. For example, the standards series shows net easings for much of the early 2000s during the real estate boom, followed by tightenings preceding and during the recession of 2007-2009. The data also show several episodes when a significant number of banks were easing and tightening standards contemporaneously.

3.1.2 The Home Mortgage Disclosure Act (HMDA)

The Home Mortgage Disclosure Act of 1975 is a disclosure law for mortgages and mortgage applications. Most banks, savings and loan associations, credit unions, and consumer finance companies are required to report under HMDA. Avery et al. (2007) estimate that the more than 8,900 lenders then covered by the law accounted for approximately 80 percent of all home lending nationwide in 2006.[6]HMDA requires lenders to collect and publicly disclose information on housing-related applications. The mandatory reporting threshold for depository institutions has changed slightly over time, but includes almost all commercial banks that originate mortgage loans. The threshold for data collection in 2015 was $44 million in total assets.[7] Any bank with assets above the threshold, with a branch in an MSA,

[6]Avery et al. (2007) provide an extensive discussion of HMDA data. The FFIEC website also provides a history: www.ffiec.gov/hmda/history2.htm.

[7]Domestic banks participating in the SLOOS must have at least $3 Billion in assets so this threshold does not eliminate any banks. See Supporting Statement for the Senior Loan Officer Opin-

and that originated at least one mortgage loan in the calendar year must file a HMDA report.[8] The Federal Reserve Board had rulemaking authority over the reporting form until mid-2011. After that, rulemaking authority passed to the Consumer Financial Protection Bureau (CFPB).

We match HMDA applications and SLOOS responses at the bank level for the period between 1990 and 2013. In addition, HMDA respondents owned by a bank holding company (BHC) are linked to the largest commercial bank ("lead bank") within that organization. These lead banks are often SLOOS respondents. Because the SLOOS sample is somewhat limited in size (60 banks), respondents are generally selected as the largest banking subsidiary in a BHC without duplicates in the same BHC.[9]

The action date on the HMDA form is used to link an application to a specific quarter.[10] For each bank-quarter, the denial rate is calculated using only home purchase loan applications.[11] To stay in the testing panel, a bank observation must have at least 30 purchase applications in both the current quarter and the prior quarter. In addition, a bank must have at least four quarters of testable data. The main testing panel averages 49 banks per quarter.[12]

Figure 2 plots quartiles of the denial rate for our SLOOS panel of banks. Although the

ion Survey on Bank Lending Practices (FR 2018; OMB No. 7100–0058), Federal Reserve Board, http://www.federalreserve.gov/boarddocs/SnLoanSurvey/about.htm, Accessed May 3, 2016.

[8]For details of the filing requirements see Home Mortgage Disclosure Act Examination Procedures, Federal Reserve Board, https://www.federalreserve.gov/boarddocs/caletters/2009/0910/09-10_attachment.pdf, accessed on May 3, 2016.

[9]It is believed that the standards and practices of loan officers are generally similar for banks that operate within the same BHC.

[10]We use a confidential version of HMDA that includes the action date, unlike in the publicly available data, which shows only the year a loan occurred. The action date is the closing date for originated loans, the withdrawal date for loans approved but withdrawn by the potential borrower, and the denial date for denied loans.

[11]We exclude refinance and home improvement loans to match the SLOOS mortgage question. Other exclusions from the HMDA applications include: multifamily, manufactured housing, pre-approvals, and non-owner-occupied housing.

[12]While the SLOOS has approval to survey up to 60 banks per quarter for most of the time frame studied, on average, 57.3 banks responded between 1990:Q3 and 2013:Q4. Of those, 4.2 banks did not answer the mortgage questions. Banks generally do not answer questions about loan types that are not core to their business model. Other decreases in observations are primarily due to the purchase application and four-quarter requirements. Recall that several banks were added in 2012.

rate is, as expected, countercyclical, it does not vary much over time; the median is generally between 10 percent and 15 percent for much of the sample.

The only borrower credit characteristic in HMDA is reported income. We use this and loan size to calculate a loan-to-income (LTI) ratio for each application. We then divide the applications into LTI ratio buckets based on LTI quintile thresholds in 2002 (the sample midpoint). There is also a missing LTI category for the relatively small number of applications without reported income. We use the shares for each category as explanatory variables (dropping the largest for collinearity) to control for changes in borrower characteristics of a bank's applicant pool. In principle, a higher LTI ratio should indicate a riskier application, although several authors have raised concerns about the accuracy of reported income in HMDA applications (e.g., Avery et al. (2011) and Mian and Sufi (2015)). Furthermore, this ratio is limited in scope as it does not capture other debt the applicant may have (e.g., student loans and credit cards). In general, unobservable credit characteristics may be negatively correlated with observable ones conditional on application amount; high down payment and high FICO score borrowers can expect to successfully borrow larger amounts conditional on income.

For more information about the credit quality of a bank's borrower pool, we use data from Lender Processing Services (LPS) Applied Analytics (formerly known as McDash Analytics). These data consist of mortgage loans currently being serviced by some of the nation's largest servicers. Loans in LPS represent approximately two-thirds all serviced residential mortgages. The data include updated FICO scores of the borrower and the current delinquency status of the loan. Licensing restrictions prohibit the triple merge of LPS-HMDA-SLOOS because the bank would be identifiable to the authors. As an alternative, we use geographic data in HMDA and LPS to build borrower controls and to test MSA-level outcomes. Because LPS data has improved coverage in later years, regressions using these data are confined to the period 2005 to 2013.

Table 1 presents summary statistics for the testing panel. As shown in figure 1, reports

of tightening occur over two times more often than reports of easing (mean value of 0.11 versus 0.04 on the dummy variables). Reports of strengthening demand occur about as often as reports of weakening demand (mean value of 0.27 versus 0.29 on the dummy variables). Figure 1 shows that banks have a strong common component to their changes in standards and more heterogeneous experiences in borrower credit demand.

3.2 Empirical Strategy

3.2.1 Estimating the Impact of Changes in Underwriting Policies

A mortgage is a multidimensional product, consisting of, at a minimum, a loan amount, an interest rate, and a maturity date. These features are usually contingent on a variety of borrower and loan characteristics of which a non-exhaustive list includes: credit scores, the total debt-to-income (DTI) ratio, and the loan to (property) value (LTV) ratio.

Loan officers thus have many margins to change standards and terms. A tightening in standards, for example, may simultaneously involve an increase in credit scores and down payment percentages, and decreases in DTI and LTV that are required to qualify for specific combinations of loan amounts, interest rates, and maturity dates. The SLOOS provides a univariate measure of changes in lending standards that might encompass one or more changes in these components of lending policies.

In our main analysis, we primarily look at the effects of this univariate measure on the fraction of applications not approved—the denial rate—for each SLOOS bank. Because the SLOOS responses measure *changes* in standards, our main specifications use *changes* in denial rates. In particular, we estimate the changes in denial rates that are associated with banks' changes in standards.

We also report additional results on changes in the total quantity of mortgage credit extended. This quantity is a less pure measure of the impact of changes in credit standards than denial rates because mortgage credit is also affected by changes in demand. However, we control for demand by including answers to the SLOOS questions on changes in demand.

3.2.2 Potential Endogeneity Problems

There are at least two potential endogeneity problems that may confound our ability to estimate the relationship between changes in denial rates and reported changes in lending standards on the SLOOS.

First, changes in the applicant pool may respond to potential applicants' perceptions of changes in banks' standards. For example, when banks tighten standards, potential borrowers with lower credit scores may disproportionately choose not to apply because they believe they no longer qualify. This could leave denial rates on those applicants who do apply unchanged in response to the tightening in standards. Indeed, despite the severity of the financial crisis, denial rates on mortgage loans rose only a few percentage points (as seen in figure 2).

To the extent this issue is problematic, we would also expect to see the volume of applications rise when SLOOS banks report easings and fall when they report tightenings.[13] Figure 3 plots year-over-year growth in applications at a quarterly frequency (done to control for seasonality) against the net percentage tightening series.[14] Consistent with this endogenous application process, the two series are negatively correlated, though the correlation is much smaller in the earlier part of the sample when variation in changes in standards is much smaller.

Second, changes in local or national macroeconomic conditions could lead to changes in underwriting policy standards and changes in borrower credit quality (and thus denial rates). For example, a recession might lead to a lower-credit-quality applicant pool, higher denial rates, and tighter standards.

Both of these problems predict changes in the quality of the applicant pool, but in opposite directions: the first problem predicts a smaller overall pool, but one of higher quality, while the second predicts a lower-quality pool. Since both problems involve changes

[13] We assume here that potential borrowers are aware that banks, generically, are changing standards, but not that a particular bank they are considering applying to is changing standards while another bank is not.

[14] Net percent tightening equals percent tightening minus percent easing, which are each plotted in figure 1.

in credit quality of either actual applicants or the pool of potential applicants, we attempt to control for them by including measures of borrower credit quality as additional explanatory variables. One crude measure available in our HMDA sample is the LTI ratio. For regressions in which the amount of mortgage credit extended is the dependent variable, we use income shares as control variables.

3.2.3 Measuring Changes in Demand

The SLOOS also asks about changes in loan demand. We can thus estimate the relationship between this qualitative response and changes in mortgage loan applications. We do so using the same controls as for the change in standards specification.

3.2.4 Model Specification

Given the above discussion, our main specification for the changes in standards is:

$$\begin{aligned} \Delta DR_{i,t} &= \alpha_i + \beta_1 Tighten_{i,t} + \beta_2 Ease_{i,t} + \beta_3 Stronger_{i,t} + \beta_4 Weaker_{i,t} \\ &\quad + \sum_{j=5}^{9} \beta_j \Delta LTI_{i,t} + \gamma \text{ macro controls}_t \\ &\quad + \phi \text{ quarter dummies}_t + \epsilon_{i,t}, \end{aligned} \tag{1}$$

where

$$\begin{aligned} \Delta DR_{i,t} &= \text{change in denial rate} \\ \alpha_i &= \text{SLOOS bank fixed effect} \\ Tighten_{i,t}, Ease_{i,t} &= \text{dummy variables for standards (unchanged is the omitted variable)} \\ Stronger_{i,t}, Weaker_{i,t} &= \text{dummy variables for demand (unchanged is the omitted variable)} \\ LTI_{i,t} &= \text{vector of loan-to-income share buckets} \\ \text{macro controls} &= \text{real GDP growth, change in market unemployment rate, and} \\ \epsilon_{i,t} &= \text{error term.} \end{aligned}$$

Our specification for the quantity of mortgage credit extended is:

$$\begin{aligned}\Delta M_{i,t} &= \alpha_i + \beta_1 Tighten_{i,t} + \beta_2 Ease_{i,t} + \beta_3 Stronger_{i,t} + \beta_4 Weaker_{i,t} \\ &\quad + \sum_{j=5}^{10} \beta_j \Delta I_{i,t} + \gamma \text{ macro controls}_t + \phi \text{ quarter dummies}_t + \epsilon_{i,t}, \end{aligned} \tag{2}$$

where

$$\begin{aligned}\Delta M_{i,t} &= \text{change in log of mortgage credit extended, and} \\ I_{i,t} &= \text{vector of income share buckets.}\end{aligned}$$

And our main specification for changes in demand is:

$$\begin{aligned}\Delta App_{i,t} &= \alpha_i + \beta_1 Tighten_{i,t} + \beta_2 Ease_{i,t} + \beta_3 Stronger_{i,t} + \beta_4 Weaker_{i,t} \\ &\quad + \gamma \text{ macro controls}_t + \phi \text{ quarter dummies}_t + \epsilon_{i,t}, \end{aligned} \tag{3}$$

where

$$\Delta App_{i,t} = \text{change in log of applications (number).}$$

4 Results

In this section, we first present our principal results on the impact of changes in standards on changes in loan denial rates. We then report on how these results vary by differences in bank policies—propensity to securitize mortgage loans—and in applicant risk characteristics—

variations across loan-to-income levels or approved applications for high interest rate loans. We estimate the amounts by which the total dollar amount of credit and the volume of applications change with reports of changes in standards or demand for loans. Finally, we examine the consequences of changes in standards for the performance of the portfolio.

4.1 Principal Results on Changes in Standards

Table 2 presents the results of estimating equation (1) with different combinations of explanatory variables. The first column shows the results simply using all of the SLOOS dummy variables. In the absence of other controls, tightenings in standards are associated with an increase in denial rates of about 1 percentage point, statistically significant at a 99 percent level of confidence.[15] The easing dummy shows about the same economic effect in the opposite direction and is significant at a 95 percent level of confidence. The demand variables are not statistically different from zero.

Column (2) adds in the quarter dummies. The coefficient on the tightening dummy lowers slightly, but the results generally hold. Controlling for macroeconomic variables—real GDP growth and the market unemployment rate for the MSAs where a bank operates, column (3)—has little further effect on the coefficients on both the tightening and easing dummies.[16]

Column (4) presents the results of including proxies for changes in borrower credit quality—changes in LTI shares. The inclusion of these additional variables slightly increases the coefficient on the tightening dummy and slightly decreases the coefficient on the easing coefficient. The statistical significance of the easing dummy is also weakened. The relatively imprecise measurement of the coefficient on the easing dummy is likely due to the relatively few reports of easing. However, these results overall suggest that a reported tightening of standards is associated with an increase in a bank's denial rate of 1 percentage point,

[15]Standard errors are robust to autocorrelation, heteroskedasticity, and spatial correlations, using the method of Driscoll and Kraay (1998).

[16]The market unemployment rate for a bank equals an MSA-weighted unemployment rate, where MSA weights are the share of applications received by the bank from an MSA. Weights are updated quarterly. In alternative specifications, we add expected changes in both of these variables from the Blue Chip Surveys. Their inclusion does not change the estimates on the tightening and easing dummies.

and a reported easing of standards is associated with a decrease of a bank's denial rate of 1 percentage point.

4.1.1 Economic Significance

The estimates in table 2 suggest that tightenings result in changes in denial rates of about 1 percentage point. One way of computing the economic significance of this result is to calculate the reduction in mortgage credit extended by banks in response to a tightening. In 2013, all banks that are HMDA filers received on average 442,000 purchase applications per quarter. Thus, a 1 percentage point increase in denial rates results in a decline in approved applications of about 4,420. The median loan amount was $177,000. In the worst tightening phase of the SLOOS survey, 88 percent of banks reported tightening. Using a similar percent for the whole bank market corresponds to an aggregate reduction in mortgage credit of about $690 million in one quarter purely through the channel of higher denial rates.

4.1.2 Comparison with Aggregate Results

For reasons of confidentiality, the bank-level SLOOS responses used in this paper are not publicly available. However, the public release for the survey contains aggregate statistics on changes in lending standards (through the total number of banks reporting tightening and easing standards) and changes in loan demand (through the total number of banks reporting having seen strengthening or weakening demand). We use these data to perform an exercise similar to table 2. This exercise shows to what extent the strong results of table 2 are driven by the cross-section of changes in lending standards rather than by aggregate, time-series changes in lending standards. Alternatively, because bank-specific measures of changes in standards and demand are likely measured with less error than their aggregate counterparts, this may instead show the importance of superior measures of credit standards and demand in understanding the standards/demand relationship with denial rates. Both of these interpretations are in the spirit of Cunningham (2006), who also looked at the relationship

between aggregate standards and aggregate credit. Table 3 presents the summary of these results.

In general, the results in table 3 are much weaker than the results in table 2. In all four specifications the coefficients on the changes in standards variables are indistinguishable from zero. In the bank-level regressions, all eight standards coefficients had the correct signs predicted by a shift (left or right) in the supply curve, and seven were statistically significant. In contrast, the national regressions have the wrong sign in four of the eight changes in standards coefficients, and none are statistically significant. Changes in demand in the aggregate regressions have generally larger coefficients than in the bank-level regressions and are generally statistically insignificant. Also, all eight demand regression coefficients are positive in the aggregate regressions. This is likely an indication of poor model fit as it is implausible that in a properly specified regression of denial rates on standards, both strengthening and weakening demand would increase denial rates.

4.2 How Do Changes in Denial Rates Vary by Bank Securitization Policy?

Securitization (the bundling of mortgage loans into a security) alters loan officer incentives to change standards. When securitization is available, mortgages can be originated and sold as a security without exposing the bank to significant loan performance risk (Loutskina and Strahan (2009)).[17] In the absence of securitization, banks are incentivized to use the best possible information on economic conditions and borrower characteristics to underwrite loans (ignoring internal agency problems). Because the loan quality of a securitizing bank is not at risk, there is less incentive to use information not screened by the security buyers in determining to whom to extend credit. Therefore, when a bank that heavily securitizes

[17]More precisely, securitization does expose mortgage originators to some risk associated with loan performance, particularly to loans where performance sours rapidly or where there is a breach of one of the life-of-loan representations and warranties and the loan fails to perform. However, these risks are sufficiently limited that financial institutions that securitize mortgages gain significant relief by their regulators over holding those same loans on their balance sheet.

its mortgages has a report of changing lending conditions, we hypothesize a much smaller impact on credit availability than a nonsecuritizer.[18]

Table 4 shows tests of this hypothesis by generalizing the denial regressions setup in table 2 to allow for differential effect of tightening and easing for securitizers and nonsecuritizers. For all specifications, the effect of tightening or easing standards by securitizers on denial rates is indistinguishable from zero. In contrast, when nonsecuritizers change standards the resulting denial rate changes are larger than those estimated in table 2. Because the effects for securitizers are imprecisely estimated, we additionally perform an F-test of the hypothesis that $\beta_{Tightening,Securitizers} = \beta_{Tightening,Nonsecuritizers}$ and of the hypothesis $\beta_{Easing,Securitizers} = \beta_{Easing,Nonsecuritizers}$. five out of six cases, we can reject that the coefficients are equal at the 10 percent level (three out of six at the 5 percent level). On balance, this is evidence that loan standards matter less for securitizing banks. This is consistent with Keys et al. (2008) which find that the securitization process reduced the incentives of financial intermediaries to carefully screen borrowers and resulted in much worse ex-post performance.

4.3 How Do Changes in Denial Rates Vary Across Applicants?

The results in table 2 show that overall denial rates rise with tightenings (and fall, though not statistically significant, with easings). We might expect that changes in standards are felt differently across borrowers depending on credit quality. We attempt to evaluate the extent to which this is true by directly testing denial rates for each of the LTI categories and by examining loans with relatively higher interest rates.

Table 5 shows the results of running the same regressions as in table 2, but separately for applications within an LTI category.[19] If it were the case that lower credit quality

[18]Securitizer = 1 for banks with 50 percent or more of their mortgages securitized in the last and current quarter. Nonsecuritizer = 1 if securitizer = 0. Securitization information is available in the HMDA data. A loan is considered securitized if it is sold to Fannie Mae, Ginnie Mae, Freddie Mac, or a private securitizer. To focus on behavior around the financial crisis, this testing specification is limited to between 2002 and 2013.

[19]For each LTI category, each bank-quarter observation must have at least 30 applications both in the

borrowers were more affected by changes in standards, the coefficients on the tightening dummy would generally increase as the LTI category increases. There is not a perfectly monotonic relationship in table 5. Columns (5) and (6) do have higher coefficients than (3) and (4), but the denial rates are not statistically different.

As an alternative approach, we exploit a HMDA variable of higher-risk approved loans available since 2004. This "rate spread" variable records the interest rate spread on the loan if the rate is substantially higher than the average prime offer rate—thus indicating whether the loan is a nontraditional one.[20] We would expect the number of approved applications for such loans to be negatively related to our indicator variable for tightening and positively related to our variable for easing.

Table 6 presents the results from this regression, using the same controls as in table 2.[21] We restrict our sample to banks approving at least 30 such applications in the current and prior quarter. In all sets of results, the growth rate of approved applications fall with a tightening. The estimate ranges between 14 percent and 20 percent—economically large effects.

4.4 How Does Total Credit Change With Supply and Demand?

Although denial rates are the cleanest expression available to us of the impact of changing standards, we are also interested in seeing how such standards affect the amount of credit extended. Because mortgage credit is the effect of changes in both supply and demand, we attempt to control for the latter by including responses to the SLOOS questions on changes in demand. We condition for changes in the applicant pool by including the shares of applications in different income categories.

Table 7 reports the results of estimating equation (2). In the full specification, we find that

current quarter and the prior quarter.

[20]The thresholds for being substantially higher are defined by HMDA, roughly 1.5 percentage points for first lien loans. Note that this variable is only available for approved loans. Mayer and Pence (2008) use this variable as a measure of subprime loans.

[21]Note that Driscoll-Kraay errors cannot be used due to the shorter time series.

tightening is associated with a 5 percent decrease in the amount of mortgage credit extended. The results on easing remain statistically insignificant, though the point estimates are of an equal but opposite magnitude to those for the tightening effect. As expected, reports of changes in demand are associated with changes in the quantity of credit—an increase of about 4 percent for stronger demand and a decrease of about 2 percent for weaker demand (though the latter result is not statistically significant). These results show that changes in the supply of credit have a much larger impact on the change in total credit than changes in demand.

4.5 How Do Applications Change With Supply and Demand?

We examine the relationship between changes in application volume and responses about changes in loan demand on the SLOOS to determine the extent to which reports of increases and decreases in the latter are reflected in the former. Table 8 presents the results from estimating equation (3) of changes in the log of applications on the SLOOS dummy variables. As expected, the results show that the volume of applications is positively related to the SLOOS strengthening demand dummy, with reports of strengthening associated with about a 4 to 7¾ percent increase in applications. For comparison, mean application growth over the sample is about flat, with a standard deviation of about 40 percent (table 1).

Table 9 repeats the exercise of table 8 but performs a separate regression for each of the LTI buckets. Much like table 5, this explores if the effects of credit standards are heterogeneous across applications of various levels of credit risk. Like in the applications models (table 8), these LTI-specific regressions do not show a strong statistical relationship between credit standards and applications. Similarly, the applications by LTI have a much stronger statistical and economically larger relationship with the demand measures than the supply measures. Higher LTI loans do, on average, have a greater sensitivity to fluctuations in demand than do the lower LTI loans. Indeed, our highest LTI group is about twice as sensitive as our lowest LTI group. Since no such pattern emerges in the denial rates of table

8, this suggests that high LTI loan demand is more volatile than high LTI loan supply.

4.6 How Do Loans Perform After Changes in Standards?

In general, underwriting standards are used by banks to appropriately price loan risk; in part, this involves minimizing the likelihood that borrowers become delinquent or default. So it is natural to ask, "When banks report tightening standards, what happens to the performance of newly originated loans?" However, data limitations prevent us from tracking the performance of individual loans by bank over time. Recall that data license agreements prohibit us from doing an LPS-HMDA-SLOOS merge. Moreover, bank-level data on delinquencies and charge-offs conflate the behavior of newly originated loans with those of existing loans. Thus, for example, even if a bank tightens standards on new loans, delinquency rates may rise at that bank if delinquencies increase on the (much larger) stock of existing loans.

In attempt to get around the data limitation, we use variations in delinquency rates across geographic areas that differ in their degree of exposure to banks in the SLOOS panel. Specifically, we use the LPS data to track loan performance at the MSA-quarter level, comparing changes in delinquency rates in those MSAs with relatively more tightening (measured as net-percent tightening or percent tightening and percent easing) with those with unchanged standards. We test this with two specifications

$$\begin{aligned}
\Delta\text{Delinquency rate}_{t,m} &= \alpha_m + \text{Net percent tightening}_{t-8,m} \\
&\quad + \gamma\,\text{macro control}_t + \phi\,\text{quarter dummies}_t + \epsilon_{t,m} \\
\Delta\text{Delinquency rate}_{t,m} &= \alpha_m + \text{Percent tightening}_{t-8,m} + \text{Percent easing}_{t-8,m} \\
&\quad + \gamma\,\text{macro control}_t + \phi\,\text{quarter dummies}_t + \epsilon_{t,m},
\end{aligned}$$

where Delinquency $\text{rate}_{t,m}$ is the current delinquency rate on the cohort of loans that were originated eight quarters ago in a given MSA (m). Percent tightening (easing) is the percent of SLOOS banks that tighten (ease) standards. Only banks that receive appli-

cations in a given MSA are considered for that MSA. Net percent tightening$_{t-8,m}$ = Percent tightening$_{t-8,m}$ – Percent easing$_{t-8,m}$. Table 10 shows the results. Columns (1) and (2) use the first specification; columns (3) and (4) use the second specification. Columns (2) and (4) add in a macro control and quarter dummy variables.

The results indicate that tightened standards lead to lower delinquency rates. An MSA where 100 percent of banks are tightening is expected to have delinquency rates 1¼ to 3 percentage points lower relative to the previous quarter. To put this in perspective, the average delinquency rate across MSAs on two-year-old mortgages was 8 percent during the testing period. Therefore, a single quarter of 100 percent tightening would decrease delinquency rates by one-sixth to one-third in that MSA relative to the average. Because tightening standards is usually contemporaneous to challenging economic conditions, and poor conditions are unlikely to improve delinquency rates, it seems unlikely that reverse causality is at play here. The most likely explanation is the simple causal one, that when banks say they are raising mortgage underwriting standards they are indeed curtailing credit availability to borrowers who have trouble repaying their debts. This suggests that reports of changing credit standards are a leading indicator of banking system vulnerability to shocks to real estate prices.

4.7 How Do House Prices React to Changes in Standards?

So far, we have examined the role of changes in lending standards and demand on bank-related variables: changes in denial rates on loans, changes in quantities of loans extended, changes in mortgage applications made to banks, and changes in loan performance at banks. These changes on bank behavior should also have effects on the housing markets in which these banks operate. In particular, we might expect increases in denial rates on mortgage applications from tightening standards to be associated with lower demand for house purchases, and thus lower house prices.[22]

[22]One might also expect that persistent tightenings in mortgage standards would be associated with reduced supply of new homes for purchase, though the lags associated with this effect would make it difficult

Table 11 shows the results of regressing MSA-level changes in house prices on the MSA-level changes in standards (same standards variables as in table 10 but without the eight-quarter lag). CoreLogic price indexes that exclude distressed sales are used in the table. The results are as expected; columns (1)-(3) show that an MSA in which all banks were tightening standards should see house prices fall by about 2½ percent. MSAs in which all banks were easing standards should see prices increase by about ⅓ percent. We find similar results when we employ CoreLogic price indexes that include distressed sales or when we employ Zillow's house price index (which is available for fewer MSA-quarters).

5 Conclusions

Lending standards are a crucial determinant for credit availability. However, because loans are complex financial contracts, obtaining a summary measure of standards is both valuable and difficult. One attempt at such a summary measure is provided by the Federal Reserve's Senior Loan Officer Opinion Survey (SLOOS), which asks loan officers at 60 or more major banks whether they have tightened, eased, or left unchanged standards on a variety of loan categories over the preceding three months. Not only is this measure qualitative, it is also not clear what real economic consequences are.

In this paper, we match the SLOOS responses at the bank level with data from HMDA on loan applications. Because the HMDA data allows us to observe both approved and denied applications, we are able to determine denial rates by bank. We can thus examine the association between changes in denial rates and reported changes in standards on the SLOOS. We estimate this relationship using quarterly panel data over the period 1990–2013, using information on credit quality of the borrowers and other controls to attempt to account for potential endogeneity problems.

We find that SLOOS bank reports of tightening lead to about a 1 percentage point increase in denial rates, corresponding to a decrease in total mortgage credit in the aggregate

to test.

of about $690 million per quarter. Denial rates increase more strongly at banks that hold their loans on portfolio (rather than securitizing them). Reports of SLOOS easings—though less frequent over our sample period—are associated with declines in denial rates of a similar magnitude. The amount of mortgage credit extended varies in an economically significant way with reports of changes in both standards and demand.

In addition, we find that approved applications for loans with high interest rates—a proxy for subprime and other nontraditional mortgages—fall by between 14 percent and 20 percent when SLOOS banks report tightening and applications for all kinds of loans rise strongly when banks report stronger demand.

MSAs with more exposure to SLOOS banks that have tightened standards show lower delinquency rates two years after such tightenings. The opposite is true for easings. This suggests that tightened standards are indeed associated with better loan performance. This validates using reports of changing standards as a leading indicator of financial industry vulnerability to shocks.

Finally, house prices fall in MSAs with SLOOS bank exposure when such banks tighten standards. This may be caused by the increases in denial rates on mortgage loan applications, which in turn lower the demand for housing.

Overall, SLOOS responses on standards and demand have the expected relationships with the HMDA variables. The effects are economically significant, and imply that repeated tightenings—which, given the serial correlation in such reports, are likely—could have even more sizeable economic effects.

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Table 1: Summary Statistics

	Obs	Mean	Std. Dev.	Median
SLOOS data				
Tightening dummy	4,578	0.11	0.31	0.00
Easing dummy	4,578	0.04	0.20	0.00
Strengthening dummy	4,578	0.27	0.44	0.00
Weakening dummy	4,578	0.29	0.45	0.00
Macro controls				
Real GDP growth	4,578	2.5	2.5	2.7
Unemployment rate	4,578	6.2	1.6	5.7
Δ Unemployment rate	4,578	0.0	0.3	-0.1
MSA-weighted FICO	3,264	647	197	703
Δ MSA-weighted FICO	3,219	12.0	87.7	0.5
HMDA data				
Denial rate	4,578	17	11	14
Δ Denial rate	4,578	0.0	5.5	0.0
Denied applications	4,578	800	2,166	147
Total applications	4,578	5,227	13,859	1,012
Ln(applications)	4,578	7.0	1.7	6.9
Δ Ln(applications)	4,578	-0.1	40.2	-4.0
Denial rates by LTI category				
Missing LTI	1,359	17.4	15.3	13.5
<20 LTI percentile	3,877	19.9	13.0	17.3
20–40 LTI percentile	3,888	15.0	11.5	12.1
40–60 LTI percentile	3,722	13.1	10.4	10.7
60–80 LTI percentile	3,572	13.4	9.7	11.0
80-90 LTI percentile	2,863	15.0	10.1	12.6
>90 LTI percentile	2,827	24.1	14.9	20.9
High interest rate loan subsample (2004-2013)				
(bank obs. with at least 30 loans in consecutive quarters)				
Rate spread applications	550	1,118	3,301	188
Ln(rate spread applications)	550	5.6	1.5	5.2
Δ Ln((rate spread applications)	550	1.5	68.7	0.0

Table 2: Regressions of Changes in Denial Rates on Changes in Standards & Demand

The denial rate is equal to the number of home purchase applications denied divided by the total number of purchase applications (and multiplied by 100 for scaling). These calculations are done at the bank-quarter level. Only owner-occupied, 1-4 family applications are included. LTI is the loan-to-income ratio based on the HMDA form. The market unemployment rate is the unemployment rate of the MSAs from which a bank receives applications. The tightening dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The easing dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The omitted variable is "about unchanged." The demand dummies (strengthening and weakening) work similarly.

VARIABLES	(1) ΔDenial Rate Baseline	(2) ΔDenial Rate w/ Quarter FE	(3) ΔDenial Rate w/ Macro	(4) ΔDenial Rate w/ Shares
Tightening Dummy	1.081***	0.921***	0.902***	1.105***
	(0.263)	(0.231)	(0.283)	(0.247)
Easing Dummy	-1.180**	-1.203***	-1.198**	-0.927*
	(0.471)	(0.455)	(0.481)	(0.469)
Strengthening Dummy	-0.147	-0.103	-0.107	-0.0675
	(0.184)	(0.147)	(0.145)	(0.152)
Weakening Dummy	0.292	0.413**	0.412**	0.343*
	(0.219)	(0.198)	(0.201)	(0.190)
Δ Share Missing LTI				0.127
				(0.130)
Δ Share ≤20th LTI Percentile				0.156***
				(0.0535)
Δ Share 20–40th LTI Percentile				-0.0178
				(0.0553)
Δ Share 40–60th LTI Percentile				-0.112**
				(0.0555)
Δ Share 60–80th LTI Percentile				-0.192***
				(0.0541)
Real GDP Growth Rate			-0.00520	-0.0122
			(0.0421)	(0.0434)
Δ Market Unemployment Rate			0.0262	0.0965
			(0.396)	(0.372)
Constant	-0.0939	2.037***	2.033***	1.876***
	(0.137)	(0.351)	(0.398)	(0.384)
Quarter Dummies?	No	Yes	Yes	Yes
Firm Fixed Effects?	Yes	Yes	Yes	Yes
Observations	4,578	4,578	4,578	4,578
Number of Groups	130	130	130	130

Driscoll and Kraay (1998) errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.10

Table 3: Regressions of National Changes in Denial Rates on Changes in Standards & Demand

The denial rate is equal to the number of home purchase applications denied divided by the total number of purchase applications (and multiplied by 100 for scaling). These calculations are done at the quarter level. Only owner-occupied, 1-4 family applications are included. LTI is the loan-to-income ratio based on the HMDA form. Percent tightening (percent easing) is the percent of SLOOS banks that tightened (eased) standards. Net percent tightening is the net percent of banks tightening; net percent tightening ≡ percent tightening - percent easing. A bank is considered to be tightening if standards have tightened "considerably" or "somewhat." A bank is considered easing if standards have tightened "considerably" or "somewhat."

VARIABLES	(1) ΔDenial Rate Baseline	(2) ΔDenial Rate w/ Quarter FE	(3) ΔDenial Rate w/ Macro	(4) ΔDenial Rate w/ Shares
Percent Tightening	0.517	-0.174	0.328	2.494
	(1.873)	(1.376)	(1.189)	(1.608)
Percent Easing	2.337	1.381	1.153	-1.800
	(6.474)	(5.520)	(5.615)	(3.703)
Percent Strengthening	2.138	3.079	3.343	2.669
	(4.130)	(2.931)	(2.973)	(1.964)
Percent Weakening	3.343	4.113*	4.179**	1.390
	(3.162)	(2.080)	(2.071)	(2.055)
Δ Share Missing LTI				-0.293
				(0.632)
Δ Share ≤20th LTI Percentile				0.266
				(0.234)
Δ Share 20–40th LTI Percentile				1.275**
				(0.566)
Δ Share 40–60th LTI Percentile				-1.237*
				(0.669)
Δ Share 60–80th LTI Percentile				-0.435
				(0.555)
Real GDP Growth Rate			0.0738	0.0975
			(0.126)	(0.0990)
Constant	-1.770	0.0930	-0.173	0.319
	(1.841)	(1.689)	(1.693)	(1.139)
Observations	94	94	94	94
R-squared	0.028	0.335	0.337	0.765
Adj. R-squared	-0.0154	0.280	0.274	0.727

Robust standard errors are in parentheses and clustered at the bank level.
*** p<0.01, ** p<0.05, * p<0.10

Table 4: Effects of Standards Changes Conditional on Securitization

The denial rate is equal to the number of home purchase applications denied divided by the total number of purchase applications (and multiplied by 100 for scaling). These calculations are done at the bank-quarter level. Only owner-occupied, 1-4 family applications are included. Securitizer = 1 for banks with 50 percent or more of their mortgages securitized in the last and current quarter. Nonsecuritizers = 1 if securitizer = 0. LTI is the loan-to-income ratio based on the HMDA form. The market unemployment rate is the unemployment rate of the MSAs from which a bank receives applications. The tightening dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The easing dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The omitted variable is "about unchanged." The demand dummies (strengthening and weakening) work similarly.

VARIABLES	(1) ΔDenial Rate Baseline	(2) ΔDenial Rate w/ Quarter FE & Macro	(3) ΔDenial Rate w/ Shares
Securitizer Dummy * Tightening Dummy	0.111	0.304	0.472*
	(0.307)	(0.240)	(0.273)
Securitizer Dummy * Easing Dummy	-0.0604	0.279	0.219
	(0.589)	(0.523)	(0.476)
Nonsecuritizer Dummy * Tightening Dummy	1.352***	1.067***	1.279***
	(0.353)	(0.369)	(0.330)
Nonsecuritizer Dummy * Easing Dummy	-1.508**	-1.627***	-1.261**
	(0.603)	(0.597)	(0.586)
Strengthening Dummy	-0.159	-0.122	-0.0797
	(0.184)	(0.144)	(0.151)
Weakening Dummy	0.284	0.408**	0.338*
	(0.219)	(0.202)	(0.191)
Δ Share Missing LTI			0.128
			(0.130)
Δ Share ≤20th Percentile			0.154***
			(0.0534)
Δ Share 20–40th Percentile			-0.0178
			(0.0551)
Δ Share 40–60th Percentile			-0.114**
			(0.0553)
Δ Share 60–80th Percentile			-0.193***
			(0.0540)
Real GDP Growth Rate		-0.00484	-0.0120
		(0.0424)	(0.0437)
Δ Market Unemployment Rate		0.0349	0.104
		(0.395)	(0.372)
Constant	-0.0892	2.034***	1.876***
	(0.137)	(0.397)	(0.383)
Quarter Dummies?	No	Yes	Yes
Firm Fixed Effects?	Yes	Yes	Yes
F-Test Statistics From:			
F(1,92) test tight sec = tight nonsec	6.55*	3.12*	3.09*
F(1,92) test ease sec = ease nonsec	2.72	5.83**	4.04**
Observations	4,578	4,578	4,578
Number of Groups	130	130	130

Driscoll and Kraay (1998) errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.10

Table 5: Regressions of Changes in Denial Rates on Changes in Standards & Demand, by LTI Category

The denial rate is equal to the number of home purchase applications denied divided by the total number of purchase applications (and multiplied by 100 for scaling). These calculations are done at the bank-quarter level. Only owner-occupied, 1-4 family applications are included. LTI is the loan-to-income ratio based on the HMDA form. The market unemployment rate is the unemployment rate of the MSAs from which a bank receives applications. The tightening dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The easing dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The omitted variable is "about unchanged." The demand dummies (strengthening and weakening) work similarly. For each LTI category, each bank-quarter observation must have at least 30 applications both in the current quarter and the prior quarter.

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔDenial Rate	ΔDenial Rate	ΔDenial Rate	ΔDenial Rate	ΔDenial Rate	ΔDenial Rate
	LTI	LTI	LTI	LTI	LTI	LTI
VARIABLES	≤20	20-40	40-60	60-80	80-90	>90
Tightening Dummy	0.630*	1.209***	0.826**	0.908**	1.192***	1.018**
	(0.365)	(0.426)	(0.359)	(0.373)	(0.406)	(0.416)
Easing Dummy	-0.917**	-1.690**	-1.224*	-1.307*	-2.043**	-1.568*
	(0.441)	(0.727)	(0.684)	(0.663)	(0.823)	(0.882)
Strengthening Dummy	-0.0417	-0.162	-0.215	0.0763	-0.179	0.0426
	(0.215)	(0.191)	(0.233)	(0.210)	(0.282)	(0.295)
Weakening Dummy	0.711**	0.0532	0.182	0.357*	0.360	0.628***
	(0.322)	(0.230)	(0.240)	(0.198)	(0.258)	(0.229)
Real GDP Growth Rate	-0.0894**	-0.00203	0.00482	0.0179	0.0119	0.00867
	(0.0375)	(0.0481)	(0.0501)	(0.0518)	(0.0660)	(0.0619)
Δ Market Unemployment Rate	0.290	-0.270	0.0214	-0.204	-0.519	-0.531
	(0.251)	(0.338)	(0.469)	(0.554)	(0.534)	(0.741)
Constant	2.584***	2.437***	1.417***	1.345***	1.396***	1.228**
	(0.441)	(0.420)	(0.418)	(0.452)	(0.404)	(0.579)
Quarter Dummies?	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,877	3,888	3,722	3,572	2,863	2,827
Number of Groups	120	119	118	116	102	106

Driscoll and Kraay (1998) errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.10

Table 6: Regressions of Changes in Rate Spread Loans on Changes in Standards & Demand

The change in home purchase loans is measured in log differences (and multiplied by 100 for scaling). These calculations are done at the bank-quarter level. Only owner-occupied, 1-4 family applications are included. Rate spread is a definition set by HMDA and is only defined for approved loans. Only bank observations that have 30 or more rate spread loans in consecutive quarters are included. LTI is the loan-to-income ratio based on the HMDA form. The market unemployment rate is the unemployment rate of the MSAs from which a bank receives applications. The tightening dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The easing dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The omitted variable is "about unchanged." The demand dummies (strengthening and weakening) work similarly.

VARIABLES	(1) Log Diff Apps Baseline	(2) Log Diff Apps w/ Quarter FE	(3) Log Diff Apps w/ Macro	(4) Log Diff Apps w/ Shares
Tightening Dummy	-18.55***	-19.90***	-14.27***	-16.24**
	(5.046)	(5.387)	(5.125)	(6.946)
Easing Dummy	31.10	29.24	26.37	18.91
	(22.06)	(21.76)	(21.79)	(16.88)
Strengthening Dummy	2.340	0.667	3.126	-1.125
	(10.89)	(11.16)	(11.41)	(11.66)
Weakening Dummy	5.004	5.234	5.679	0.175
	(7.525)	(7.881)	(8.127)	(8.469)
Δ Share Missing LTI				6.515*
				(3.621)
Δ Share ≤20th LTI Percentile				-1.034
				(3.597)
Δ Share 20–40th LTI Percentile				1.349
				(3.001)
Δ Share 40–60th LTI Percentile				2.048
				(3.693)
Δ Share 60–80th LTI Percentile				6.074
				(4.461)
Real GDP Growth Rate			1.125	0.629
			(1.346)	(1.141)
Δ Market Unemployment Rate			-11.02*	-13.46**
			(6.442)	(6.606)
Constant	2.135	8.729	13.56*	14.43
	(4.973)	(7.453)	(7.802)	(8.903)
Quarter Dummies?	No	Yes	Yes	Yes
Firm Fixed Effects?	Yes	Yes	Yes	Yes
Observations	550	550	550	550
R-squared	0.074	0.089	0.099	0.145
Adj. R-squared	-0.017	-0.007	0.000	0.043

Robust standard errors are in parentheses and clustered at the bank level.
*** p<0.01, ** p<0.05, * p<0.10

Table 7: Regressions of Changes in Credit Approved on Changes in Standards & Demand

Credit is the total dollar amount of home purchase loans approved. Changes in credit is measured in log differences (and multiplied by 100 for scaling). These calculations are done at the bank-quarter level. Only owner-occupied, 1-4 family applications are included. Income percentile thresholds are based on HMDA data and set each quarter. The market unemployment rate is the unemployment rate of the MSAs from which a bank receives applications. The tightening dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The easing dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The omitted variable is "about unchanged." The demand dummies (strengthening and weakening) work similarly.

VARIABLES	(1) Log Diff Credit Baseline	(2) Log Diff Credit w/ Macro & Quarter FE	(3) Log Diff Credit w/ Income
Tightening Dummy	-8.645***	-4.472**	-5.010**
	(2.675)	(2.036)	(2.232)
Easing Dummy	8.294*	5.979	5.376
	(4.842)	(4.452)	(4.645)
Strengthening Dummy	7.742***	4.176***	4.050***
	(1.967)	(1.272)	(1.197)
Weakening Dummy	-1.797	-2.169	-2.439
	(2.356)	(1.642)	(1.680)
Δ Share Income Missing			0.158
			(0.624)
Δ Share Income Percentile <10			-1.210***
			(0.370)
Δ Share Income Percentile 10–25			-0.383
			(0.352)
Δ Share Income Percentile 25-50			0.338
			(0.479)
Δ Share Income Percentile 50–75			0.968*
			(0.577)
Δ Share Income Percentile 75–90			0.289
			(0.356)
Real GDP Growth Rate		0.257	0.153
		(0.266)	(0.305)
Δ Market Unemployment Rate		-5.653***	-6.301***
		(1.835)	(2.078)
Constant	-0.179	-8.081***	-8.667***
	(1.073)	(2.860)	(3.202)
Quarter Dummies?	No	Yes	Yes
Firm Fixed Effects?	Yes	Yes	Yes
Observations	4,578	4,578	4,578
Number of Groups	130	130	130

Driscoll and Kraay (1998) errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.10

Table 8: Regressions of Changes in Applications on Changes in Standards & Demand

The change in home purchase loans is measured in log differences (and multiplied by 100 for scaling). These calculations are done at the bank-quarter level. Only owner-occupied, 1-4 family applications are included. The market unemployment rate is the unemployment rate of the MSAs from which a bank receives applications. The tightening dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The easing dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The omitted variable is "about unchanged." The demand dummies (strengthening and weakening) work similarly.

VARIABLES	(1) Log Diff Apps Baseline	(2) Log Diff Apps w/ Quarter FE	(3) Log Diff Apps w/ Macro
Tightening Dummy	-5.588**	-3.869*	-1.570
	(2.273)	(2.029)	(2.034)
Easing Dummy	3.333	1.866	1.140
	(3.856)	(3.572)	(3.506)
Strengthening Dummy	7.794***	4.039***	4.525***
	(1.709)	(1.237)	(1.283)
Weakening Dummy	-1.454	-1.725	-1.742
	(2.011)	(1.346)	(1.327)
Real GDP Growth Rate			0.327
			(0.239)
Δ Market Unemployment Rate			-5.244***
			(1.669)
Constant	-1.296	-10.22***	-8.080***
	(0.921)	(2.114)	(2.782)
Quarter Dummies?	No	Yes	Yes
Firm Fixed Effects?	Yes	Yes	Yes
Observations	4,578	4,578	4,578
Number of Groups	130	130	130

Driscoll and Kraay (1998) errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.10

Table 9: Regressions of Changes in Applications on Changes in Standards & Demand, by LTI Category

The change in home purchase loans is measured in log differences (and multiplied by 100 for scaling). These calculations are done at the bank-quarter level. Only owner-occupied, 1-4 family applications are included. LTI is the loan-to-income ratio based on the HMDA form. The market unemployment rate is the unemployment rate of the MSAs from which a bank receives applications. The tightening dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The easing dummy takes a value of one if standards have tightened "considerably" or "somewhat" and zero otherwise. The omitted variable is "about unchanged." The demand dummies (strengthening and weakening) work similarly. For each LTI category, each bank-quarter observation must have at least 30 applications both in the current quarter and the prior quarter.

	(1)	(2)	(3)	(4)	(5)	(6)
	Log Diff Apps	Log Diff Apps	Log Diff Apps	Log Diff Apps	Log Diff Apps	Log Diff Apps
	LTI	LTI	LTI	LTI	LTI	LTI
VARIABLES	≤20	20-40	40-60	60-80	80-90	>90
Tightening Dummy	-6.765**	-0.965	0.816	0.171	-0.514	0.935
	(3.088)	(2.110)	(1.979)	(2.103)	(2.673)	(3.002)
Easing Dummy	0.112	6.162	0.644	3.011	3.025	-0.622
	(3.790)	(5.087)	(3.503)	(3.474)	(4.084)	(3.299)
Strengthening Dummy	2.653*	3.365**	3.021*	4.224**	4.716**	6.784***
	(1.437)	(1.528)	(1.584)	(1.661)	(1.891)	(1.794)
Weakening Dummy	-1.651	-0.620	-1.952	-2.795*	-4.356***	-3.732**
	(1.529)	(1.660)	(1.588)	(1.648)	(1.480)	(1.545)
Real GDP Growth Rate	0.774***	0.472*	0.557**	0.666*	0.625*	0.424
	(0.242)	(0.252)	(0.275)	(0.337)	(0.355)	(0.461)
Δ Market Unemployment Rate	-4.503**	-4.388**	-5.314**	-3.465	-2.727	-3.218
	(1.844)	(2.202)	(2.132)	(2.343)	(2.581)	(2.524)
Constant	-3.239	-7.960**	-10.11***	-8.893***	-8.794***	-7.782**
	(2.946)	(3.152)	(3.066)	(3.177)	(2.936)	(3.334)
Quarter Dummies?	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,877	3,888	3,722	3,572	2,863	2,827
Number of Groups	120	119	118	116	102	106

Driscoll and Kraay (1998) errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.10

Table 10: Regressions of Changes in Delinquency on Changes in Standards & Demand

Delinquency rates are calculated using LPS data at the MSA-quarter level. Only mortgages originated 8 quarters ago are included in the calculation. Lag8 percent tightening (lag8 percent easing) is the 8-quarter lagged percent of SLOOS banks issuing loans in an MSA-quarter that tightened (eased) standards. Lag8 net percent tightening is the net percent of banks tightening; lag8 net percent tightening ≡ lag8 percent tightening - lag8 percent easing. A bank is considered to be tightening if standards have tightened "considerably" or "somewhat." A bank is considered easing if standards have tightened "considerably" or "somewhat." Δ_8 MSA unemployment rate is the change in the unemployment rate over the past 8 quarters.

	(1)	(2)	(3)	(4)
	ΔDelinq Rate	ΔDelinq Rate	ΔDelinq Rate	ΔDelinq Rate
VARIABLES	Baseline	w/ Macro & Quarter FE	Baseline	w/ Macro & Quarter FE
Lag8 Net Percent Tightening	-1.498***	-2.986***		
	(0.0602)	(0.135)		
Lag8 Percent Tightening			-1.319***	-2.950***
			(0.0776)	(0.181)
Lag8 Percent Easing			2.497***	3.108***
			(0.371)	(0.365)
Δ_8 MSA Unemployment Rate		0.316***		0.314***
		(0.0190)		(0.0215)
Constant	0.224***	-1.312***	0.104**	-1.332***
	(0.0100)	(0.0717)	(0.0414)	(0.0891)
Quarter Dummies?	No	Yes	No	Yes
MSA Fixed Effects?	Yes	Yes	Yes	Yes
Observations	13,712	13,172	13,712	13,172
R-squared	0.017	0.086	0.018	0.086
Adj. R-squared	-0.0107	0.0600	-0.0104	0.0600

Robust standard errors are in parentheses and clustered at the MSA level.
*** p<0.01, ** p<0.05, * p<0.10

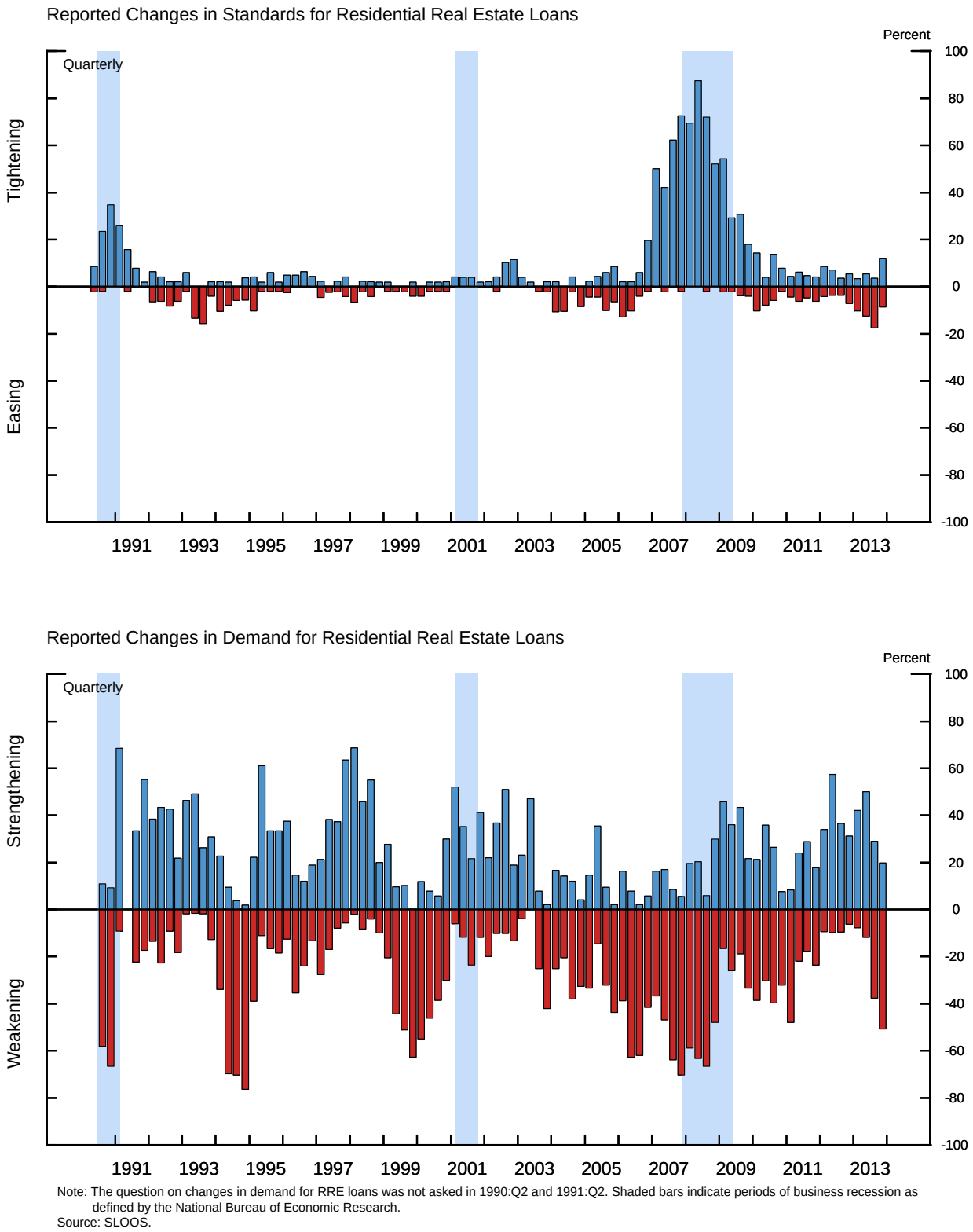
Table 11: Regressions of Changes in House Prices on Changes in Standards & Demand

Changes in house prices are calculated using CoreLogic price indexes (excluding distressed sales) at the MSA-quarter level. Percent tightening (percent easing) is the percent of SLOOS banks issuing loans in an MSA-quarter that tightened (eased) standards. A bank is considered to be tightening if standards have tightened "considerably" or "somewhat." A bank is considered easing if standards have tightened "considerably" or "somewhat."

VARIABLES	(1) Δ MSA House Price Index	(2) Δ MSA House Price Index	(3) Δ MSA House Price Index
Percent tightening	-2.622***	-2.571***	-2.421***
	(0.106)	(0.106)	(0.107)
Percent easing	0.594***	0.314***	0.334***
	(0.116)	(0.114)	(0.115)
Percent strengthening	0.0679	-0.370***	-0.357***
	(0.0673)	(0.0658)	(0.0676)
Percent weakening	-0.674***	-0.803***	-0.841***
	(0.0633)	(0.0636)	(0.0653)
Δ MSA Unemployment Rate			-0.154***
			(0.0252)
Constant	1.275***	1.109***	1.256***
	(0.0399)	(0.0459)	(0.0503)
Quarter Dummies?	No	Yes	Yes
MSA Fixed Effects?	Yes	Yes	Yes
Observations	34,340	34,340	32,942
R-squared	0.139	0.205	0.205
Adj. R-squared	0.129	0.196	0.196

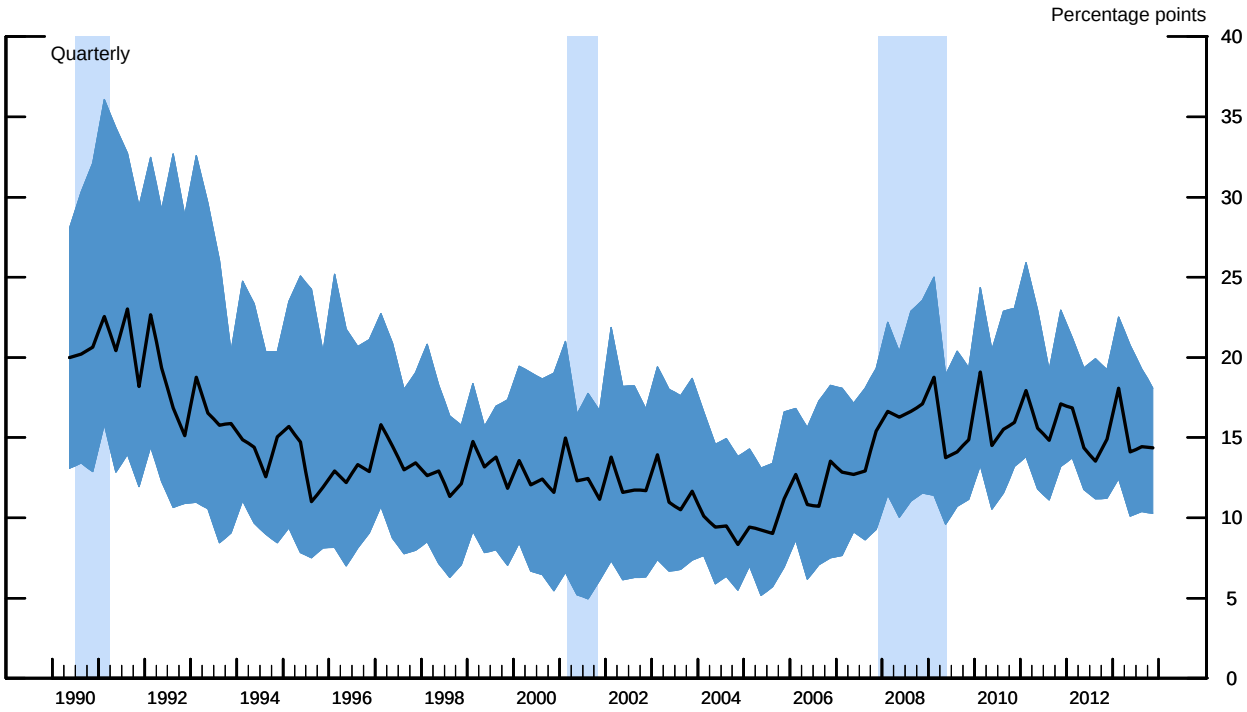
Robust standard errors are in parentheses and clustered at the MSA level.
*** p<0.01, ** p<0.05, * p<0.10

Figure 1: Standards and Demand, 1990–2013



Note: The question on changes in demand for RRE loans was not asked in 1990:Q2 and 1991:Q2. Shaded bars indicate periods of business recession as defined by the National Bureau of Economic Research.
Source: SLOOS.

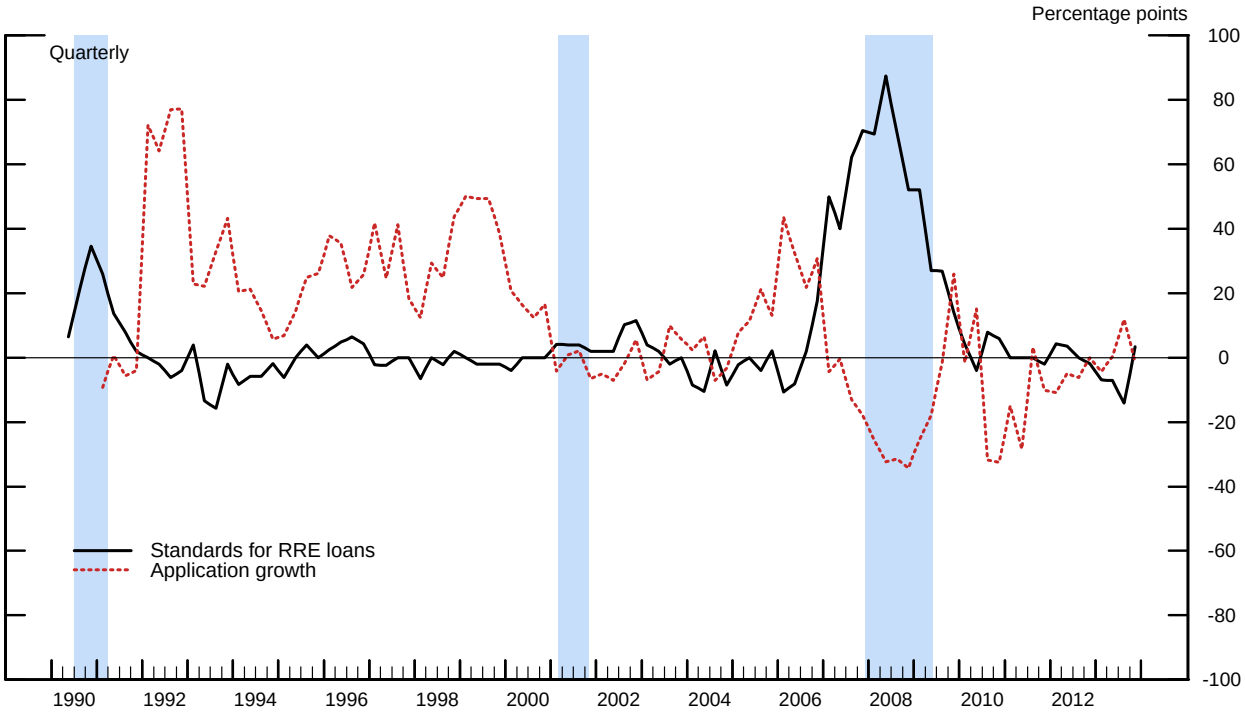
Figure 2: Denial Rates, 1990–2013



Note: The line denotes the median denial rate and bands denote the 25th and 75th percentiles.
Source: HMDA.

Figure 3: Standards and Application Growth, 1990–2013

This figure plots net percent tightening and year-over-year purchase application growth for the testing panel. Net percent tightening ≡ percent tightening - percent easing. Percent tightening and percent easing are shown in figure 1.



Source: HMDA and SLOOS.