

Recourse to Non-Housing Assets and Mortgage Credit Supply

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ABSTRACT

Because state anti-deficiency statutes rarely change over time, the opportunity to test the importance of recourse to borrower's non-housing assets for the mortgage market is limited. I exploit the bankruptcy reform in 2005 (which effectively strengthens recourse) as a quasi-natural experiment to show that aggregate quantity of mortgage lending is increased after the reform is implemented. Lenders appear to adjust their underwriting through approval decision rather than interest rate. Overall, my study finds that strengthening recourse—while potentially useful as a tool to discourage strategic default and foreclosure—can also expand credit supply through increased collateral value.

JEL classification: D12, G21, G23, K2, K25

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1. Introduction

Should mortgage borrowers be liable for the shortfalls if the value of their properties fall below outstanding debt? In the U.S., the ability of lenders to pursue the shortfalls (also known as deficiency judgments) on mortgage loans is governed by state anti-deficiency statutes. Such states are often referred to as “recourse states” and are the majority of states in the U.S. Because non-recourse mortgages reduce the exposure of borrowers to downside risks, they essentially give the option for borrowers to default in a less costly fashion. Thus, one would expect to see lower default in recourse states, as default puts borrowers’ non-housing assets at risk (see, for example, Ambrose et al. (1997), Corbae and Quintin (2010), Quintin (2012)). Academic work on the relevance of recourse in the mortgage market is not a recent phenomenon (see, for example, Ambrose and Pennington-Cross (2000), Clauretje (1987)), but the issue has received renewed attention since the subprime crisis, particularly because an unprecedentedly large proportion of households find themselves owing more on their mortgage than their properties are worth (a situation referred to as “negative equity” or “underwater”). Since some states prohibit lenders from pursuing deficiency judgments on the shortfalls, this creates an incentive for households who could otherwise afford the payments to strategically exercise their option to default. Observers such as Feldstein (2008) and Kling (2013) have proposed recourse mortgages as a way to alleviate the foreclosure spiral and prevent future speculative bubble in the housing market. Comparisons of mortgage market conditions such as foreclosure are often made between the U.S. and other countries that have recourse mortgages, such as Spain (Roxborough (2012)) and Canada (Crawford et al. (2013), Economist (2012), Paulo et al. (2013)). The main argument is that, because households also share the downside of housing market risk, they are less likely to

strategically default on their loans.¹ They also have more incentive to pay down their debt and build equity, reducing the likelihood of default (and foreclosure), as shown in the Canadian data presented by Crawford et al. (2013).

Because state anti-deficiency statutes rarely change over time, the opportunity to test the importance of recourse is limited.² Moreover, the persistence nature of state statutes makes empirical inferences susceptible to potential omitted variable biases from unobserved heterogeneity. For example, if borrowers in recourse states tend to have higher income or credit score, lower interest rates in those states may not be due to the recourse but because borrowers are more creditworthy. Moreover, factors that cannot be easily observed or quantified such as region-specific attitude toward risk or default can further confound the analysis. One key feature of deficiency judgments is that they are classified as unsecured debt. Under the U.S. bankruptcy code, a borrower facing deficiency judgment may be able to reorganize or discharge the debt, depending on whether the filing is made under Chapter 13 or Chapter 7. Thus, the value of deficiency judgments to lenders depends on how easily a borrower can file for bankruptcy under Chapter 7. Exploiting a bankruptcy reform in 2005 that makes filing for bankruptcy more difficult and effectively changes the value of deficiency judgments, I investigate the impact of strengthening recourse on the mortgage market.

While the debate surrounding the recourse feature of mortgage contracts often focuses on default and foreclosure, changes in anti-deficiency statutes will also have an implication on

¹ Preventing strategic default and foreclosure can be socially beneficial, as foreclosures exert price negative externalities on surrounding properties (for example, Campbell et al. (2011)) and can be contagious (Guiso et al. (2013)).

² Recently, there have been several changes in state statutes that decrease recourse by prohibiting deficiency judgments on particular loans. North Carolina prohibits judgments on both purchase and refinance mortgages under the conforming limit in 2009. Nevada prohibits judgment only on purchase mortgages on single family primary homes made from October 2009, but has no loan size limit. Li and Oswald (2014) study this change and its impact on the mortgage market in detail. California also prohibits judgments on loans made from January 2013. It is worth noting that the three changes all reduce the strength of recourse, and two of them are states that experienced substantial price boom and bust in the recent housing cycle.

intermediation of mortgage credit.³ The issue of recourse is directly related to the literature on collateralized lending. Mortgage contracts by definition are collateralized loans, so strengthening of recourse can be viewed as increase in pledgeability of asset or enhancement of collateral value. For this reason, I choose to focus my study on credit intermediation instead. Recent empirical papers by Assunção et al. (2013) and Jappelli et al. (2005) have shown that legal frameworks which affect the value of collateral have direct impact on intermediation, as improvements in the ability for lenders to recover collateral enable riskier borrowers to enter the credit market. In a study more related to mine, Li and Oswald (2014) investigate the abolishment of deficiency judgments in Nevada in October 2009 and find that lenders' reduce mortgage approval rates and loan size, but the law change does not appear to affect default or foreclosure outcomes.

Using aggregate HMDA data, I show the bankruptcy reform (which effectively strengthens recourse) increases the quantity of aggregate credit (measured by the frequency of purchase loans in a zip code) in recourse states by 9.5 to 24 percent. Next, with micro-level data from a mortgage lender and Freddie Mac, I find that lenders adjust their underwriting through approval decision rather than interest rate. After the reform, rejection rate in recourse states decline by approximately 3 percentage points, representing a 40 percent decrease from the average rejection rate. Interest rates, on the other hand, only decline by about 4 basis points, which is not economically very significant. The same pattern is observed in GSEs market represented by the Freddie Mac data. Hurst et al. (2014) and Saengchote (2014) also find similar irresponsiveness of interest rates in the mortgage market, suggesting that lenders may prefer to

³ The evidence of recourse on default rate has largely been mixed. Two most often-cited papers find different results. Using aggregate lending data, Clauretie (1987) finds that default rates in recourse states are not significantly different than those that do. Ghent and Kudlyak (2011) find similar results unconditionally in micro loan data, but when combined with negative equity, default rates are significantly higher in non-recourse states, pointing to strategic default as a motive.

adjust on other dimensions instead—in this case, the decision to approve the application.⁴ Borrower risks in recourse states do not appear to be significantly different after the reform, except for the greater willingness from the lender to accept borrowers with past default and/or bankruptcy history.

I conduct additional tests by using the income means test intended to preclude high-income borrowers from filing under Chapter 7. The expansion of credit seems occur equally across the income groups (defined by using state median income level as cutoff, where the means test is binding). However, lower-income self-employed borrowers may have been displaced from the market. Overall, my study finds that strengthening recourse—while potentially useful as a tool to discourage strategic default and foreclosure—can also expand credit supply through increased collateral value. However, a conclusive policy recommendation cannot be drawn from this analysis, as welfare implications of the expansion also need to be addressed.

My research is related to the literature on creditor rights and credit supply (Bae and Goyal (2009), Djankov et al. (2007), Laeven and Majnoni (2005), LaPorta et al. (1997), López de Silanes et al. (1998), Severino et al. (2014)), the empirical literature on collateralized lending (Assunção et al. (2013), Benmelech (2009), Benmelech and Bergman (2008), Benmelech and Bergman (2009), Benmelech and Bergman (2011), Benmelech et al. (2005), Berger and Udell (1990), Jappelli et al. (2005), Vig (2013)) and the impact of legal frameworks on the mortgage market (Ambrose et al. (1997), Ambrose and Pennington-Cross (2000), Ambrose and Sanders (2005), Berkowitz and Hynes (1999), Chomsisengphet and Elul (2006), Clauretje (1987), Clauretje (1989), Clauretje and Herzog (1990), Corbae and Quintin (2010), Corbae and Quintin (2013), Desai et al. (2013), Ghent and Kudlyak (2011), Gropp et al. (1997),

⁴ Petersen and Rajan (1994) also document a similar finding in commercial lending to small businesses. They show that firms' relationships with financial institutions are reflected in availability of financing rather than interest rate.

Li et al. (2014), Li et al. (2011), Lin and White (2001), Mitman (2011), Morgan et al. (2012), Pence (2006), Quintin (2012)).

The rest of the paper is organized as follows. Section 2 outlines the institutional details of deficiency judgment, bankruptcy and the reform. Section 3 describes the data, empirical strategy and the relevance of recourse on mortgage credit. Section 4 presents the results. Section 5 concludes.

2. Institutional Details

2.1. Recourse and Deficiency Judgment

In the event that a borrower defaults on his mortgage payment, a lender may foreclose on the property and receive the proceeds from the foreclosure sale. If the proceeds are not sufficient to cover the remaining debt, depending on the state statutes, the lender may be able to obtain a deficiency judgment to cover the shortfall. Such states are referred to as recourse states. Ghent and Kudlyak (2011) discuss the foreclosure laws and mechanisms across different states in detail. The clarity of state statutes with respect to recourse is not always uniform therefore interpretation may vary. In this study, I follow the definition of Ghent and Kudlyak (2011), who classify Alaska, Arizona, California, Iowa, Minnesota, Montana, Oregon, Washington and Wisconsin as non-recourse states.⁵ Figure 1 shows the locations of no-recourse states in the U.S. up until the recent changes starting in 2009. These statutes rarely change over time, making empirical investigations particularly prone to omitted variable biases. This potential problem motivates my empirical strategy, to be discussed in the next section.

⁵ While many studies have classified the purchase mortgage of North Carolina as non-recourse, the ruling by North Carolina Court of Appeals in October 1999 on *G.E. Capital Mortgage Services Inc. v. James E. Neely and Wylene Neely* clarifies the definition of purchase money mortgage as one where the mortgagee is the seller. For third-parties such as lenders, the anti-deficiency statute does not apply.

While mortgage debt is secured by the underlying property, deficiency judgment obtained from foreclosure is an unsecured debt. Under the U.S. bankruptcy code, a borrower facing deficiency judgment may be able to reorganize or discharge the debt, depending on whether the filing is made under Chapter 13 or Chapter 7. Thus, for the value of deficiency judgment for lenders depends on how easily a borrower can file for bankruptcy under Chapter 7.

2.2. Bankruptcy Reform

The Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 (BAPCPA) was passed by Congress in April and 2005 and signed into law by President Bush on 20 April 2005. Most provisions of the act did not come into effect until 17 October 2005. The reform was intended to instill financial discipline and make bankruptcy, especially Chapter 7, more costly. Prior to the passing of the law, the reform had been receiving strong support from banks, credit card companies and other unsecured creditors as they were the ones bearing the losses for debts discharged through bankruptcy. The reform set forth several changes, mostly to increase the costs of filing and limit the “gains from filing” by stricter eligibility and reduced exemptions. The most important changes are that are relevant for my investigation are increased economic cost of filing and income means testing.⁶

The reform made bankruptcy filing more difficult in general by imposing a number of new requirements on both debtors and bankruptcy lawyers, as well as raising the direct cost of filing fees. Debtors are required to submit copies of past tax returns and, take credit counseling

⁶ The reform also reduced the cap on homestead exemption. Homestead exemption allows bankruptcy filers to protect certain assets from claims by creditors – in this case, the equity they hold in their homes. Prior to the reform, homeowners in some states (such as Arizona, Florida, Massachusetts and Nevada) had very high homestead exemption, which allows them to maintain their mortgages while discharging other unsecured debt. See White (2009) for a more in depth review of the changes introduced by the reform.

course before they file and a debt management course (also called debtor education) before they receive a discharge (White (2009)).⁷

The means test introduced requires higher-income bankruptcy filers to file for Chapter 13 rather than Chapter 7. Instead of having unsecured debt discharged, Chapter 13 involves reorganization where debtors must use their non-exempt income to pay down debt over five years. The new criteria for Chapter 7 eligibility is that filers whose earnings exceed the exemption by more than \$167 per month are ineligible to file under Chapter 7. The income exemption is equal to the median family income in the filer's state of residence.

The changes made by the reform make discharging unsecured debt through bankruptcy filing more difficult. Since deficiency judgments are classified as unsecured debt, the reform indirectly increases the value of deficiency judgments in the states that allow them.

3. Data and Empirical Strategy

3.1. Data

I use three main sources of lending data to investigate the effect of recourse on mortgage market condition. The first is the Home Mortgage Disclosure Act (HMDA) data, which covers the majority of mortgage applications by banks, savings associations, credit unions, and mortgage companies in the U.S. While the data reported does not include borrower or loan characteristics which would be required to make inferences on the intensive margin adjustments, it is useful to assess the impact on the aggregate volume of lending given its breadth of coverage. In this paper, I only include first lien loans (because loss exposure of subordinated liens is much more severe and thus the expected recovery rate of any shortfall is much lower) and exclude refinances for two reasons. First, refinances where borrowers do not take out their home equity

⁷ See <http://www.justice.gov/ust/eo/bapcpa/ccde/index.htm> for guidelines on counseling.

(also referred to as rate refinances) are subject to different, more streamlined underwriting standard. Second, refinances where borrowers do take out equity (cash out refinances) are more informationally sensitive (Agarwal et al. (2011)) and lenders may apply different underwriting criteria for different reasons of cashing out (e.g. financing consumption versus home improvements).

To analyze lender's response to the change in recourse, I need more detailed information about borrower's risk and characteristics of the mortgage contract in order to draw inference, as pointed out by Quintin (2012). For this analysis, I turn to the remaining two sources. The first is the loan origination database of New Century Financial Corporation. The database was maintained as part of New Century's operation and was sold by New Century Liquidating Trust during their bankruptcy process. The data contains more than 3.2 million loans applications between 1996 and March 2007. At the height of the real estate boom, New Century was the number two subprime lender in the U.S., behind Countrywide. Figure 2 shows the coverage of New Century's lending in the U.S. New Century data provides a unique opportunity to test the relevance of recourse for two reasons. First, the data contains a rich set of information underwriters observes. Secondly, the data covers not only loans funded but all applications, which allows one to investigate the impact of change in recourse on lender screening.

The second micro dataset used is Freddie Mac's Single Family Loan-Level Dataset, which covers approximately 15.7 million fully-amortizing 30-year fixed-rate single-family mortgages that Freddie Mac acquired with origination dates from 1999 to 2011. Unlike New Century data, Freddie Mac data does not contain adjustable rate, interest-only or low-documentation mortgages. Information available on borrower and loan is also more limited, with only loan-to-value ratio, debt-to-income ratio and FICO score available. Four missing key

information are: (1) internal risk grade (which captures past delinquency/bankruptcy filing), (2) borrower age, (3) borrower income and (4) whether borrower is self-employed. The omission of age is likely deliberate, since the Equal Credit Opportunity Act (ECOA) prohibits lenders from discriminating borrowers based on age, provided the applicant has the capacity to enter into a contract. Because all mortgages are fully-amortizing with fixed interest rates, one can calculate monthly payment from the contact term. With an assumption that all borrowers have no other source of debt, one can calculate monthly income from the debt-to-income ratio and the monthly payment. This assumption allows income be inferred and provides a minimum estimate of borrower income.

The two micro datasets cover different segments of borrowers: the Freddie Mac dataset represents the segment served by government-sponsored mortgage enterprises (GSEs), which comprises more prime borrowers, while the New Century dataset better represents the subprime segment of the market which is securitized privately. To control for macroeconomic conditions, I augment all datasets with additional sources. Data for unemployment rate, house price growth and volatility, population and average income is obtained from the Bureau of Labor Statistics, the Federal Housing Finance Agency, Zillow, and the Bureau of Economic Analysis.

3.2. Empirical Strategy

Many empirical papers have documented the effect of differences in anti-deficiency statutes on the mortgage market. Because non-recourse mortgages essentially give the option for borrower to default in a less costly fashion, one would expect more default in non-recourse states. All else equal, lenders may price the higher probability of default by increasing interest

rates in non-recourse states.⁸ Using aggregate lending data, Clauretie (1987) finds that default rates in recourse states are not significantly different than those that do. Ghent and Kudlyak (2011) find similar results unconditionally in micro loan data, but when combined with negative equity, default rates are significantly higher in non-recourse states, pointing to strategic default as a motive. However, they find that loans in non-recourse states seem to have higher interest rates. On the other hand, Ambrose and Sanders (2005) find that subordinated loans in less lender-friendly states (states that are non-recourse or require lenders to foreclose through court proceedings) pay higher effective interest rate.

However, a common identification challenge across all these studies is that anti-deficiency statutes rarely change over time, making empirical inferences susceptible to potential omitted variable biases from unobserved heterogeneity. Indeed, borrower characteristics, interest rates and default rates tend to have different local means. Cross-sectional analyses of aggregate data that do not control for borrower-specific information will be affected by these variations. For example, if borrowers in states that allow lender recourse tend to have higher income or credit score, lower interest rates in those states may not be due to the recourse but because borrowers are more creditworthy. Moreover, factors that cannot be easily observed or quantified such as region-specific attitude toward risk or default can further confound the analysis. Because anti-deficiency statutes are state-specific, one cannot demean the data by geographic definitions that are a subset of states or include of geography fixed effects. Some studies such as Pence (2006) use discontinuities in legal treatment in metropolitan areas that span multiple states and use loans on properties close to state borders to control for the unobservable variations.

⁸ In particular, one would also expect borrowers with higher ex-ante probability of default to be more adversely affected.

A theoretical paper by Quintin (2012) further highlights this concern, and cautions that empirical analyses on aggregate outcomes can be misleading. For example, while increasing recourse may be expected to reduce default, lenders may be more willing to expand credit to those who were previously unserved. As the marginal borrower may be of significantly worse credit risk, the aggregate implication on default rate is unclear. Quintin (2012) stresses the need for micro-level data that is able to control for borrower credit risk.

To address this issue, I exploit the bankruptcy reform in 2005, which effectively increases the value of deficiency claims for lenders, i.e. strengthening lender recourse. Deficiency claims are classified as unsecured debt, which can be discharged in bankruptcy under Chapter 7. The reform made bankruptcy filing more difficult in general by increasing the hurdle one must go through before filing, as well as precluding more wealthy borrowers from filing under Chapter 7 at all. Theoretical models of recourse and credit (Jappelli et al. (2005), Quintin (2012)) broadly seek to answer two economic questions when recourse is strengthened, i.e. access to finance and its implication for borrower risk. They can now be explored by exploiting this reform as quasi-natural experiment with the difference-in-difference strategy.

3.3. Recourse and Mortgage Credit Intermediation

Q1: Does strengthening of recourse increase supply of mortgage credit?

The strengthening of recourse can manifest in both the demand and supply channel. For the demand channel, as Quintin (2012) remarks, borrowers who are strategic (those who would default on mortgages they could afford because the collateral value is worth less than the outstanding loan) may drop out of the market, reducing demand for credit. In addition, borrowers bear more of the downside risk in the adverse states of the world, so the reduction in risk-sharing

can also reduce demand from borrowers who value the downside insurance. For the supply channel, the increase in collateral value allows for greater debt capacity (Hart and Moore (1994), Harris and Raviv (1990)), allowing lenders to expand supply of credit, all else equal. The theoretical prediction on equilibrium price and quantity of credit is unclear, as it depends on the relative strength of the positive supply effect (increased quantity, lower price) and the negative demand effect (lower quantity and price). However, we can empirically investigate the net effect; if the aggregate quantity of credit is higher, the supply effect must dominate the demand effect.⁹

To answer this question, I use the difference-in-difference strategy with geography and time fixed effects. The geography fixed effects alleviates the concern from potentially omitted variable bias that arises from geography-specific unobserved heterogeneity that does not vary over time. The time fixed effects control for macroeconomic conditions at the national level, such as interest rate. Specifically, I estimate a regression specification of Equation (1).

$$(1) \quad q_{zt} = \eta_g + \delta_t + \beta_0 \cdot recourse_z + \beta_1 \cdot recourse_z \cdot post_z + \phi'Z_z + \varepsilon_{zt}$$

q_{zt} , average number of loans per housing unit, is defined as follow. For each zip code, I aggregate the number (not dollar amount) of first lien loans made for home purchase. Because the public version of HMDA data reports dates only in years, each unit of observation is at the zip code-year level. Next, I divide the aggregate lending volume by the number of housing units in each zip code (obtained from the Census Bureau) to control for size of zip code. Since the zip code-level data is only available in the decennial survey, I use the values in 2000 and 2010 and linearly interpolate the years in between. The variable $post_z$ is an indicator which takes value one for observations in 2006 and after. Geography fixed effects, η_g , are census-based statistical areas (CBSA) or zip codes. As zip codes do not span across states and anti-deficiency statutes do

⁹ See Severino et al. (2014) for a similar discussion.

not change over the sample period, the inclusion of zip code fixed effects will make β_0 unidentifiable. To control for other economic factors that may influence the mortgage market, I include the log of population, log of average income and unemployment rate at the county level, which are represented by Z_z in the regression equation. Since housing transactions are often positively correlated with housing price growth, in some specifications, I also include lagged housing price growth and housing price volatility to control for these effects. To better represent the situation a borrower in recourse states would face after the reform, regressions are weighted by the number of housing units in each zip code. Standard errors are clustered at either the CBSA or zip code level, depending on the choice of geographical fixed effects. $\beta_1 > 0$ would suggest that the effect from expanded access to credit dominates the effect from strategic borrowers dropping out of the market.

Q2: Does strengthening of recourse improve access to finance for borrowers with a given level of credit risk?

The relevance of collateral is well-documented in the literature. The theoretical model of Stiglitz and Weiss (1981) illustrate that adverse selection in the credit market can lead to credit rationing, which Bester (1985) and Wette (1983) show can be overcome by pledging collateral as sorting device. Other models of asymmetric information, such as Besanko and Thakor (1987a), Besanko and Thakor (1987b), Berger and Udell (1990), Boot et al. (1991), Chan and Kanatas (1985), and Chan and Thakor (1987), and also underscore the importance of collateral in the credit market. Benmelech and Bergman (2009) provide detailed discussion of this issue. Mortgage contracts by definition are collateralized loans, so strengthening of recourse can be viewed as increase in pledgeability of asset or enhancement of collateral value. Similar to Jappelli et al. (2005), Quintin (2012) and Assunção et al. (2013), one might expect that, for a

borrower with the same characteristics, lenders may become more lenient. Specifically, as the supply curve is shifted outward, are borrowers with the same credit risk more likely to have their loan applications accepted after the reform? Are the interest rates charged by lenders lower? To investigate this question, I estimate the difference-in-difference regression presented in Equation (2).

$$(2) \quad y_{izt} = \eta_g + \delta' D_{it} + \beta_0 \cdot \text{recourse}_i + \beta_1 \cdot \text{recourse}_i \cdot \text{post}_i + \gamma' X_i + \phi' Z_i + \varepsilon_{izt}$$

y_{izt} represents two outcome variables of interest, which are (1) indicator for rejection, and (2) interest rate charged by lender. With the specification, the analysis on the rejection rate is performed using the linear probability model. The unique strength of the New Century data is that it includes applications that are funded and declined, which allows me to investigate whether applications are screened less strictly after recourse is strengthened. Moreover, by performing the interest rate analysis on the pool of all applications, I am able to limit any potential selection bias that might otherwise be present if one only had data on funded loans as opposed to declined loans. Since the pool of applications in the sample has both fixed rate mortgages (FRMs) and adjustable rate mortgages (ARMs), and ARMs often have low initial rates (teaser rate) that reset to higher rates in the future, I need a definition of interest rate that more accurately reflects the cost of borrowing.¹⁰ For FRMs, I use the note rate paid; for ARMs, I use the fully-indexed rate, which is a combination of a benchmark rate (often LIBOR) and a margin. To control for any potential differences in underwriting standard between FRMs and ARMs, the time fixed effects for each type of loan are included separately. Because of the level detail afforded by the data, I

¹⁰ The data on interest rates for declined loan applications is available because of the nature of the application process. Lenders maintain “menus” (referred to as rate sheets) of interest rates given different borrower and loan attributes. A loan application will contain information about the borrower, the loan and the proposed interest rate, and the lender then decides whether or not to fund the loan.

am able to include very detailed time fixed effects, up to the year-month level. In other words, I control for year-month-type variations in underwriting and interest rate policies by New Century by inclusion of D_{it} . In addition, the time fixed effects are subdivided into maturity categories for the interest rate regressions, to better reflect the differential risks inherent in loans with different maturities. In both of the regressions, I include detailed covariates on borrower, property and loan characteristics (represented by X_i), as well as macroeconomic controls (represented by Z_z) as in the HMDA analysis. Geography fixed effects, η_g , are census-based statistical areas (CBSA) or zip codes. Standard errors are clustered at either the CBSA or zip code level, depending on the choice of geographical fixed effects.

For the rejection rate regression, I expect β_1 to be negative; after recourse is strengthened, lenders should view applications in recourse states more favorably, and, all else equal, should be less likely to reject an application. The adjustment could occur in terms of more lenient credit policy, or lower cost of credit, or both. For the interest rate regression, one may also expect β_1 to be negative; all else equal, strengthening recourse increases collateral value in recourse states, so note rate can be lowered to achieve the same expected return.

Q3: Does strengthening of recourse allow riskier borrowers access to mortgage credit market?

As recourse is strengthened, the willingness of lenders to expand credit is increased from the collateral channel; consequently, the marginal borrower should be of lower credit risk. Ideally, one would like to compare the distributions of credit risks for borrowers who are funded before and after the reform. One way to explore this question is to look at the average risks of borrowers in recourse states before and after the reform. Similar to the earlier analysis, I estimate Equation (3) with borrower or loan characteristics as outcome variables of interest.

$$(3) \quad y_{izt} = \eta_z + \delta' D_{it} + \beta_0 \cdot \text{recourse}_i + \beta_1 \cdot \text{recourse}_i \cdot \text{post}_i + \gamma' X_i + \phi' Z_i + \varepsilon_{izt}$$

The borrower characteristics that I consider are (1) Indicator for high-risk borrowers, (2) FICO score, (3) borrower age, (4) indicator for self-employed borrower, and (5) indicator for low-documentation loan. For loan characteristics, the variables of interest are (1) loan-to-value ratio and (2) debt-to-income ratio. For regressions that examine individual borrower characteristics, I drop all borrower controls. Similarly, the regressions that examine loan characteristics do not include loan controls.

3.4. Summary Statistics

Table 1 displays the summary statistics of the HMDA and macroeconomic data used for the aggregate lending analysis. The sample period covered is between 2004 and 2007, divided equally into the pre- and post-reform period. I restrict the sample to include only zip codes that receive at least 10 loan applications in each year to exclude potentially remote areas, where lender considerations may be different. There are 49,482 zip code-year observations in total. Compared to all outstanding stock of housing in the U.S., only a tiny fraction is involved in a transaction each year. In the sample, there are only 3 purchase loans per 100 housing units on average. This reflects the illiquid nature of the housing market; inventory turnover is very low compared to financial assets. The average lagged housing price growth rates in both recourse and non-recourse states are still positive in the two periods of the sample, as the major price declines start in mid-2007, so the lagged growth rates corresponding to the downturn years are not in the sample. The growth rates at the zip code level tell another story, as some zip codes exhibit the price declines earlier than the aggregate trend.

For the micro-level analysis of lender response, I restrict the applications to be from the first quarter of 2004 to the first quarter of 2007. The end date of the sample is dictated by data availability, but the start date is chosen such that there are sufficient observations with national coverage, but not too far from the reform date that other unobserved changes could also affect the outcome. The reform was signed in April 2005 but did not take effect until October 2005. Because the effect of the reform would be realized when borrowers default, the effective date is less relevant than the signing date: lenders would revise their underwriting policy when uncertainty regarding the law is resolved. For this reason, I classify loan applications received after April 2005 as post-reform. After cleaning the data (process described in the appendix), there are approximately 275,000 loan applications in the sample. Table 2 presents the summary statistics of the data. On average, 7.5 percent of the loan applications are rejected by the lender. More than 80 percent of the loans in the sample carry adjustable interest rates. Since the lender is California-based, and property prices in California were growing more rapidly than other states, the average rejection rate is much lower in non-recourse states than recourse states, while average loan amount and likelihood that a loan carries subordinated liens are higher. Borrowers in non-recourse states are more likely to be self-employed, have low documentation, have higher credit score, and have higher income. All these are typical features of low-documentation loans. The variables that are more consistent across states are LTV, DTI, interest rate and borrower age. This similarity potentially suggests that lenders may choose to fix certain components of the mortgage offering and compete on other dimensions instead.

Finally, Table 3 displays the summary statistics for New Century's loans that are comparable to Freddie Mac's loans. Because Freddie Mac's data only contains loans with full documentation, I drop low-documentation loans in the New Century sample. Freddie Mac only

reports the quarter in which the loan was made, so I classify loans made after the second quarter of 2005 as post-reform. There are 81,253 funded New Century loans with full-documentation, and approximately 1.2 million funded loans bought or guaranteed by Freddie Mac. Compared to the government-sponsored market, loans in the private market, represented by New Century data, have lower FICO score and higher income, LTV, DTI, and are more likely to have subordinated liens and prepayment penalty. Interest rates across the two samples are not directly comparable, because New Century sample comprises mainly adjustable-rate mortgages, while Freddie Mac sample contains only fixed-rate mortgages. Similar to the pattern observed in New Century data, LTV, DTI, and interest rate do not differ much across recourse and non-recourse states.

4. Results

4.1. Aggregate Lending

To motivate the difference-in-difference strategy, I plot the average number of funded purchase loans per housing unit in each year separately for recourse and non-recourse states for 2004 to 2008. Prior to 2004, HMDA data does not distinguish between first and subordinated liens so I exclude observations prior to 2004 from the analysis. Data after 2008 is excluded because I do not want the financial crisis to influence the results. The averages are weighted by the number of housing units in each zip code and scaled such that the values in 2004 are normalized to 1. The results are plotted in Figure 3. The graph suggests that lending slows down less quickly in recourse states after the reform, which is consistent with the expansion of credit supply after recourse is strengthened. On the national level, loan volume decreases as the housing market cycle enters the downturn, but the slowdown is less pronounced in recourse states.

The results of the multivariate analysis are shown in Table 4. In the baseline specification where CBSA fixed effects are used to control for time-invariant unobserved heterogeneities, the number of funded loans per housing unit is significantly higher in recourse states after the reform. To further allow variations in unobserved heterogeneities over finer definition of geography, I replace the CBSA fixed effects with zip code fixed effects. The adjusted R-squared value increases significantly, from 0.24 to 0.86, but the difference-in-difference coefficient remains essentially unchanged, suggesting that the increase is not driven by area-specific differences.¹¹ Based on this model, the relative increase in number of purchase loans per housing unit in recourse states after the reform is 0.008 transactions per unit, which is approximately an increase of 24 percent relative to the sample mean of 0.032.¹² Because empirical evidence shows that trading volume of real estate transactions and housing prices are positively correlated, I include lagged housing price growth and housing price volatility as control variables to account for this effect.¹³ The inclusion of housing price growth absorbs some the increase in loan volume, and because average housing price growth is higher in recourse states, the estimated coefficient is further reduced. The magnitude of the estimated coefficient is reduced by more than 50 percent, but still both economically and statistically significant. This estimate suggests that loan quantities are 9.5 percent higher.¹⁴ Finally, including the zip code level housing price growth from Zillow also reduced the estimated coefficient. Because the housing price growth

¹¹ One concern with using legal changes as a quasi-natural experiment is that the change may be driven by economic conditions. Since the reform is a national change that is intended to target bankruptcy, the inclusion of time fixed effects helps address this concern to a certain extent. However, one may also argue that the change was instigated as a response to economic conditions in particular states. The robustness of the result to the change in definition of geography fixed effects helps address the concern that the change in law was driven by local economic conditions.

¹² The reciprocal of the average can be interpreted as the average time it takes for a household to move, which is approximately 31 years.

¹³ Several explanations have been proposed for this correlation. For example, in Stein (1995), down-payment requirements leads to self-reinforcing mechanism to demand shocks, while in Genesove and Mayer (2001), loss aversion delays homeowners decisions to sell in downturns.

¹⁴ One may be concerned from looking at Figure 3 that the effect may be driven by other pre-existing trends instead. The inclusion of county-level and state-level linear trends do not materially affect the results, and hence are not reported for the sake of brevity.

data is not available in all zip codes, the sample is more restricted. Similar to the full sample, housing price growth and loan volume are positively related, explaining part of the increase in loan volume observed in the baseline regression.

The result in this section is consistent with the findings of Assunção et al. (2013) and Jappelli et al. (2005); strengthening recourse (hence collateral value) has a positive net effect on the volume of credit intermediated. The supply effect dominates the demand effect. The increase from expansion of credit to those who may have been previously denied access to the market outweighs the decrease from strategic borrowers who value the option to default. Because the loan under consideration is for the purpose of purchasing properties, a strategic borrower dropping out of the market would be tantamount to a buyer who chooses alternative financing to a mortgage or who foregoes buying the property altogether. Given that there are few alternative sources of financing for an average buyer and that a decision to buy a property is often inflexible, it is unlikely that such borrowers will exist in sufficient mass, thus the result found in this section may not be too surprising.¹⁵

4.2. Lender Response

Does strengthening of recourse improve access to finance for borrowers with a given level of credit risk? The two ways that the improvement could manifest are through more lenient screening and/or lower interest rate for borrowers who are observationally equivalent. To avoid potential selection bias based on unobservable borrower information, I perform the analysis on all loan applications rather than funded loans. Summary statistics presented in Table 2 provide an early preview of what to expect: the unconditional rejection rate in non-recourse states increases

¹⁵ Because I use the number of funded purchase loans per housing unit in each zip code as dependent variable, the effect on aggregate lending observed here is potentially a result of both demand and supply. In unreported regressions, I use the number of purchase applications instead and the magnitude of the results relative to the sample mean is unchanged.

significantly by 2.5 percent, while rejection rate in recourse states decreases by 0.68 percent. The first column of Table 5 reports the effect of the reform on rejection rate with CBSA as choice of geography fixed effects. After the reform, observationally equivalent loans in recourse states are 3.07 percent less likely to be rejected, a 40 percent decrease from the average rejection rate. The magnitude is very similar to the change observed in the summary statistics. When zip code is used instead of CBSA for geography fixed effects, the magnitude of the estimated coefficient is similar but slightly lower. Strengthening of recourse seems to significantly increase likelihood of financing.¹⁶

Do interest rates also react to the strengthening of recourse? Ghent and Kudlyak (2011) do not find that interest rates in recourse states are lower but rather the opposite result is found. Similarly, Li and Oswald (2014) find that lenders actually reduced interest rates after Nevada abolished deficiency judgments in 2009. Both studies rely on cross-sectional data for this analysis. Using the same difference-in-difference strategy and controlling for observable borrower characteristics, I find that interest rates are slightly lower as recourse is strengthened. However, the magnitude is very small and economically not very meaningful: the decrease is only 4 basis points, a 0.5 percent decrease relative to the average interest rate. The result of the analysis is reported in Table 6.

Taken together, the results suggest that lenders appear to take the issue of recourse into account, but the margin of adjustment is in the decision to approve a loan, rather than explicitly pricing the risk into interest rates, a telltale of Stiglitz-Weiss credit rationing. Using the data from

¹⁶ Saengchote (2014) finds that low-documentation loans are more sensitive to soft information than full-documentation loans. While the summary statistics in Table 2 suggests that the proportion of applicants with low-documentation and rejection rate increase significantly in non-recourse states, the reduction in rejection rate does not appear to driven by this composition change. In unreported regressions where the model in column 2 of Table 5 is re-estimated separately for low-documentation and full-documentation loans, the effect on reduction in rejection rate is largely the same as the pooled sample.

the same lender, Saengchote (2014) also finds that New Century does not seem to price potential risks from soft information in the interest rate, but rather adjusts through the approval decision. A similar result in small business lending is documented Petersen and Rajan (1994), who find that firms' relationships with financial institutions are reflected in availability of financing rather than interest rate. One may challenge the external validity of this finding in the mortgage market, since the data comes from a single lender. However, Hurst et al. (2014) also find that GSEs do not appear to price predictable regional default risks in their interest rates but instead seem to adopt a national interest rate policy instead. Non-GSE market, on the other hand, appears to price some of the risks in their interest rates. There are at least two potential explanations for this finding. First, because a mortgage contract entails a menu of prices given different combination of attributes, it may be simpler for lenders in terms of internal operation and competition to standardize their pricing schedule and adjust on approval decision, rather than customize interest rates for individual borrowers. Second, setting interest rates based on geographical differences may unintentionally violate the Equal Credit Opportunity Act (ECOA). Lenders may be reluctant to adjust through interest rate, which is more transparent than approval decision.¹⁷

4.3. Effect on Borrower Risk

Are lenders more willing to lend to those who previously did not have access to the credit market? Table 7 reports the results the strengthening of recourse has on average borrower and loan characteristics from estimating Equation (3). For this section, the analysis is performed on the pool of funded loans, rather than applications, to better capture the degree of risk accepted by the

¹⁷ Petersen and Rajan (1994) provides two theoretical reasons why lenders choose to adjust through availability of credit rather than price. First, borrowers faced with Stiglitz-Weiss credit constraint would prefer more, rather than cheaper, credit. Second, given how specific lending guidelines usually are, soft information about the firm is more easily incorporated through approval decision rather than interest rate. The second reason is more directly related to the setting of Saengchote (2014) and this study.

lender.¹⁸ Column 1 examines the change in proportion of borrowers whom New Century classifies as high-risk. The internal risk grade is determined based on past default and bankruptcy history. In other words, the risk grade explicitly captures delinquency-related events from a borrower's past credit history, which is one of many dimensions that make up the FICO score. I define high-risk as those with internal rating of B or worse. Borrowers with rating of B or worse had missed payments or filed for bankruptcy in the past, so the issue of deficiency judgment is more pertinent for this pool of applicants. After the reform, the proportion of high-risk borrowers increase by 1.2 percentage point, more than 30 % increase from the average. New Century is significantly more willing to lend to borrowers with higher ex-ante probability of default in recourse states after the reform, exemplifying the interpretation of the net increase in credit as expansion of supply from the collateral channel.

The results on other attributes, however, seem to suggest that borrowers on average are less risky after the reform: FICO score and borrower age are higher, while the proportion of self-employed, applicants with low-documentation, LTV and DTI are lower. It is worth noting that the magnitude of the change in borrower age, LTV and DTI are very small. An average borrower is only 7 months older, and LTV and DTI are not even one percentage point lower. While these three variables may not be very indicative of any material changes in lending policy after the reform, the reduction in the proportion of self-employed and low-documentation can be interpreted as the reduction in demand from borrowers with insurance motive. Self-employed borrowers typically are synonymous with low-documentation borrowers due to their inability to provide the W-2 form in their application. As self-employed borrowers have more volatile income than regularly employed borrowers, their need for insurance is greater. The strengthening of recourse weakens the downside insurance, discouraging self-employed borrowers from

¹⁸ Similar estimation on the sample of applications (rather than funded loans) reveals the same pattern.

applying for mortgages. To reconcile the coexistence of the increase in average FICO score and increase in proportion of borrowers classified as high risk, one has to consider them jointly. Since both FICO score and internal risk grade are ex-ante predictors of default, New Century may be willing to borrowers with history of default only if they have higher FICO score.¹⁹

4.4. Private versus GSE Markets

Is this response representative of the broad market? While the rich information in the New Century dataset allows concerns raised by Quintin (2012) to be addressed, one maybe concerned that the response by one company be generalizable, particular since the market is dominated by GSE-backed loans. The Freddie Mac dataset allows for a subset of the questions addressed earlier by the New Century dataset to be explored, with a tradeoff on the level of details one can observe. Since the Freddie Mac dataset only contains full-documentation loans, I restrict the New Century sample to funded full-documentation for comparability. In addition, I include only control variables that are present across the two datasets and include year-quarter fixed effects rather than year-month. Table 8 reports the result of regressing interest rates on common set of loan, borrower, county and housing market controls. Because geographical locations in the Freddie Mac dataset is only identified to the three-digit zip code level, some geographical areas cover multiple states so the indicator for recourse state is no longer absorbed by the fixed effects. The reform reduces interest rates in the private segment, but increases interest rates in the GSE segment. However, the magnitudes of the differences are very small; particularly, the magnitude in the Freddie Mac sample is only 1 basis point. Similar to the finding of Hurst et al. (2014), the adjustment in the mortgage market seems to occur in channels other than interest rates.

¹⁹ Based on the estimates from Saengchote (2014), the incremental default risk from accepting borrowers internally classified as high risk by 30 percent is adequately compensated by an average increase in FICO score of 3.8.

One can also explore whether an average borrower in the pool is riskier after the reform. The regressions on borrower risk are repeated for the two samples, and the results are presented in Table 9. The result for New Century sample is similar to earlier: average FICO score in recourse states is higher after the reform, while LTV and DTI are lower. For the Freddie Mac sample, however, there is no evidence that FICO score is significantly different. LTV and DTI, while statistically higher, are not economically different. One reason why borrower risk does not appear to be different in the Freddie Mac sample is proposed in Hurst et al. (2014): GSEs may be maintaining a national policy for underwriting due to political pressure and fear of unintended discrimination.

4.5. High Income Borrowers

In addition to making bankruptcy more difficult and costly overall, the reform was intended to specifically target wealthier people who tend turn to Chapter 7 as a way to discharge their unsecured debt. The income-based means test precludes borrowers whose income exceeds an exemption level from filing under Chapter 7 and instead must file under Chapter 13, which makes discharge of deficiency judgment more difficult. The exemption is approximately equal to the state median income. To see if the reform has an extra effect on those with higher income, I define an indicator which takes value one if the borrower's income exceeds the state median, and estimate the interaction term separately for high income borrowers and others. Approximately 70 percent of borrowers in the sample satisfy the condition, and the proportion is the same before and after the reform. To decompose the effect of the reform by income group, I estimate Equation (4) with the same control variables as the main New Century regressions.

$$(4) \quad y_{izt} = \eta_z + \delta' D_{it} + \beta_1 \cdot \text{recourse}_i \cdot \text{post}_i \\ + \beta_2 \cdot \text{recourse}_i \cdot \text{highincome}_i \cdot \text{post}_i + \gamma' X_i + \phi' Z_i + \varepsilon_{izt}$$

Table 10 reports the results of rejection rate for the high-income borrowers. The rejection rate for higher-income borrowers is not significantly different from the lower-income borrowers after the reform. However, the estimated coefficient, albeit small, has a negative sign as one would expect from relatively greater difficult of filing for bankruptcy under Chapter 7. Similar regressions for borrower risk characteristics are performed and the results are presented in Table 11. Because earlier results seem to indicate that the relevant margin of adjustment is in the approval rate and propensity for New Century to accept people with past delinquencies, the focus of the analysis is on the indicator for high-risk borrower and FICO score, which are more directly related to credit risk than other attributes. To further examine the reduction in demand from insurance channel posited earlier, I also estimate Equation (4) on indicators for self-employment and low-documentation loans. The increases in borrowers with worse internal risk grade are approximately the same in both income groups, as the differential coefficient for the higher-income borrowers is not statistically significant. However, lower-income borrowers who are funded do not have materially different FICO score, while higher-income borrowers have significantly higher score. The results in column 3 and 4 suggest that the reduction in self-employed, low-document borrowers (those associated with more volatile income) is stronger among lower-income borrowers. After the reform, higher-income borrowers in the sample are more likely to be self-employed and have low-documentation, two characteristics which are correlated with higher FICO score. To the extent that lower income could be associated with greater vulnerability to income shocks, a possible interpretation for this finding is as follow. As recourse is strengthened, the reduction in insurance value discourages self-employed borrowers

in recourse states who are more exposed to income shock from applying for a mortgage. As a result, an average self-employed person has higher income (and thus FICO score) after the reform. The findings in this section suggest that credit expansion is similar across income group, but lower-income self-employed borrowers may have been displaced.

There are three potential explanations for the lack of differential expansion in credit. First, the increased difficulty of bankruptcy filing may be more costly to lower-income borrowers, making the increase in recourse relatively more stringent for them (since the direct cost of filing is a fixed fee). Second, since means test is based on non-exempt income, which has many deductible items, the proportion of borrowers whom the constraint actually binds may be smaller than estimated.²⁰ Indeed, White (2009) remarks that the formula for the means test is generous enough that most debtors still qualify for Chapter 7 even if their incomes are in the top decile of the income distribution. Third, Li et al. (2011) document that the reform caused prime and subprime mortgage default rates to rise by 23% and 14%, respectively, and more so for high-income borrowers.²¹ Prior to the reform, borrowers had the ability to shift funds from paying unsecured debt such as credit cards to paying their mortgages. Their data shows that borrowers—presumably higher-income—rushed to file for bankruptcy under Chapter 7 prior to the enactment of the law. It is possible that lenders experienced higher default rate among high-income borrowers and thus adjust their underwriting criteria accordingly. However, the default-induced tightening of credit standard does not threaten my identification, as the increase in default rates

²⁰ Exemptions include allowances for housing and utilities, transport, food, clothing, personal care. Details of the means test and the exemptions can be found at <http://www.justice.gov/ust/eo/bapcpa/meanstesting.htm>.

²¹ A similar result in the subprime mortgage market is also found by Morgan et al. (2012). In unreported regressions, I redefine high-income as those who earn more than twice the median income. The probability of rejection for those borrowers is actually higher, providing suggestive evidence that lenders may have been wary of such borrowers following higher default experience. Also, the probability of rejection for lower-income borrowers is magnified.

documented by the study is a national phenomenon and driven by asset exemptions in bankruptcy filing rather than recourse.

5. Conclusion

Should mortgage contracts in the U.S. have recourse to borrowers' non-housing assets? Observers have proposed recourse mortgages as a way to alleviate the foreclosure spiral and prevent future speculative bubble in the housing market, and cases are often made that the recourse feature of mortgages in other countries, such as Canada, helps keep default and foreclosure in check. However, because recourse is directly related to collateral value, changes that affect the strength of recourse will also have an effect on the credit market. Departing from the usual debate of whether recourse mortgages can be help reduce foreclosure, I explore the relevance of recourse on mortgage credit intermediation.

Using the bankruptcy reform (which effectively strengthens recourse) as a quasi-natural experiment, I document that the aggregate quantity of mortgage lending is increased after the reform is implemented, suggesting that the supply effect of increased collateral outweighs the demand effect from reduced insurance value. Lenders appear to adjust their underwriting through approval decision rather than interest rate, and borrower risks do not appear to be significantly different, except for the greater willingness from the lender to accept borrowers with past default and/or bankruptcy history. While lower-income self-employed borrowers may have been displaced, the overall expansion of credit seems to occur equally across the income range.

Overall, my study finds that strengthening recourse—while potentially useful as a tool to discourage strategic default and foreclosure—can also expand credit supply through increased collateral value. However, a conclusive policy recommendation cannot be drawn from this analysis, as welfare implications of the expansion also need to be addressed.

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Appendix: List of Variables for Micro-level Datasets

Data in the New Century sample includes first lien loan applications which are funded, declined, or withdrawn. Loans must have FICO score between 300 and 850, borrower age between 18 and 100, loan-to-value ratio between 10 and 120, debt-to-income ratio between 5 and 65 and APR less than 25 percent. Because Alaska and Hawaii may be substantially different from the rest of the U.S., I exclude loan applications in the two states (there are fewer than 15,000 loans). Data in the Freddie Mac sample is taken as is, with loans in Alaska, Hawaii, Puerto Rico and Guam exclude for the same reason.

Outcome Variables	
Rejection*	Indicator variable which equals one if the loan application is rejected by New Century. Not available for Freddie Mac dataset.
Interest rate	For fixed rate mortgages, the variable is defined as the contractual interest rate. For adjustable rate mortgages, it is defined as the index rate (typically the LIBOR at origination) plus the margin. The sum is known as the fully-indexed rate, which the rate the borrower will pay when the loan becomes fully floating.
Loan Characteristics	
Ln(loan amount)	The natural log of loan amount. Used as continuous variable.
Loan-to-value ratio	Measures the loan amount relative to appraisal value. Used as continuous variable.
Debt-to-income ratio	Debt-to-income ratio used in this study is the back-end ratio, which includes all other non-mortgage payments. Agency loans often have caps on the debt-to-income ratio, and lenders may require borrowers to take out private mortgage insurance if the ratio is excessively high. While there are caps for different types of agency loans, the different thresholds also apply to different method of underwriting (e.g. manual or through software). Other compensating factors may also be considered when underwriting the loans. Debt-to-income ratio is used as continuous variable in the analysis.

Prepayment penalty	Indicator variable which equals one if the loan contract contains a prepayment penalty. Prepayment penalties come as the baseline choice for New Century and borrowers have to opt out by paying additional interest adjustment.
Has subordinated lien	Indicator variable which equals one if the loan is taken out with attached subordinated liens originated by New Century, typically referred to as a piggyback loan, or has combined LTV ratio greater than LTV, indicating the presence of other liens on the underlying property.
Interest-only loan	Indicator variable which equals one if the loan contains a period where the loan does not amortize.
Property Characteristics	
Property is a condominium	Indicator variable which equals one if the property is condominium.
Borrower Characteristics	
Borrower risk grade*	Indicator variables defined in accordance with New Century rate sheet. The categories are A+, A-, B, and C. The absorbing category is AA, which is the majority of New Century's portfolio. Risk grade is defined primarily by recent bankruptcy status and notice of default (NOD) received. The risk grade determines the base rate and margin. For example, a risk grade of AA requires that the borrower has never been 30 or more days behind in payment (0x30) and no NOD in last 24 months. This will set the borrower's base ARM margin to 6.05% in March 2007. Not available for Freddie Mac dataset.
FICO score, squared	FICO score summarizes the borrower's default risk based on information on the borrower's credit history. A borrower's credit history does not directly record the borrower's income and hence must be supplemented with other sources of income verification. FICO score is used as continuous variable in the analysis.
Borrower age, squared*	Used as continuous variable. Not available for Freddie Mac dataset.
Ln(monthly income)*	Natural log of monthly income as stated on the loan application. Not directly available but can be inferred for Freddie Mac dataset.
Self-employed*	Indicator variable which equals one if the borrower states on the loan application that she is self-employed. Not available for Freddie Mac dataset.
Limited-documentation*	Indicator variable which equals one if the borrower does not submit two written forms of income verification, or 12 or more consecutive monthly bank statements showing stable income for at least 12 months. To be classified as limited, the borrower needs to submit six consecutive monthly bank statements on their individual bank accounts. Not available for Freddie Mac dataset.
Stated-documentation*	Indicator variable which equals one if the borrower does not submit any proof of income. According to New Century's 10-K in 2005, "Under the stated income documentation program, an applicant may be qualified based upon monthly income as stated on the mortgage loan application if the applicant meets certain criteria." Not available for Freddie Mac dataset.
Low-documentation*	The sum of limited-documentation and stated-documentation variables. Not available for Freddie Mac dataset.
Neighborhood Characteristics and Macroeconomic Condition	
Ln(Population)	Natural log of population at the county level. Data is obtained from the Bureau of Economic Analysis.
Ln(Av income)	Natural log of average income at the county level. Data is obtained from the Bureau of Economic Analysis.

Unemployment rate	Unemployment rate at the county level. Data is obtained from the Bureau of Labor Statistics.
Housing price growth	Changes in the House Price Index in the previous year at the CBSA level. Data is obtained from the Federal Housing Finance Agency.
5-year housing price volatility	Volatility of housing price growth in the CBSA over the last 5 years. Data is obtained from the Federal Housing Finance Agency.

* Indicates information exclusive to the New Century dataset.

Figure 1. Non-Recourse States in the U.S.

The following map shows the nine states where anti-deficiency statutes prohibit lenders from pursuing mortgage shortfalls. While North Carolina's purchase mortgage is often considered non-recourse, the ruling by North Carolina Court of Appeals in October 1999 clarifies that for third-parties such as lenders, the anti-deficiency statute does not apply. For this reason, I classify North Carolina as recourse state. For California and Montana, dark-shaded on the map, mortgage loans are non-recourse as long as the loan purpose is to purchase new properties. Once borrowers refinance, they lose the anti-deficiency protection and become recourse loans.

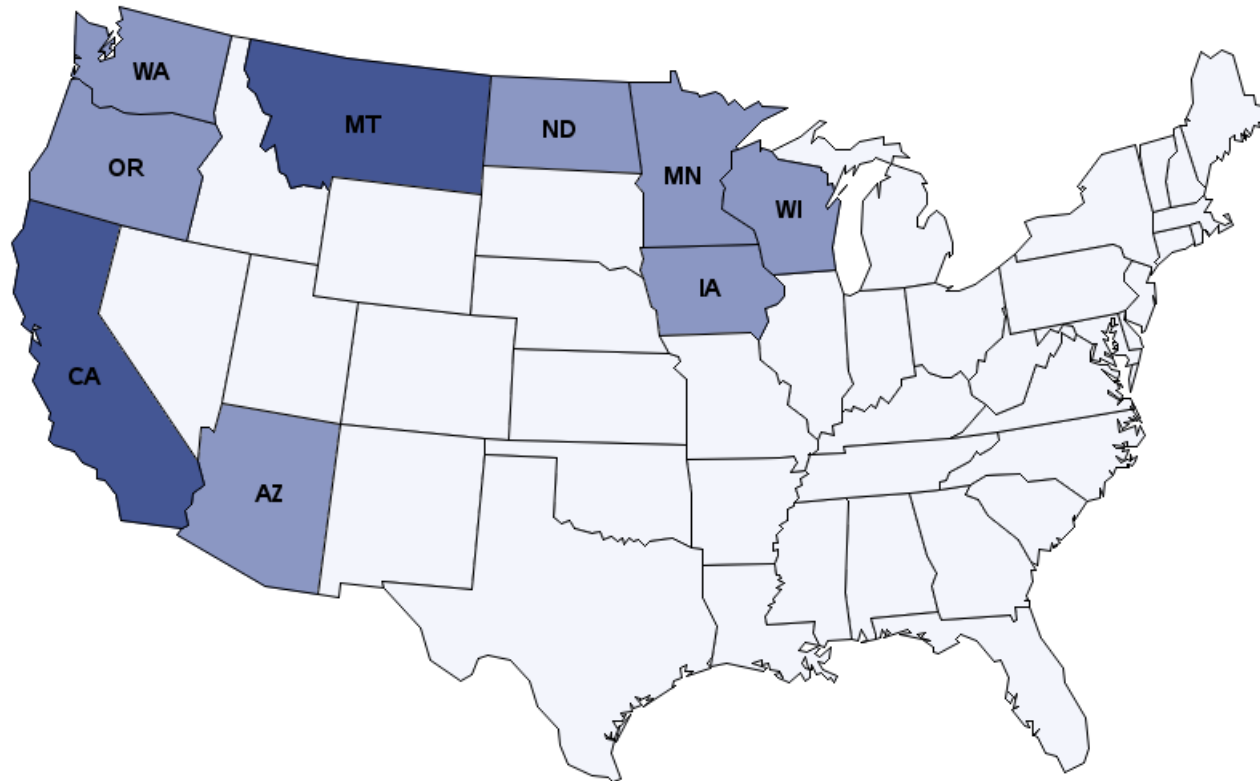


Figure 2. Geographical Distribution of New Century's Purchase Loans

The following map shows the distribution of purchase loans applications received by New Century. The coverage is national, with approximately 60 percent of the applications in non-recourse states. The most represented recourse state in the sample is Florida, and non-recourse state California.

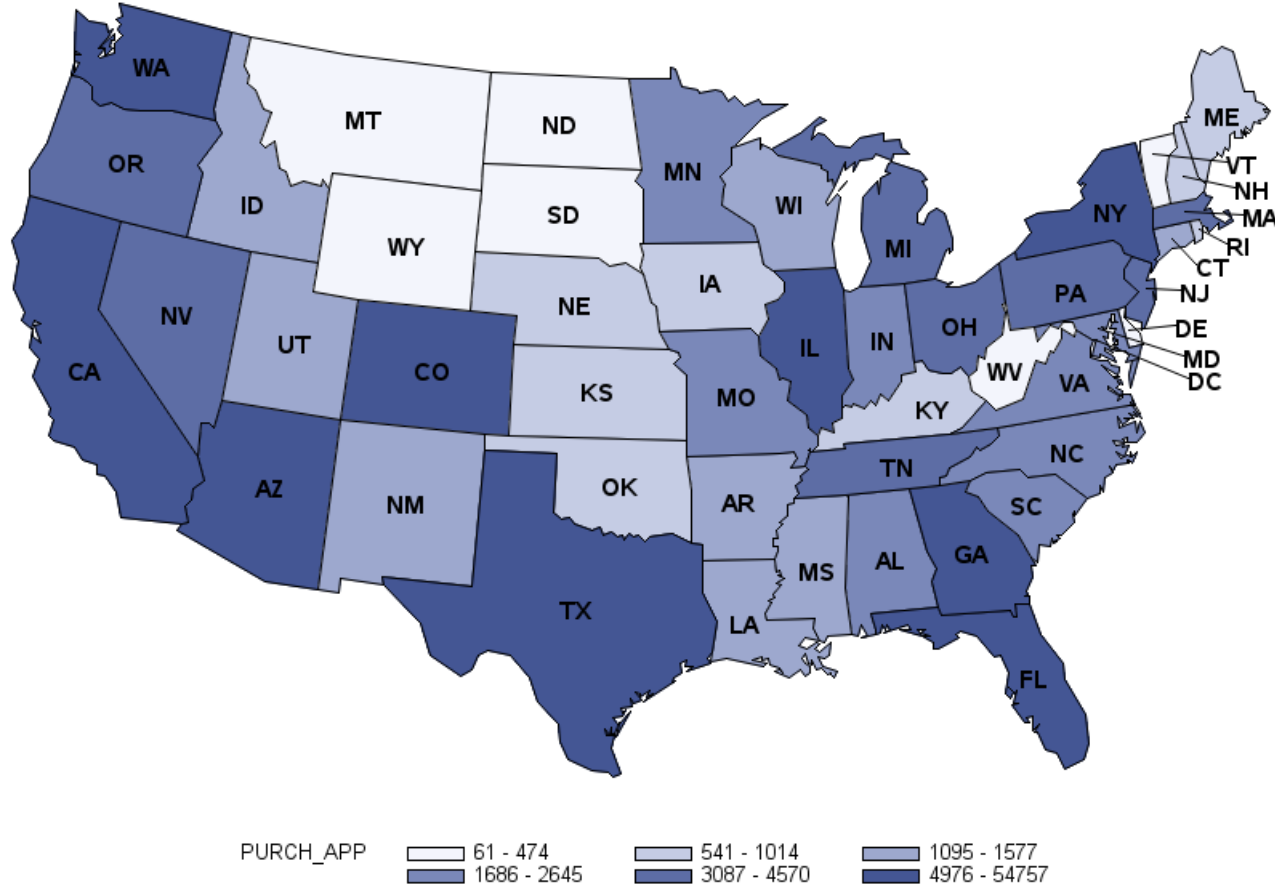


Figure 3. Average Number of Funded Purchase Mortgage per Housing Unit

The following graph shows the average number of purchase mortgage funded per housing unit in each zip code. The annual averages, weighted by the number of housing units in each zip code, are calculated for each year between 2004 and 2008 and then scaled by the values of 2004 for ease of comparison. On the national level, loan volume decreases as the housing market cycle enters the downturn, but the slowdown is less pronounced in recourse states.

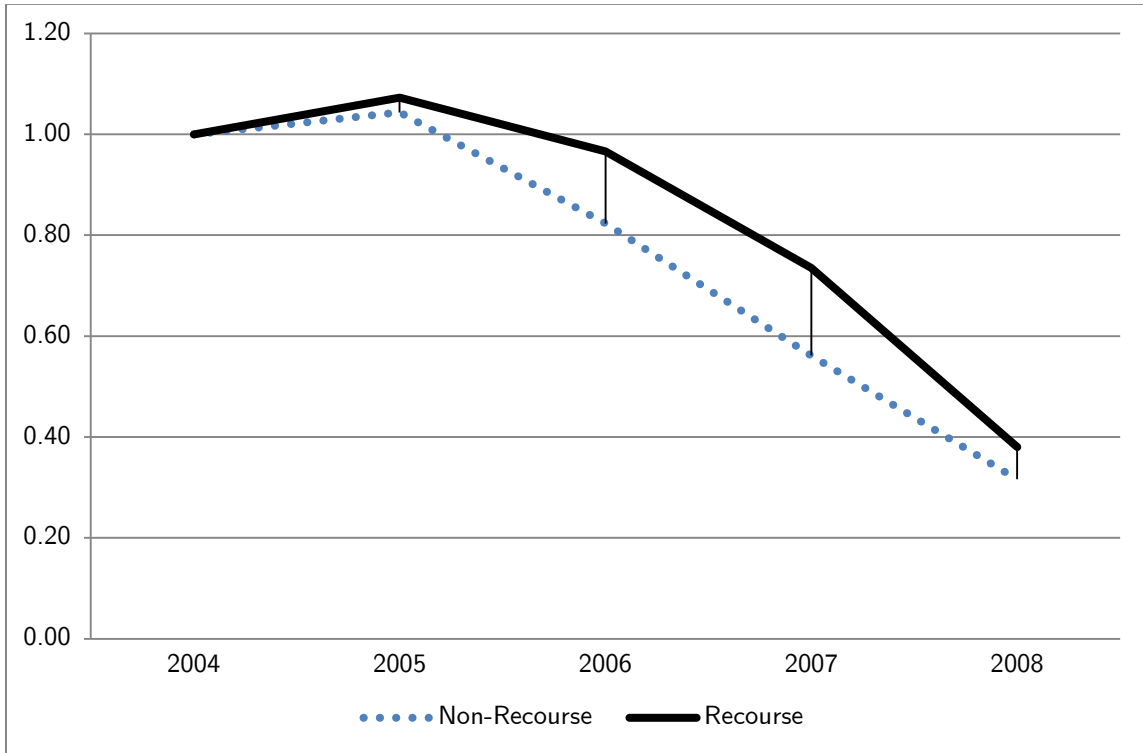


Table 1. Summary Statistics of Aggregate Lending Data

This table provides descriptive statistics for the data used in the analysis of aggregate lending at the zip code level. Data included is from 2004 to 2007, where the first two years are classified as before the reform and the last two years as after.

	Non-recourse states		Recourse states		Obs.
	Before	After	Before	After	
No. of purchase loan per housing unit (Zip code)	0.0430 (0.0328)	0.0297 (0.0230)	0.0345 (0.0335)	0.0284 (0.0300)	49,482
Lagged housing price growth (CBSA)	0.0284 (0.0556)	0.0852 (0.0768)	0.0591 (0.0414)	0.0657 (0.0495)	6,538
Lagged 5-year housing price volatility (CBSA)	3.9012 (3.5594)	3.9192 (3.4690)	4.2078 (3.3613)	4.1790 (3.3304)	6,538
Lagged Housing price growth (Zip code)	0.1627 (0.0941)	0.0906 (0.1260)	0.1019 (0.0840)	0.0642 (0.0984)	30,240
Ln(Population '000) (county)	3.94 (1.33)	3.96 (1.34)	3.87 (1.17)	3.89 (1.17)	9,010
Ln(Av income \$000) (county)	3.98 (0.20)	4.06 (0.21)	4.02 (0.23)	4.09 (0.23)	9,010
Unemployment rate (county)	5.54 (1.89)	4.98 (1.70)	5.51 (1.52)	4.86 (1.48)	9,010

Table 2. Summary Statistics of New Century Data

This table provides descriptive statistics for the data used in the analysis of lender response to change in value of deficiency judgment. Data covers purchase loan applications submitted to New Century from 2004Q1 to 2007Q1. Loan applications submitted after April 2005 are classified as after the bankruptcy reform.

	Non-recourse states		Recourse states	
	Before	After	Before	After
Rejected	0.0379	0.0636	0.0931	0.0875
Interest rate	7.46 (0.95)	10.50 1.21	7.65 (0.89)	10.37 (1.38)
Adjustable rate mortgage	0.93	0.95	0.87	0.84
Ln(loan amount)	12.38 (0.51)	12.57 (0.52)	11.84 (0.54)	11.90 (0.59)
Loan-to-value ratio	82.15 (7.00)	81.29 (6.14)	84.51 (8.42)	83.41 (7.31)
Debt-to-income ratio	41.42 (7.67)	42.56 (7.37)	39.64 (8.80)	40.27 (8.93)
Prepayment penalty	0.90	0.86	0.70	0.70
Has subordinated lien(s)	0.68	0.78	0.49	0.61
Interest-only	0.47	0.46	0.16	0.15
Property is a condominium	0.11	0.11	0.08	0.08
High risk (internal rating)	0.05	0.04	0.05	0.08
FICO score	655.26 (56.58)	651.84 (53.98)	624.22 (58.88)	622.49 (57.13)
Borrower age	37.74 (10.60)	37.70 (10.98)	37.92 (10.64)	38.21 (10.93)
Ln(borrower income)	8.69 (0.53)	8.92 (0.56)	8.39 (0.58)	8.48 (0.60)
Borrower is self-employed	0.27	0.38	0.18	0.21
Low-documentation	0.59	0.69	0.49	0.47
Income exceeds state median	0.78	0.85	0.63	0.63

Total number of observations = 275,985

Table 3. Summary Statistics of New Century/Freddie Mac Data

This table provides descriptive statistics for the data used in the comparison of private versus GSE markets. Data covers full-documentation purchase loans funded by New Century and purchased loans backed by Freddie Mac from 2004Q1 to 2007Q1. Loans funded after 2005Q1 are classified as after the bankruptcy reform.

	Non-recourse states		Recourse states	
	Before	After	Before	After
Interest rate	7.53 (1.02)	10.55 (1.17)	7.80 (0.98)	10.44 (1.32)
Ln(loan amount)	12.26 (0.52)	12.33 (0.56)	11.75 (0.51)	11.75 (0.52)
Loan-to-value ratio	81.55 (6.47)	80.93 (6.22)	83.75 (7.83)	82.83 (6.80)
Debt-to-income ratio	42.15 (7.04)	42.42 (7.36)	40.27 (8.28)	40.53 (8.47)
Prepayment penalty	0.91	0.87	0.74	0.75
Has subordinated lien(s)	0.75	0.78	0.59	0.67
Property is a condominium	0.11	0.11	0.07	0.07
FICO score	639.01 (53.21)	630.33 (52.00)	610.87 (52.26)	606.11 (50.78)
Ln(borrower income)	8.51 (0.53)	8.61 (0.59)	8.24 (0.54)	8.28 (0.56)

Total number of observations = 81,253

	Non-recourse state		Recourse state	
	Before	After	Before	After
Interest rate	5.80 (0.33)	6.15 (0.43)	5.85 (0.34)	6.23 (0.44)
Ln(loan amount)	12.01 (0.48)	12.10 (0.50)	11.88 (0.51)	11.95 (0.52)
Loan-to-value ratio	76.33 (14.96)	75.16 (15.38)	78.96 (14.05)	78.14 (14.33)
Debt-to-income ratio	37.28 (10.87)	37.91 (11.34)	36.09 (11.21)	36.92 (11.69)
Prepayment penalty	0.00	0.00	0.00	0.00
Has subordinated lien(s)	0.21	0.28	0.18	0.26
Property is a condominium	0.09	0.13	0.10	0.12
FICO score	729.90 (51.50)	736.15 (52.74)	724.48 (53.64)	729.41 (55.65)
Ln(borrower income)	7.91 (0.54)	8.02 (0.56)	7.83 (0.58)	7.91 (0.59)

Total number of observations = 1,182,912

Table 4. Effect of the Reform on Aggregate Lending

The following table reports the results from estimating difference-in-difference OLS regressions with the number of purchase loans divided by number of housing units at the zip code level as the dependent variable. The model in column 1 is estimated with CBSA fixed effects, and models in column 2 to 4 are estimated with zip code fixed effects. Column 3 augments the model with controls for housing price at the CBSA level (growth and volatility). Finally, column 4 controls for housing price growth at the zip code level. The regressions are weighted by the number of housing units in each zip code. Controls in all regressions include county-level macroeconomic conditions (natural log of population, natural log of average income, and unemployment rate), geography and year fixed effects. Standard errors, clustered at either the CBSA or zip code level, are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
VARIABLES	purchf_unit	purchf_unit	purchf_unit	purchf_unit
Sample mean	0.0325	0.0325	0.0325	0.0361
Recourse (deficiency judgment allowed)	-0.00189 (0.00281)			
Recourse * I[2006-2007]	0.00794*** (0.00124)	0.00792*** (0.000444)	0.00309*** (0.000446)	0.00593*** (0.000475)
Lagged housing price growth (CBSA)			0.0289*** (0.00235)	
Lagged 5-year housing price volatility (CBSA)			-0.0344*** (0.00193)	
Lagged Housing price growth (Zip code)				0.0226*** (0.00153)
Observations	49,482	49,482	49,482	30,240
County-level controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Geography fixed effects	CBSA	Zip code	Zip code	Zip code
Standard error cluster level	CBSA	Zip code	Zip code	Zip code
Adjusted R-squared	0.244	0.860	0.872	0.857

Table 5. Effect of the Reform on Lender Screening

The following table reports the results from estimating linear probability model with indicator for loan rejection on the interaction of recourse and indicator for post-reform. The model in column 1 is estimated with CBSA fixed effects, and model in column 2 is estimated with zip code fixed effects. Controls in all regressions include loan and borrower characteristics (natural log of loan amount, LTV, DTI, prepayment penalty, multiple liens, interest-only, condominium, indicators for risk grade, FICO score and its square, borrower age and its square, natural log of borrower monthly income, indicators for loan documentation level) and county-level macroeconomic conditions (natural log of population, natural log of average income, and unemployment rate). Year-month fixed effects are included separately for FRM and ARM loans. Standard errors, clustered at either the CBSA or zip code level, are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)
VARIABLES	rejected	rejected
Sample mean	0.0757	0.0757
Recourse (deficiency judgment allowed)	-0.0329** (0.0148)	
Recourse * I[Post BAPCPA]	-0.0307*** (0.00636)	-0.0276*** (0.00275)
Observations	275,985	275,985
Loan and borrower controls	Yes	Yes
County controls	Yes	Yes
Rate-type * year-month fixed effects	Yes	Yes
Geography fixed effects	CBSA	Zip code
Standard error cluster level	CBSA	Zip code
Adjusted R-squared	0.149	0.164

Table 6. Effect of the Reform on Mortgage Interest Rate

The following table reports the results from estimating difference-in-difference OLS regressions with the (fully-indexed) interest rate as the dependent variable. The model in column 1 is estimated with CBSA fixed effects, and model in column 2 is estimated with zip code fixed effects. Controls in all regressions include loan and borrower characteristics (natural log of loan amount, LTV, DTI, prepayment penalty, multiple liens, interest-only, condominium, indicators for risk grade, FICO score and its square, borrower age and its square, natural log of borrower monthly income, indicators for loan documentation level), county-level macroeconomic conditions (natural log of population, natural log of average income, and unemployment rate), and CBSA-level housing market conditions (lagged housing price growth and price volatility). Year-month fixed effects are included separately for FRM and ARM loans by maturity length (categories included are 10, 15, 20, 25 and 30 years). Standard errors, clustered at either the CBSA or zip code level, are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)
VARIABLES	rate	rate
Sample mean	9.407	9.407
Recourse (deficiency judgment allowed)	-0.0691** (0.0351)	
Recourse * I[Post BAPCPA]	-0.0461*** (0.0145)	-0.0442*** (0.00515)
Observations	272,799	272,799
Loan and borrower controls	Yes	Yes
County controls	Yes	Yes
Rate-type * maturity class * year-month fixed effects	Yes	Yes
Geography fixed effects	CBSA	Zip code
Standard error cluster level	CBSA	Zip code
Adjusted R-squared	0.926	0.927

Table 7. Effect of the Reform on Borrower Risk

The following table reports the results from estimating difference-in-difference OLS regressions with the different dimensions that represent borrower risk as the dependent variables. The first five dependent variables represent borrower type, and the last two represent contract type. Controls include loan and borrower characteristics (natural log of loan amount, LTV, DTI, prepayment penalty, multiple liens, interest-only, condominium, indicators for risk grade, FICO score and its square, borrower age and its square, natural log of borrower monthly income, indicators for loan documentation level), county-level macroeconomic conditions (natural log of population, natural log of average income, and unemployment rate), CBSA-level housing market conditions (lagged housing price growth and price volatility), and zip code fixed effects. In regressions of borrower type, I drop borrower characteristics from the set of control variables. Similarly, in regressions of contract type, I drop loan characteristics. Year-month fixed effects are included separately for FRM and ARM loans. Standard errors, clustered at the zip code level, are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	High risk	FICO score	Borrower age	Self-employed	Low-doc	LTV	DTI
Sample mean	0.0330	635.7	37.82	0.249	0.529	82.60	40.79
Recourse * I[Post BAPCPA]	0.0120*** (0.00251)	3.861*** (0.693)	0.584*** (0.137)	-0.0592*** (0.00633)	-0.0806*** (0.00644)	-0.415*** (0.0789)	-0.635*** (0.0901)
Observations	171,134	171,134	171,134	171,134	171,134	171,134	171,134
Loan and borrower controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rate-type * year-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geography fixed effects	Zip code	Zip code	Zip code	Zip code	Zip code	Zip code	Zip code
Adjusted R-squared	0.231	0.258	0.037	0.095	0.140	0.356	0.274

Table 8. Effect of the Reform on Mortgage Interest Rate: Private versus GSEs

The following table reports the results from estimating difference-in-difference OLS regressions with the (fully-indexed) interest rate as the dependent variable. The model in column 1 is estimated with New Century data, and model in column 2 is estimated with Freddie Mac data. Controls in all regressions include loan and borrower characteristics (natural log of loan amount, LTV, DTI, prepayment penalty, multiple liens, condominium, FICO score and its square, natural log of (inferred) borrower monthly income), county-level macroeconomic conditions (natural log of population, natural log of average income, and unemployment rate), CBSA-level housing market conditions (lagged housing price growth and price volatility), and (3-digit) zip code fixed effects. (Zip code is only available up to the 3-digit level for Freddie Mac data. Consequently, the area may cover multiple states.) Year-quarter fixed effects are included separately for FRM and ARM loans by maturity length (categories included are 10, 15, 20, 25 and 30 years). Standard errors, clustered at (3-digit) zip code level, are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	(1) New Century rate	(2) Freddie Mac rate
Sample mean	9.254	6.047
Recourse (deficiency judgment allowed)		-0.0421*** (0.0134)
Recourse * I[Post BAPCPA]	-0.0665*** (0.00870)	0.0122*** (0.00317)
Observations	81,253	1,182,912
Loan and borrower controls	Yes	Yes
County controls	Yes	Yes
Rate-type * year-quarter fixed effects	Yes	Yes
Geography fixed effects	Zip code	Zip code*
Adjusted R-squared	0.933	0.592

Table 9. Effect of the Reform on Borrower Risk: Private versus GSE

The following table reports the results from estimating difference-in-difference OLS regressions with the different dimensions that represent borrower risk as the dependent variables. The first dependent variable represents borrower type, and the last two represent contract type. The models in column 1 to 3 are estimated with New Century data, and models in column 4 to 6 are estimated with Freddie Mac data. Controls in all regressions include loan and borrower characteristics (natural log of loan amount, LTV, DTI, prepayment penalty, multiple liens, condominium, FICO score and its square, natural log of (inferred) borrower monthly income), county-level macroeconomic conditions (natural log of population, natural log of average income, and unemployment rate), CBSA-level housing market conditions (lagged housing price growth and price volatility), and (3-digit) zip code fixed effects. (Zip code is only available up to the 3-digit level for Freddie Mac data. Consequently, the area may cover multiple states.) In regressions of borrower type, I drop borrower characteristics from the set of control variables. Similarly, in regressions of contract type, I drop loan characteristics. Year-quarter fixed effects are included separately for FRM and ARM loans by maturity length (categories included are 10, 15, 20, 25 and 30 years). Standard errors, clustered at (3-digit) zip code level, are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	New Century FICO score	New Century LTV	New Century DTI	Freddie Mac FICO score	Freddie Mac LTV	Freddie Mac DTI
Sample mean	615.9	82.63	40.97	728.3	77.99	36.75
Recourse (deficiency judgment allowed)				-78.80*** (1.843)	-1.292** (0.606)	0.720*** (0.0830)
Recourse * I[Post BAPCPA]	3.410*** (1.025)	-0.288** (0.132)	-0.0918 (0.146)	-0.639 (0.392)	0.331*** (0.109)	0.0650*** (0.0206)
Observations	81,269	81,269	81,269	1,182,941	1,182,906	1,182,912
Loan and borrower controls	Yes	Yes	Yes	Yes	Yes	Yes
County controls	Yes	Yes	Yes	Yes	Yes	Yes
Rate-type * year-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Geography fixed effects	Zip code	Zip code	Zip code	Zip code*	Zip code*	Zip code*
Adjusted R-squared	0.232	0.316	0.250	0.103	0.182	0.924

Table 10. Effect of the Reform on Lender Screening by Income Level

The following table reports the results from estimating linear probability model with indicator for loan rejection on the double interaction of recourse state and indicator for post-reform, and also indicator for income above state median. The model in column 1 is estimated with CBSA fixed effects, and model in column 2 is estimated with zip code fixed effects. Controls in all regressions include loan and borrower characteristics (natural log of loan amount, LTV, DTI, prepayment penalty, multiple liens, interest-only, condominium, indicators for risk grade, FICO score and its square, borrower age and its square, natural log of borrower monthly income, indicators for loan documentation level), county-level macroeconomic conditions (natural log of population, natural log of average income, and unemployment rate), and CBSA-level housing market conditions (lagged housing price growth and price volatility). Year-month fixed effects are included separately for FRM and ARM loans. Standard errors, clustered at either the CBSA or zip code level, are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)
VARIABLES	rejected	rejected
Sample mean	0.0757	0.0757
Recourse (deficiency judgment allowed)	-0.0337** (0.0147)	
Recourse * I[Post BAPCPA]	-0.0278*** (0.00661)	-0.0261*** (0.00315)
Recourse * High income * I[Post BAPCPA]	-0.00401 (0.00296)	-0.00204 (0.00204)
Observations	275,985	275,985
Loan and borrower controls	Yes	Yes
County controls	Yes	Yes
Rate-type * year-month fixed effects	Yes	Yes
Geography fixed effects	CBSA	Zip code
Standard error cluster level	CBSA	Zip code
Adjusted R-squared	0.149	0.164

Table 11. Effect of the Reform on Borrower Risk by Income Level

The following table reports the results from estimating difference-in-difference OLS regressions with the different dimensions that represent borrower risk as the dependent variables. For this analysis, I investigate the borrower characteristics that are more related to borrower credit risk and income volatility: the indicator for high-risk, FICO score, indicator for self-employed and indicator for low-documentation loan. Controls include loan characteristics (natural log of loan amount, LTV, DTI, prepayment penalty, multiple liens, interest-only, condominium), county-level macroeconomic conditions (natural log of population, natural log of average income, and unemployment rate), CBSA-level housing market conditions (lagged housing price growth and price volatility), and zip code fixed effects. Similarly, in regressions of contract type, I drop loan characteristics. Year-month fixed effects are included separately for FRM and ARM loans. Standard errors, clustered at the zip code level, are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
VARIABLES	High risk	FICO score	Self-employed	Low-doc
Sample mean	0.0330	635.7	0.249	0.529
Recourse * I[Post BAPCPA]	0.0129*** (0.00293)	-0.507 (0.792)	-0.0608*** (0.00656)	-0.143*** (0.00753)
Recourse * High income * I[Post BAPCPA]	-0.00185 (0.00193)	6.271*** (0.549)	0.0124*** (0.00439)	0.103*** (0.00577)
Observations	171,134	171,134	171,134	171,134
Loan and borrower controls	Yes	Yes	Yes	Yes
County controls	Yes	Yes	Yes	Yes
Rate-type * year-month fixed effects	Yes	Yes	Yes	Yes
Geography fixed effects	Zip code	Zip code	Zip code	Zip code
Adjusted R-squared	0.232	0.262	0.161	0.195