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What Broker Charges Reveal about Mortgage Credit Risk*

Antje Berndt† Burton Hollifield‡ Patrik Sandås§

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Abstract

Prior to the subprime crisis, mortgage brokers charged higher percentage fees for loans that turned out to be riskier ex post, even when conditioning on other risk characteristics. High conditional fees reveal borrower attributes that are associated with high borrower risk, such as suboptimal shopping behavior, high valuation for the loan or high borrower-specific broker costs. Borrowers who pay high conditional fees are inherently more risky, not just because they pay high fees. We find a stronger association between conditional fees and delinquency risk when lenders have fewer incentives to screen borrowers, for purchase rather than refinance loans, and for loans originated by brokers who have less frequent interactions with the lender. Our findings shed light on the proposed QRM exemption criteria for risk retention requirements for residential mortgage securitizations.

JEL Classifications: G12, G18, G21, G32

Keywords: Mortgage brokers; Loan performance; Subprime crisis; Credit risk retention; Qualified residential mortgages

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Mortgage brokers act as financial intermediaries matching borrowers with lenders. In this paper, we explore the loan-level link between broker charges and mortgage credit risk.[1] A credit event occurs when the loan becomes delinquent for the first time. We establish that high broker revenues, measured as a percentage of loan amount, are associated with high delinquency risk. Our data include all broker-originated loans funded by formerly one of the largest subprime lenders, New Century Financial Corporation, between 1997 and 2006. The average 12-month delinquency rate increases from 10% for loans with percentage revenues of 1-2% to 19% for loans with percentage revenues of more than 5%.

The link between percentage broker revenues and mortgage credit risk may arise because revenues proxy for other risk characteristics. For example, as long as there are fixed broker costs associated with originating a loan, percentage revenues are likely to be larger for smaller loans. In our data, average percentage revenues decline steadily as the loan size increases. Small loans, however, are often taken out by low-income, low-FICO-score borrowers and are generally riskier than large loans. As a result, high percentage revenues serve as an unconditional indicator of high delinquency risk.

Are broker revenues related to delinquency risk even when conditioning on other observable characteristics? "Observable" refers to loan, property, borrower and broker characteristics observed by the lender and the econometrician. Observable data include mortgage rates but exclude information available only to the borrower and the broker. We provide comprehensive evidence that high conditional broker revenues reflect otherwise unobserved mortgage credit risk. Based on a proportional odds duration model for the probability of first-time delinquency, a marginal increase in percentage revenues by 1% is associated with a 6.4% higher odds ratio.

The mortgage brokers in our sample are compensated by charging a direct fee to the borrower and from a yield spread premium (YSP) paid by the lender. The marginal predictive power of broker revenues for delinquency risk stems from the direct fees rather than the yield spread premia. Given a set of observable characteristics and the YSP, an increase in percentage fees by 1% is associated with a 7.6% higher odds ratio of first-time delinquency. A one standard deviation increase in conditional percentage fees is associated with a 8.0% higher odds ratio. Our finding that high conditional fees predict high mortgage credit risk is supported by several robustness checks.

The association between high conditional fees and high delinquency risk that we document

[1] Most recent studies, such as Demyanyk and Van Hemert (2011) and Jiang, Nelson, and Vytlacil (2011), relate delinquency risk to loan, property and borrower characteristics but, due to a lack of data, do not control for loan originator compensation. An exception is Garmaise (2009) who takes an in-depth look at broker-lender relationships for prime loans. The median borrower in his sample, however, does not pay any direct broker fees, thereby making it difficult to establish a link between such charges and mortgage credit risk.

suggests that there are unobserved borrower attributes that are associated with high mortgage credit risk. To shed light on these attributes we use a simple model of bargaining between the borrower and broker where the broker learns the borrower's reservation value for the fees and has all the bargaining power. The broker can set the fees without a feedback effect on other terms of the loan. Borrowers shop from one or more brokers according to a second-price auction process (Woodward and Hall (2012)).

The model implies that brokers extract high conditional fees from borrowers with any of the following attributes: *(i)* borrowers who shop from few brokers, including *(ii)* borrowers with a high conditional value for the loan who shop from only one broker, or *(iii)* borrowers who shop from multiple brokers but for whom brokers perceive conditional origination costs to be high. Our findings suggest that borrowers with these attributes tend to pay higher fees and tend to be more risky than borrowers with the same observable characteristics but without these attributes.

We present evidence that refutes the hypothesis that borrowers are riskier because they pay higher fees, in favor of the hypothesis that borrowers who pay high conditional fees are inherently more risky. We conjecture that the more the lender knows about the borrower, the weaker the association between conditional fees and delinquency risk, especially if the additional information is incorporated into mortgage rates. We offer a number of results in support of the conjecture. First, we find a stronger association between conditional fees and delinquency risk when lenders have fewer incentives to screen borrowers for "soft" information such as the borrower's exposure to future income shocks. Keys, Mukherjee, Seru, and Vig (2009) and Bubb and Kaufman (2009) argue that during our sample period, lenders had less incentive to screen borrowers with high FICO scores than borrowers with low FICO scores. We interact percentage fees with FICO scores and find that conditional fees reveal more unobserved borrower risk for high-FICO loans.

Second, conditional fees are less informative about delinquency risk for refinance loans than for purchase loans. Lenders are likely to have more housing-related information about borrowers who refinance an existing loan than borrowers who purchase a home for the first time. In addition, refinance loans tend to have a lower combined loan-to-value ratio than purchase loans. Borrowers with larger down payments may be more homogeneous in their attitude towards delinquency risk. Third, we document a weaker association between conditional fees and delinquency risk for loans originated by active brokers, that is by brokers who have frequent interactions with the lender. Active brokers may value their relationship with the lender more than inactive brokers, and hence may transmit more soft information regarding the borrower's ability to repay the loan to the lender.

Can the empirical link between broker charges and delinquency risk that we uncover be used

by lenders or regulators? Given a set of observable characteristics, consider a broker-revenue-based rate schedule where the mortgage rate increases if percentage revenues exceed the threshold $\bar{R}$. If $\bar{R}$ is a constant, the schedule reflects the unconditional link between percentage revenues and delinquency risk. If $\bar{R}$ is some benchmark conditional revenue, the schedule reflects the conditional link between revenues and delinquency risk.

The Dodd-Frank Act subjects residential mortgage securitizations to credit risk retention requirements. Rule 8 of the proposed Qualified Residential Mortgage (QRM) restrictions for loans to be exempt from risk retention is likely to result in a revenue-based rate schedule with $\bar{R} = 3\%$. We do not speculate how the introduction of such a rate schedule may impact future borrower-broker interactions. Instead, we observe that borrowers would have to pay a higher rate whenever the broker's percentage costs exceed 3%. Broker costs are the costs that the broker expects to incur between the time she strikes a deal with the borrower and the loan closing.

We consider a wide range of cost estimates spanned by two polar cases. In the first case, that of perfect rent extraction, the broker's cost is equal to the minimum conditional revenue. Provided some loans are originated at cost, the perfect rent extraction case is consistent with a scenario where borrowers shop from only one broker and there is no unobserved heterogeneity in costs. In the second case, that of perfect competition, the cost is set equal to the revenue. The perfect competition case is consistent with borrowers shopping from multiple brokers with the same cost.

We show that independent of the assumptions underlying the cost estimates, average percentage costs are larger for smaller loans. Hence the proposed QRM Rule 8 is likely to result in higher rates for smaller–and unconditionally riskier—loans. It is unlikely, however, to impose any constraints on mortgage rates for larger loans.

1. The Mortgage Origination Process

We develop a model of the mortgage origination process to understand how broker origination charges are determined and what they may reveal about mortgage credit risk. We focus on loans originated in the wholesale market, where independent mortgage brokers act as financial intermediaries matching borrowers with lenders. Brokers assist borrowers in the selection of the loan and in completing the loan application, and provide services to wholesale lenders by generating business and helping them complete the paperwork.

Consider a borrower who arrives at a broker requesting a mortgage.[2] The broker evaluates the

[2]The borrower is matched with the broker either by chance, following a recommendation of a real estate broker or someone else, or as a result of marketing efforts by the broker. We do not model borrower-broker interactions prior

borrower's and the property's characteristics, and based on that information provides the borrower with one or more financing options. A financing option consists of a specification of the loan terms such as the loan amount, type of loan and level of income documentation, and of the associated mortgage rate. It also outlines the fees the broker will charge the borrower.

To compile the list of financing options, the broker reviews wholesale rate sheets distributed by potential lenders. These rate sheets state the minimum rate at which a given lender is willing to finance a loan, as a function of loan, borrower and property characteristics. We refer to this rate as the lender's base rate. Rate sheets also inform the broker about the yield spread premium, if any, that the lender pays to the broker for originating the loan at a rate higher than the base rate. The borrower and the broker bargain over the terms of the loan, the rate and the fees. Once they reach an agreement, the broker submits a funding request to one or more lenders. The lender reviews the application material and responds with a decision to fund the loan or not. If the loan is funded, the broker receives the fees and YSP at the loan closing.

Suppose that a lender will fund the loan as long as the broker collects and transfers the requested application materials and secures a rate at or above the lender's base rate. Since the broker is paid only if the loan is made, she will only offer fundable proposals to the borrower and will ensure that the application materials are presented to the lender in a timely fashion. Let L denote the vector summarizing the terms of the loan including the loan type, the loan amount, the loan maturity, the documentation level, and any prepayment penalties. The initial mortgage rate r has to be at or above the base rate of the lender to whom the loan application is submitted. We use f to denote the fee that the broker charges the borrower for originating the loan. Each vector (L, r, f) represents a financing option, and the borrower and broker have to agree on L, r and f.

The borrower's net benefit from the loan is $\overline{f} - f$, where $\overline{f}$ denotes the borrower's reservation value for the fees and is given by

$$\overline{f} \quad = \quad \nu - o.$$

Here, ν measures the dollar value of the benefits the borrower expects to draw from owning the home in excess of the expected present value of the mortgage payments for the loan (L, r). We use o to denote the dollar value of the borrower's outside options as perceived by the borrower at the time the deal is made. The entire benefit that the borrower perceives to gain from purchasing the house or refinancing the loan is $\nu - o(\text{no mortgage})$, where $o(\text{no mortgage})$ is the value of not receiving the mortgage. We refer to $\nu - o(\text{no mortgage})$ as the borrower's valuation for the loan.

to the time that a deal is made.

Let y denote the YSP paid by the lender and c denote the broker's cost of originating the loan. Broker costs are the costs the broker expects to incur between the time she strikes a deal with the borrower and the time the loan closes. They include the broker's time costs of dealing with the borrower as well as any administrative costs paid by the broker for intermediating the mortgage. The broker's reservation value for the fees, $\underline{f}$, is equal to

$$\underline{f} = c - y, \tag{1}$$

and the broker's net benefit from originating the loan is $f - \underline{f}$.

The borrower's and broker's joint surplus is the sum of their respective benefits,

$$\overline{f} - \underline{f} = \nu - o + y - c. \tag{2}$$

We consider a simple model of bargaining between the borrower and broker where the broker learns the borrower's reservation value $\overline{f}$ and has all the bargaining power. The broker maximizes her net benefit $f + y - c$ by choosing the lender and (L, r, f), subject to the borrower's participation constraint, $f \leq \nu - o$, and to the broker's participation constraint, $f \geq c - y$.

We assume that fees f can be set without a feedback effect on other terms of the loan. Our inspection of several lender rate sheets revealed no connection between broker fees and the lender's base rate. While the Home Ownership and Equity Protection Act of 1994 (HOEPA) imposed a number of restrictions on loan features for certain mortgages, including those with very high fees, the ceiling on fees was binding only for a small fraction of loans.[3]

1.1. Setting fees when there is no feedback to loan terms

As long as the fees f can be set without impacting other terms of the loan, the broker sets the fee equal to the borrower's reservation value,

$$f = \nu - o. \tag{3}$$

From Equations (1) and (3) the broker's net benefit is $\nu - o + y - c$: the broker captures all the joint gains from trade in Equation (2). The terms of the loan and the mortgage rate are set so as

[3] HOEPA high-fee loans are defined as loans for which total origination charges exceed the larger of \$592 or 8% of the loan amount. The \$592 figure is for 2011. The amount is adjusted annually by the Federal Reserve Board, based on changes in the Consumer Price Index. For details see www.ftc.gov/bcp/edu/pubs/consumer/homes/rea19.shtm. The rules for loans are listed in Section 32 of the Federal Reserve Board's Regulation Z. "Section 32 mortgages" are banned from balloon payments, negative amortization, and most prepayment penalties, among other features.

to maximize those gains from trade, provided that the broker's revenues cover the costs, $f + y \geq c$.

The broker's total revenues are $f + y = c + (\nu - o + y - c)$. The revenues are equal to the cost of intermediating the loan plus the surplus that the broker is able to capture. We refer to the surplus captured by the broker, $\nu - o + y - c$, as marginal broker profits. These marginal profits do not immediately inform about potential profits a new entrant to the mortgage broker business may obtain since they do not control for the costs of identifying and attracting prospective borrowers.

1.2. Borrower shopping behavior

The borrower's shopping behavior determines the value of his outside options, o, and therefore the broker fees. Let K denote the number of brokers the borrower shops from. If $K = 1$, the borrower shops from only one broker, the outside option is no mortgage. The broker can extract the entire benefit that the borrower perceives to gain from purchasing the house or refinancing the loan, and fees are equal to the borrower's valuation for the loan, $\nu - o(\text{no mortgage})$.

If $K \geq 2$, the borrower shops from multiple brokers.[4] Similar to Woodward and Hall (2012), we assume a second-price auction process where the borrower seeks initial quotes from K brokers and uses these quotes to extract better proposals until the process ends with one quote that no other broker is willing to beat. The observed revenue is the cost of the second-lowest-cost broker. The originating broker extracts all of the surplus in the bargain with the borrower, whose outside option is to accept the runner-up bid. In summary, the originating broker's revenue is equal to

$$f + y = \begin{cases} \nu - o(\text{no mortgage}) + y, & \text{when } K = 1 \\ \text{cost of second-lowest-cost broker}, & \text{when } K \geq 2. \end{cases} \tag{4}$$

2. Linking Broker Charges and Mortgage Credit Risk

We use our model framework to formulate a number of hypotheses about the link between percentage broker charges and mortgage credit risk. Percentage charges refer to charges measured as a percentage of the loan amount. We refer to a loan with certain characteristics as risky if average delinquency rates across all loans with those characteristics are high.

Hypothesis 1. *Unconditionally, loans with high percentage revenues are riskier than loans with low percentage revenues.*

Assuming that broker revenues are set as in Equation (4), the following scenario is consistent with Hypothesis 1:

[4] We only count those brokers whose reservation value for the fees does not exceed the borrower's benefit from purchasing the house or refinancing the loan.

Scenario 1. *There are fixed costs associated with originating loans so that broker costs, as a percentage of loan amount, are decreasing in the size of the loan. Borrowers' valuations for loans, as a percentage of loan amount, are larger for smaller loans. Percentage yield spread premia are flat or decreasing in the size of the loan. As a result, percentage revenues are larger for smaller loans. Unconditionally, smaller loans are riskier.*

Are broker revenues related to delinquency risk even when we condition on other observable characteristics? To define the term "observable characteristics," we take the view that the broker's information set, as it pertains to a mortgage transaction, includes the borrower's information set. The econometrician—meaning us, a regulator or another third party—observes the information provided on the loan application, including the broker's identity and fees. The econometrician also observes certain broker characteristics and any yield spread premia paid by the lender, which the borrower may or may not observe. The lender's information set is the same as the econometrician's, unless the lender exerts additional efforts to screen applicants for soft information. We refer to "observable" data as the data observed by the econometrician at the time of origination, inclusive of mortgage rates. Conditional revenues do not condition on fees nor on YSP. Conditional fees, however, do condition on YSP in addition to the other controls.

If there is variation in conditional broker fees, it may be unrelated to mortgage credit risk. Alternatively, high conditional fees may be associated with high delinquency risk, or high conditional fees may be associated with low delinquency risk. We formally test the hypothesis:

Hypothesis 2. *Conditional on a set of observable characteristics, broker fees have no predictive power for mortgage credit risk.*

A scenario consistent with Hypothesis 2 is one where there is no unobserved heterogeneity in broker fees. Suppose that Hypothesis 2 is rejected by the data and that we find evidence that high conditional fees predict high mortgage credit risk. According to Equation (4), brokers extract high conditional fees from borrowers who shop from few brokers, including borrowers with a high conditional valuation for the loan that shop from only one broker, and from borrowers who shop from multiple brokers but for whom brokers perceive conditional costs to be high. If high conditional fees are associated with high mortgage credit risk, the following holds:

Scenario 2. *Conditional on a set of observable characteristics, borrowers who turn out to be riskier ex post tend to shop from fewer brokers, have a higher valuation for the loan or have higher borrower-specific broker costs.*

To describe Scenario 2 in more detail, we analyze the sources of unobserved heterogeneity in the borrower's valuation for the loan, $\nu - o(\text{no mortgage})$. We measure time in months and use T to denote the maturity of the loan, T_P the time at which the borrower prepays the loan in full, and T_D the time of mortgage default. Assuming that the borrower is risk-neutral, ν is given as

$$\begin{aligned} \nu &= -p_0 + E\left\{\sum_{m=1}^{\min\{T,T_P,T_D\}-1} \delta_m\left(h_m - p_m\right) + \delta_T\left(H_T - p_T\right) 1_{\{T<\min\{T_P,T_D\}\}}\right\} \\ &\quad + E\left\{\delta_{T_P}\left(H_{T_P} - p_{T_P} - B_{T_P}\right) 1_{\{T_P<\min\{T,T_D\}\}} - \delta_{T_D} F_{T_D} 1_{\{T_D<\min\{T,T_P\}\}}\right\}, \end{aligned} \tag{5}$$

where δ_m is the borrower-specific discount factor for spending or receiving one dollar m months from now and $1_{\{\cdot\}}$ denotes the indicator function.

We use h_m to denote the value the borrower receives from occupying in the house in month m, and H_m to denote the time-m value that the borrower receives from the home from month m on. The mortgage is terminated early if either prepayment or default occurs prior to the original maturity date. The payments made in month m are denoted by p_m. They include the principal and interest payments due after m months, and may also include any additional down payments on principal that the borrower plans to make. p_0 are net payments due at closing, in addition to the fees charged by the broker. They include the downpayment for the loan and lender discount points. For a refinance loan, the amount of cash taken out, if any, would be subtracted.

If the loan is paid off early after m months, B_m denotes the outstanding balance on the mortgage at that time. If the current loan is refinanced after m months, then B_m measures the time-m value of the payments associated with the new mortgage, including any fees to obtain the refinance mortgage, minus the cash taken out. If the house is sold after m months, $H_m = h_m$ and B_m denotes the outstanding balance on the mortgage minus the sales price. F_m are the costs the borrower incurs from mortgage default at the end of month m, other than having to give up the house. Expectations are taken with regard to the joint probability distribution of

$$\left(\{\delta_m\}, \{h_m\}, \{H_m\}, \{p_m\}, B_{T_P}, F_{T_D}, T_P, T_D\right). \tag{6}$$

Consider two borrowers with the same set of observable characteristics who assign the same value to the outside option of no mortgage but differ in their expectations about the distribution of the variables in (6). The first borrower is a benchmark borrower who has objective expectations about the joint conditional distribution of the variables in (6) and the second borrower is overoptimistic. For example, the second borrower may underestimate future payments $\{p_m\}$, overestimate

the time until default T_D or underestimate the costs associated with mortgage default F_{T_D}, or underestimate the net payments B_{T_P} associated with refinancing the loan or selling the home in the future. In each of these cases, the overoptimistic borrower's valuation for the loan will be higher than that of the benchmark borrower. The following is consistent with Scenario 2:

Scenario 2a. *Borrowers shop from only one broker. Conditional on a set of observable characteristics, there is an association between overoptimistic borrowers and high mortgage credit risk. Overoptimistic borrowers pay higher fees and are more risky.*

Alternatively, the second borrower may value positive future net benefits from living in the home, $h_m - p_m$, more than the benchmark borrower, maybe because the second borrower is more exposed to income variations that may limit his access to credit and his level of consumption in future periods. As a result, the second borrower perceives future discount factors δ_m to be higher than the benchmark borrower, hence pays higher fees. The following is consistent with Scenario 2:

Scenario 2b. *Borrowers shop from only one broker. Conditional on a set of observable characteristics, there is an association between high borrower exposure to negative future shocks and high mortgage credit risk. Borrowers who are more sensitive to negative future shocks pay higher fees and are more risky.*

Suppose that based on the borrower-broker interactions during the bargaining process, brokers believe that the second borrower will need extra prodding or closer supervision while preparing the loan documents. As a result they perceive costs to be higher for the second borrower than for the benchmark borrower. Or suppose that brokers believe that the second borrower is riskier than the benchmark borrower, and that brokers assign higher reservation values for conditionally riskier borrowers to compensate for the potential loss of reputation with the lender. The following is consistent with Scenario 2:

Scenario 2c. *Borrowers shop from more than one broker. Conditional on a set of observable characteristics, there is an association between high broker costs and high mortgage credit risk. Borrowers for whom brokers perceive costs to be higher pay higher fees and are more risky.*

If the second borrower assigns the same joint distribution to the variables in (6) as the benchmark borrower, and if brokers assign equal costs to both borrowers, both borrowers will pay the same fee unless they differ in their shopping efforts. The following is consistent with Scenario 2:

Scenario 2d. *Conditional on a set of observable characteristics, borrowers have the same valuation*

for the loan and brokers perceive costs to be the same across borrowers. There is an association between low shopping efforts and high mortgage credit risk. Borrowers who shop from fewer brokers pay higher fees and are more risky.

Now suppose that Hypothesis 2 is rejected in favor of the hypothesis that high conditional fees are associated with low delinquency risk. Then the roles of riskier and safer borrowers in Scenario 2 must be reversed. Consider a scenario where both the benchmark and the second borrower introduced above shop from only one broker. The second borrower assigns the same distribution to the variables in (6) as the benchmark borrower except that he expects to default sooner based on information available to him but not the lender. The second borrower expects to draw benefits from the home for a shorter period of time. He pays a lower fee but is more risky.

Lastly, we consider the link between yield spread premia and delinquency risk. Our inspection of various lender rate sheets suggests that lenders set YSP as a function of observable characteristics, such as the loan type, documentation level, borrower credit history and the mortgage rate.[5] As long as that is the case, there is no unobserved heterogeneity in YSP and the following holds:

Hypothesis 3. *Conditional on a set of observable characteristics, YSP has no predictive power for mortgage credit risk.*

In what follows, we describe the data and investigate whether they support the posted hypotheses.

3. The New Century Loan Pool

Our dataset is obtained from IPRecovery, Inc. and contains detailed records of all loans originated by New Century Financial Corporation. New Century made its first loan to a borrower in Los Angeles in 1996 and subsequently grew into one of the top three U.S. subprime lenders. It originated, retained, sold and serviced residential mortgages designed for subprime borrowers. An increase in early delinquencies in late 2006 and early 2007, together with inadequate reserves for such losses, led to New Century' s bankruptcy filing on April 2, 2007.

New Century's origination volume grew from less than 1 billion in 1997 to almost 60 billion in 2006. The explosive growth in volume was largely fueled by independent mortgage broker activity. Between 1997 and 2006, over 70% of all New Century loans were originated through the broker channel. This is consistent with the pattern observed for the broader subprime market, where prior

[5] While the econometrician observes these characteristics and the YSP, the econometrician may not know the functional form that the lender uses to link the two. Depending on the model that the econometrician uses to control for variation in observable characteristics and the amount of data available, predicted yield spread premia may deviate somewhat from observed yield spread premia.

to the subprime crisis mortgage brokers had become the predominant channel for loan origination. For example, as of 2005 mortgage brokers originated about 71% of all subprime loans.[6] Focusing on broker-originated loans allows us to abstract from differences in the compensation structure of brokers and loan officers, while still capturing the vast majority of New Century's business. Table 1 defines the variables used in our empirical analysis. Appendix A offers a detailed description of New Century's origination and servicing data and describes the steps we take to clean the raw data. In what follows, we compare New Century's origination activity to that of other subprime lenders.

[Table 1 about here]

3.1. Origination data and loan performance

Table 2 reports descriptive statistics for the broker-originated loans funded by New Century between 1997 and 2006. We compare them to the statistics reported in Demyanyk and Van Hemert (2011) for the First American CoreLogic LoanPerformance (LP) data. The LP data contain loan-level origination and servicing records for roughly 85% of all securitized subprime mortgages and offer the widest coverage of subprime loans available.[7] One drawback of the LP data is that they do not identify brokered loans nor report broker charges. Nevertheless, we use the LP data as a benchmark to compare New Century's loan pool to the broader subprime market.

[Table 2 about here]

In the LP data, the average FICO score for first-lien loans rose from a low of 601 in 2001 to a high of 621 in 2005. In our sample, average FICO scores for first-lien loans increased from 585 to 622 over the same time period. The average loan size increased from 126K in 2001 to 212K in 2006 in the LP data, and from 149K to 217K in our data. The percentage of fixed-rate, balloon and other mortgages ranged from 33%, 7% and 60% in 2001 to 20%, 25% and 55% in 2006 in the LP data, and from 19%, 0% and 81% to 14%, 40% and 46% in the New Century sample.[8] Average combined loan-to-value ratios (CLTVs) are in almost perfect alignment between our and the LP data, from just below 80% in 2001 to 86% in 2006. Debt-to-income ratios are fairly flat and around 40% in both samples. The distribution of the loan purpose for New Century loans is similar to that reported for the LP data. The same is true for mortgage rates, rate margins, and the fraction of loans with prepayment penalties.

[6] Detailed information is available at the Mortgage Bankers Association website www.mortgagebankers.org.

[7] During our sample period, securitization shares of subprime mortgages ranged between 54% and 76% (Mortgage Market Statistical Annual (2007)).

[8] For New Century and many other subprime lenders, the share of interest-only loans started to increase in 2004 and that of balloon loans in 2005 (Gorton (2010), Landier, Thesmar, and Sraer (2011)).

Like other subprime lenders, New Century had three levels of income documentation: full, limited and stated. For a full documentation loan, the applicant was required to submit two written forms of income verification showing stable income for at least twelve months. With limited documentation, the prospective borrower was generally required to submit six months of bank statements. For stated documentation loans, verification of the amount of monthly income the applicant stated on the loan application was not required, and these mortgages were often referred to as "liar loans." The share of loans with full documentation fell from 77% in 2001 to 62% in 2006 in the LP data, but stayed fairly flat, around 60%, in the New Century data. If we were to combine full and limited documentation loans in the New Century data, the fraction would fall from 64% to 60%. Overall, the origination statistics for the New Century loans in our sample are in line with those for the broader subprime market.

From 1999 onwards, the IPRecovery data contain detailed servicing records for most of the New Century loans. For every year from 1999 to 2006, more than 99% of the funded broker loans are part of the servicing data, except for 2001 (83%) and 2002 (42%). As in Demyanyk and Van Hemert (2011) and Jiang, Nelson, and Vytlacil (2011), we consider a loan to be delinquent if payments on the loan are 60 days or more late, or if the loan is in foreclosure, real estate owned, or in default.

A report by Moody's (2005) shows that the performance of New Century loans closely tracked that of the subprime industry. We confirm this finding by comparing the cumulative delinquency rates for our data, as shown in Figure 1, with those reported by Demyanyk and Van Hemert (2011). For the LP (New Century) data, 12-month cumulative delinquency rates are 13% (20%), 9% (13.5%), 7.5% (8.5%), 9% (10%) and 12% (13%) for loans originated in 2001, 2002, 2003, 2004 and 2005, respectively. These delinquency statistics are rather similar, especially for the latter part of the sample. The only two years with larger differences in rates are 2001 and 2002, precisely the years in which a sizable portion of the New Century loans are missing from the servicing data. Given the lack of data, we put less weight on the 2001 and 2002 estimates and verify that our empirical findings are robust to excluding loans originated prior to 2003. The 2003-2005 delinquency rates reported for the LP data are about 1% lower than those for our sample perhaps because the LP data include retail loans in addition to broker loans. Jiang, Nelson, and Vytlacil (2011) find that retail loans are generally safer than broker loans.

[Figure 1 about here]

3.2. Broker charges

Until recently, independent mortgage brokers earned revenues from two sources: a direct fee paid by the borrower and an indirect fee—the YSP—paid by the lender. Direct fees include all

compensation associated with the mortgage transaction paid by the borrower directly to the broker, including finance charges such as appraisal and credit report fees. The YSP rewards the broker for originating loans with higher mortgage rates, holding other things equal.[9] Table 3 shows that total broker revenues per loan, as a percentage of loan amount, declined steadily from 4.9% in 1997 to 2.8% in 2006. The decline in percentage revenues was almost equally split between a decline in fees and in YSP. Dollar revenues per loan, on the other hand, increased over time from 4.2K in 1997 to 5.6K in 2006. The increase in dollar revenues corresponds to an annual compound rate of 3.3% which is similar to the rate of inflation. The decrease in percentage revenues and the relatively modest growth in dollar revenues may reflect an increase in broker competition over time.

[Table 3 about here]

The top panel in Figure 2 shows the unconditional distribution of broker revenues and its two components.[10] All three distributions are disperse and skewed to the right: some very large fees and yield spread premia were paid out to brokers. The right skewness in the revenue distribution appears to be a robust feature across different strata of our sample, as documented in the remaining panels in Figure 2, although the skewness is smaller after conditioning on the loan amount.

[Figure 2 about here]

The first column in the bottom panel of Table 3 reveals that brokers are generally rewarded more for originating larger loans. While brokers earn an average 2.2K per loan for mortgages of 50K or less, they earn 9.7K for loans in excess of 500K. Both direct fees and YSP contribute to the increase in revenues as loan amount increases. After controlling for the size of the loan, there is much less variation in revenues. Nevertheless, hybrid loans usually generate lower revenues than fixed-rate, balloon and interest-only loans. Borrowers with a lower FICO score often pay higher fees and yield spread premia compared to higher-credit-quality borrowers. Loans with a prepayment penalty generally yield higher broker revenues, mainly due to higher fees.

[9] New loan originator compensation rules went in effect April 1, 2011 as part of Regulation Z. They prohibit mortgage broker compensation to vary based on loan terms, other than principal. In particular, brokers can no longer receive yield spread premia from the lender.

[10] About 27% of the YSP entries in our data are left blank. All else the same, loans with lower FICO scores, lower risk grades and less documentation are more likely to have a missing YSP entry. Such loans usually have high base rates, leaving less room for brokers to convince borrowers to pay rates in excess of the base rate. Moreover, while an increase in YSP is usually associated with a decrease in direct broker fees, we find no statistical significance for a missing-YSP dummy when regressing broker fees on YSP and other observable covariates. With this in mind, we interpret missing-YSP entries as zero YSP, which brings the percentage of zero-YSP loans in our data to 30%. Our findings are robust, however, to excluding missing-YSP loans from the sample.

During our sample period, almost 56,000 different brokerage firms do business with New Century. Each company consists of one or more individuals working out of the same office. The median brokerage firm has only sporadic contact with New Century, and originates about 4 loans or 734K for this lender between 1997 and 2006. The top three loan originators in our sample are Worth Funding (9,705 loans), United Vision Financial (2,826 loans) and Dana Capital Group (1,446 loans). Our results are robust to excluding loans originated by these three brokerage firms from the data.

Two recent studies report data on broker fees and yield spread premia. Woodward and Hall (2012) analyze about 1,500 FHA fixed-rate loans originated during a 6-week period in 2001 and report average broker revenues of about 4.1K per loan and an average loan size of about 113K. In percentage terms this is comparable to the 2001 statistics we report in Tables 2 and 3, although our dollar values are somewhat higher both for revenues (4.8K) and loan size (149K). Garmaise (2009) studies a sample of almost 24,000 residential single-family mortgages originated between 2004 and 2008. He reports average percentage broker revenues of 2.1%. Neither study, however, focuses on subprime loans. A news release by 360 Mortgage Group (Reuters (2011)) on mortgage broker compensation states that brokers generated an average revenue of 2.25% per loan in recent years.[11] This figure is consistent with the compensation statistics reported in Table 3 and points to a continued decline in percentage revenues beyond 2006.

In summary, New Century's loan pool is largely representative of the broader subprime market. Following its bankruptcy filing in 2007, New Century received widespread attention in the popular press, mainly because it was the largest subprime lender to default by that date. By 2009, however, virtually all of New Century's main competitors had either declared bankruptcy, had been absorbed into other lenders, or had otherwise unwound their lending activities.[12]

3.3. Broker charges and mortgage rates

In Section 1 we assume that broker fees can be set without a feedback effect on other terms of the loan. To confirm that there are no economically meaningful feedback effects from fees to mortgage rates we estimate the regression model

$$\text{Rate} \quad = \quad \alpha + \beta_F \,\%\text{Fees} + \beta_Y \,\%\text{YSP} + \widetilde{X}_{\text{cond}}\, \beta'_{\text{cond}} + \varepsilon, \tag{7}$$

[11] The news release does not distinguish between prime and subprime mortgage brokers.

[12] New Century was joined on the OCC's 2009 list of the biggest subprime lenders in main metro areas by Long Beach Mortgage, Argent Mortgage, WMC Mortgage, Fremont Investment & Loan, Option One Mortgage, First Franklin, Countrywide, Ameriquest Mortgage, ResMae Mortgage, American Home Mortgage, IndyMac Bank, Greenpoint Mortgage Funding, Wells Fargo, Ownit Mortgage Solutions, Aegis Funding, Peoples Choice Financial, BNC Mortgage, Fieldstone Mortgage, Decision One Mortgage and Delta Funding.

where α, β_F and β_Y are scalars and β_{cond} is a row vector of coefficients. The vector of conditioning variables $\widetilde{X}_{\text{cond}}$ consists of all observable characteristics other than fees, YSP and the initial mortgage rate ("Rate"). It includes loan, property, borrower, broker, neighborhood and regulation variables, market conditions, and year and location dummies. Some of the continuous conditioning variables are discretized to add flexibility to the linear specification in Equation (7).

The results are summarized in Table 4. For $\beta_F = \beta_Y = 0$, the regression in (7) yields an R^2 of 0.78. If we include percentage YSP in the regression but keep β_F at zero, the R^2 increases to 0.85. A marginal increase in percentage YSP by 1% is associated with a significant 52 basis point increase in the initial rate. A one standard deviation increase in percentage YSP is associated with a 40 basis point increase in rates. Our results are consistent with the notion that, all else the same, lenders pay higher YSP for mortgages with higher rates. When fees are included in the regression, the estimate for β_F is 0.006. While the coefficient estimate is statistically significant, a marginal increase in percentage fees by 1% is associated with only a very small 0.6 basis point increase in rates. A one standard deviation increase in percentage fees is associated with an equally small 0.8 basis point increase in rates. The results confirm that, based on our data, there are no economically meaningful feedback effects from fees to mortgage rates.

[Table 4 about here]

4. Broker Charges Predict Mortgage Credit Risk

In this section, we establish that higher broker revenues reflect higher delinquency risk, both unconditionally and when conditioning on observable characteristics. We present evidence in support of Hypotheses 1 and 3 in Section 2. The main result is that Hypothesis 2 is rejected in favor of the hypothesis that borrowers pay high conditional fees for loans that turn out to be riskier ex post.

4.1. The unconditional link between broker charges and mortgage credit risk

The left panel in Figure 3 shows average 12-month delinquency rates for loans sorted by percentage broker revenues. Delinquency rates are lowest—about 10%—for loans with percentage revenues of 1-2%. They increase steadily as percentage revenues increase, and peak at over 19% for loans with percentage revenues of more than 5%. The average 12-month delinquency rate for loans with percentage revenues of less than 1% is slightly higher than that for loans with 1-2% revenues, consistent with somewhat higher delinquency rates among very large, low percentage revenue loans and also consistent with some extremely cash constrained borrowers obtaining small-cost loans.

Overall, however, the data support Hypothesis 1 that loans with high percentage revenues are riskier than loans with low percentage revenues.

[Figure 3 about here]

The link between percentage revenues and mortgage credit risk may hold because revenues proxy for other risk characteristics. Consistent with Scenario 1 described in Section 2, we find that percentage revenues are larger for smaller loans. As shown in the middle panel of Figure 3, average percentage revenues decline steadily as the loan size increases, from 4.4% for 50-75K loans to 2.2% for loans between 300K and 500K. At the same time, the right panel in the figure shows that small loans are generally also the riskier ones. The average 12-month delinquency rate is highest for 50-75K loans at almost 19%, and then decreases as loan size increases to a low of 11.4% for 200-300K loans. 300-500K loans are again slightly riskier, with a delinquency rate of 11.8%.

Small loan size—and hence high percentage revenues—serve as strong unconditional indicators of high delinquency risk. In our data, smaller loans are often taken out by lower-income, lower-FICO-score borrowers who tend to purchase or refinance homes in neighborhoods with a higher percentage of minorities and a lower percentage of college graduates.

4.2. The conditional link between broker charges and mortgage credit risk

While variables such as loan size predict broker revenues, we find substantial variation in revenues even after controlling for observable characteristics. Table 4 shows that observable characteristics explain 50.7% of the variation in dollar revenues and 41.9% of the variation in percentage revenues. Broker fees are harder to predict than revenues. Only 40.5% of the variation in dollar fees and 37.8% of the variation in percentage fees can be explained by observable characteristics. Residual fees are skewed to the right, with a skewness coefficient of 0.50 for dollar fees and 0.53 for percentage fees. A sizable fraction of borrowers pay high conditional fees.

Much of the observed variation in broker fees is explained by the loan amount which, by itself, yields an R^2 of 26.7% for dollar fees and 22.1% for percentage fees. Controlling for YSP in addition to size increases the R^2 for dollar and percentage fees to 32.4% and 25.4%, respectively. A marginal increase in YSP is only partially offset by lower fees, consistent with Woodward (2003).

We want to understand what the unexplained variation in broker charges reveals about mortgage credit risk. Different approaches have been used in the literature to predict delinquency risk. A large number of studies apply a duration model methodology and follow Deng (1997), Ambrose and Capone (2000) and Deng, Quigley, and Van Order (2000) who employ Cox proportional haz-

ard models.[13] Proportional hazard models are appealing not only because they allow for flexible default patterns over time but also because they offer a convenient way to incorporate censored observations. An alternative approach is to estimate a probit model as in Danis and Pennington-Cross (2005), Geradi, Goette, and Meier (2010) and Jiang, Nelson, and Vytlacil (2011). While duration models capture the time between loan origination and credit event, probit models do not distinguish between mortgages that become delinquent at different points in time.

A loan transitions from survival to nonsurvival when it becomes 60 days delinquent or worse for the first time. Since mortgage payments are due on a monthly basis, credit events occur only at discrete points in time (Demyanyk and Van Hemert (2011)). To establish a link between conditional broker charges and delinquency risk we estimate a proportional odds duration model, the discrete-time analogue to the Cox proportional hazard model. For a loan with a given set X of observable characteristics, the probability that the loan transitions to the nonsurvival state after m months, conditional on not having been delinquent before, is defined as

$$P_X(m) \quad = \quad \Pr\left(T_D = m | T_D \geq m, X\right),$$

where T_D denotes the time of the credit event.

We assume that the log proportional odds of first-time delinquency at time m are affine in X:

$$\log \frac{P_X(m)}{1 - P_X(m)} \quad = \quad a_m + X_{\text{comp}} b'_{\text{comp}} + X_{\text{cond}} b'_{\text{cond}}, \tag{8}$$

where a_m captures age effects and b_{comp} and b_{cond} are row vectors of coefficients. The vector X consists of broker compensation variables, X_{comp}, and all other observable characteristics including mortgage rates, X_{cond}.[14] The model is estimated via maximum likelihood techniques under the noninformative censoring assumption.

The estimation results are summarized in Table 5. The first two columns show the parameter estimates when $b_{\text{comp}} = 0$. Our results are consistent with the findings in Demyanyk and Van

[13] Applications of Cox proportional hazard models include Calhoun and Deng (2002), Pennington-Cross (2003), Deng, Pavlov, and Yang (2005), Clapp, Deng, and An (2006), Pennington-Cross and Chomsisengphet (2007) and Bajari, Chu, and Park (2011), among others. Some models allow for flexible baseline functions (see Han and Hausman (1990), Sueyoshi (1992) and McCall (1996)).

[14] The vector X_{cond} is composed of $\widetilde{X}_{\text{cond}}$ in Equation (7) and the mortgage rate. Whether or not to include rates depends on the objective of the loan performance analysis. Demyanyk and Van Hemert (2011) argue that subprime loan quality, when adjusted for observable characteristics including rates, deteriorated prior to the subprime crisis. Jiang, Nelson, and Vytlacil (2011) predict first-time delinquency rates for different origination channels and documentation levels. They exclude mortgage rates from the set of predictor variables to avoid endogeneity issues. In our applications, we are interested to understand if broker charges predict delinquency risk when conditioning on all other observable characteristics including mortgage rates.

Hemert (2011) and Jiang, Nelson, and Vytlacil (2011). All else the same, hybrid, balloon and interest-only loans tend to have higher delinquency rates than fixed-rate loans. Piggyback loans, high-LTV loans, limited or stated documentation loans, and loans with prepay penalties are more likely to become delinquent. Refinance mortgages, and especially refinance cash-out mortgages, are less likely to become delinquent. Borrowers with higher credit scores and lower debt-to-income ratios default less frequently on their obligations. Loans originated in neighborhoods with a higher fraction of white population or with higher educational attainment exhibit marginally lower delinquency rates. The unreported age effects are consisted with the findings in Demyanyk and Van Hemert (2011) in that the odds of first-time delinquency peak around the age of 8 to 14 months. Conditional delinquency rates increase throughout much of our sample period and peak in 2006.

[Table 5 about here]

The vector X_{cond} also includes state-by-state regulation variables. HOEPA sets a baseline for federal regulation of the mortgage market. We follow the approach taken by Ho and Pennington-Cross (2005) and Ho and Pennington-Cross (2006) and construct a "Regulation (coverage)" index that assigns higher positive values if anti-predatory lending laws for a given state cover more types of mortgages relative to HOEPA. In addition, we use the state occupational licensing laws and registration policies for mortgage brokers reported by Pahl (2007) to construct a "Regulation (brokers, Pahl)" index that has higher values for states with stricter requirements.

We find only slightly lower marginal delinquency rates for loans originated in states where a wider range of mortgages is covered under anti-predatory lending laws, but significantly lower rates in states with a higher Pahl index of broker regulation. Stricter broker licensing laws predict lower mortgage credit risk, even when conditioning on other observable risk characteristics.

The third and fourth columns of Table 5 show the estimation results when the restriction $b_{\text{comp}} = 0$ is lifted and X_{comp} measures percentage broker revenues. A marginal increase in broker revenues by 1% of the loan amount is associated with a 0.062 higher log odds ratio of first-time delinquency, or a exp(0.062)-1=6.4% higher odds ratio. A one standard deviation increase in percentage revenues is associated with a 0.091 increase in the log odds ratio.

A marginal increase in revenues may stem from a marginal increase in fees or a marginal increase in YSP. We replace $X_{\text{comp}} b'_{\text{comp}}$ by $b_F\%\text{Fees} + b_Y\%\text{YSP}$ and report the results in columns five and six of Table 5. The coefficient estimate $\widehat{b}_F$ for percentage fees is statistically significant. A marginal increase in fees by 1% of the loan amount is associated with a 0.073 higher log odds ratio, or 7.6% higher odds of delinquency. A one standard deviation increase in percentage fees is associated with a 0.097 increase in the log odds ratio.

We reject Hypothesis 2 in Section 2 that conditional fees are unrelated to mortgage credit risk, and find that high conditional fees are associated with high delinquency risk. Scenario 2 interprets our findings in light of Equation (4). Scenarios 2a through 2d are all consistent with the empirical evidence, and based on the data available to us it is not possible to rule out one or more of these scenarios. In particular, we have no information about the shopping efforts of the borrowers in our sample and we cannot directly observe the borrowers' valuation for the loan nor the brokers' costs. The only two surveys of borrowers' shopping efforts that we are aware off, Lacko and Pappalardo (2007) and Federal Reserve Board (2008), find that many but not all borrowers shop from only one broker. In any case, we believe that it is a combination of Scenarios 2a through 2d that contributes to the link between conditional broker fees and delinquency risk that we uncover.

Lastly, the coefficient estimate $\widehat{b}_Y$ for percentage YSP is not statistically significant. The data supports Hypothesis 3 that conditional on a set of observable characteristics, YSP has no predictive power for mortgage credit risk. It is important to point out that this does not imply that there is no link between YSP and loan performance. On the contrary, all else the same, more complex loans and loans with a prepayment penalty tend to have higher YSP and higher delinquency rates.

5. Robustness and Extensions

We perform a number of robustness checks to strengthen our main result that high conditional fees are associated with high delinquency risk. First, we address the issue of collinearity between percentage fees and other predictor variables in Equation (8). We reestimate the model in the last two columns of Table 5 after replacing percentage fees by the residuals obtained from regressing percentage fees on percentage YSP and X_{cond}.[15] Untabulated results show that the coefficient estimate for residual percentage fees is statistically significant, and that a one standard deviation increase in residual percentage fees is associated with a 8.0% increase in the odds of delinquency.

Second, we form a number of homogeneous loan pools, based on the vintage, size and type of the loan, the borrower's credit quality and the mortgage rate. For each of the resulting loan pools, Table 6 reports the average 12-month delinquency rates for those loans in the pool with low percentage fees and for those with high percentage fees. For most pools, the delinquency rate is higher for loans with high percentage fees and lower for loans with low percentage fees. Third, we reestimate the model in the last two columns of Table 5 for different strata of loans. Results are summarized in the bottom panel of Table 6 and confirm the finding that high conditional broker

[15] The last two columns of Table 4 show the results from regressing percentage fees on percentage YSP and X_{cond}.

fees predict high mortgage credit risk.

[Table 6 about here]

Below we discuss extensions to the model in (8) that uses $X_{\text{comp}} b'_{\text{comp}} = b_F \%\text{Fees} + b_Y \%\text{YSP}$.

5.1. Do high broker fees trigger mortgage delinquencies?

One goal is to understand whether loans with higher conditional fees turn out to be more risky simply because paying a higher fee at origination leaves borrowers more cash constrained, or whether borrowers who pay higher fees are inherently more risky. If the former were true, the effect of an increase in conditional fees on delinquency risk should be short lived and the impact of conditional fees on the odds of a first-time delinquency in month m should decrease as m increases.

We expand the model in Equation (8) to include interaction terms between fees and age effects:

$$\log \frac{P_X(m)}{1 - P_X(m)} = a_m + (b_F + b_{F,m})\ \%\text{Fees} + b_Y\ \%\text{YSP} + X_{\text{cond}} b'_{\text{cond}}, \quad b_{F,15} = 0. \tag{9}$$

The likelihood ratio test of the augmented model in (9) against the restricted model in (8) that sets $b_{F,m} = 0$ for all m has a p-value of 0.472. Hence the following hypothesis cannot be rejected:

Hypothesis 4. *Conditional on a set of observable characteristics, an increase in percentage fees is associated with a parallel shift in the log odds of first-time delinquency in month m, across m.*

We interpret the failure to reject Hypothesis 4 as a strong indication that borrowers who pay higher conditional fees are inherently more risky.

5.2. Screening incentives of lenders

Lenders observe the information provided on the loan application. We think of this information as "hard" information about the borrower. Lenders may exert additional efforts to screen applicants for "soft" information such as the stability of the borrower's future income. A lender screens a borrower if the lender bases the funding decision on both hard and soft information. Keys, Mukherjee, Seru, and Vig (2009) and Bubb and Kaufman (2009) argue that during our sample period, subprime lenders had less incentive to screen borrowers with high FICO scores than borrowers with low FICO scores.

Bubb and Kaufman (2009) explain that lenders who sold to Fannie Mae or Freddie Mac were contractually obligated to follow guidelines that required increased scrutiny of loan applications below certain thresholds. Freddie Mac (1995) and Fannie Mae (1997) established FICO scores

of 620 and 660 as key cutoffs. For borrowers with FICO scores above 660, lenders were to do a basic review of the loan application to confirm the borrower's ability to repay. For loans with FICO scores between 620 and 660, lenders were to perform a comprehensive review to underwrite all aspects of the borrower's credit history and to establish the borrower's ability to repay. For FICO scores below 620, lenders were to perform a particularly detailed review of the borrower's credit history and consider the unique circumstances of each application, such as information about non-standard sources of income, cash reserves and the borrower's explanation of recent income or payment shocks, to judge if there are compensating factors that offset the higher risk. According to Bubb and Kaufman (2009), this process was followed not only for loans sold to Fannie Mae or Freddie Mac but also for portfolio loans and loans sold to private-label securitizers.

Keys, Mukherjee, Seru, and Vig (2009) find that prior to the subprime crisis existing securitization practices had led to a decrease in the screening incentives of lenders. For limited and stated documentation loans, they argue that loans made to borrowers with a FICO score above 620 had a higher unconditional likelihood of being securitized than loans made to borrowers with a FICO score below 620, and that as a result lenders had less incentive to carefully screen borrowers above the 620 FICO score threshold. For full documentation loans, they identify a FICO score of 600 as a significant threshold for ease of securitization.

If lenders screen borrowers more carefully, they are more likely to learn about otherwise unobserved borrower attributes linked to delinquency risk. If more information about the borrower results in mortgage rates that are higher for riskier borrowers, then more thorough screening should weaken the association between conditional fees and delinquency risk. We post the hypothesis:

Hypothesis 5. *Conditional on a set of observable characteristics, an increase in fees is associated with an increase in the log odds of delinquency that is smaller for low FICO loans and larger for high FICO loans.*

To test this hypothesis, we expand the specification in Equation (8) to allow for interaction terms between fees, documentation level and FICO scores. Specifically, we replace $X_{\text{comp}} b'_{\text{comp}}$ by

$$\sum_{k=1}^{4} b_F^{f,k}\, 1_{\{\text{Full doc, FICO range } k\}}\, \%\text{Fees} + \sum_{k=1}^{4} b_F^{l,k}\, 1_{\{\text{Low doc, FICO range } k\}}\, \%\text{Fees} + b_Y\, \%\text{YSP}. \quad (10)$$

Low documentation loans include limited and stated documentation loans. FICO ranges 1 through 4 are defined as FICO < 600, FICO $\in [600, 620)$, FICO $\in [620, 660)$ and FICO ≥ 600, respectively. The results are reported in Table 7. Independent of the documentation level, a marginal increase in percentage fees tends to have a larger impact on the log odds ratio of delinquency for loans with

higher FICO scores than for loans with lower FICO scores.

[Table 7 about here]

An increase in percentage fees by 1% is more likely, however, for low-FICO-score loans than for high-FICO-score loans. For full documentation loans, the sample standard deviation of percentage fees ranges from 1.40% for loans with a FICO score of less than 600 (600− loans) to 1.28% for loans with a FICO score of 660 or higher (660+ loans). A one standard deviation increase in percentage fees translates to a 0.084 increase in the log odds ratio for 600− loans and a 0.183 increase for 660+ loans. For low documentation loans, standard deviations range from 1.38% for 600− loans to 1.12% for 660+ loans. A one standard deviation increase in percentage fees amounts to a 0.059 increase in the log odds ratio for 600− loans and a 0.190 increase for 660+ loans.

If $\sum_{k=1}^{4} b_F^{f,k} 1_{\{\text{Full doc, FICO range } k\}}$ %Fees in (10) is replaced by

$$\left(\tilde{b}_F^{f,1} + \tilde{b}_F^{f,2}\, 1_{\{\text{FICO } \geq 600\}} + \tilde{b}_F^{f,3}\, 1_{\{\text{FICO } \geq 620\}} + \tilde{b}_F^{f,4}\, 1_{\{\text{FICO } \geq 660\}}\right) 1_{\{\text{Full doc}\}}\, \%\text{Fees},$$

and if $\sum_{k=1}^{4} b_F^{l,k}\, 1_{\{\text{Low doc, FICO range } k\}}$%Fees is replaced in a similar fashion, untabulated results show that the increase in the %Fees coefficient is significant at the 600 and the 660 FICO score threshold, both for full and for low documentation loans. For low documentation loans, the estimate for $\tilde{b}^{l,3}$ is also positive although it is not statistically significant.

We also estimate the model in (10) after stratifying the data by documentation level and FICO range. We obtain coefficient estimates for percentage fees that follow a similar pattern as that for the estimates reported in Table 7. For full documentation loans and FICO score ranges 1, 2, 3 and 4, a one standard deviation increase in percentage fees is associated with a 0.058, 0.146, 0.109 and 0.188 increase in the log odds ratio of first-time delinquency. For low documentation loans, the corresponding estimates are 0.061, 0.084, 0.169 and 0.236.

Overall, our results support Hypothesis 5 and are consistent with a stronger association between conditional fees and delinquency risk when lenders have less incentive to carefully screen borrowers.

5.3. Loan purpose

Credit reports contain specific information on borrowers' payment pattern for previous mortgages. As a result, more housing-related information is available about borrowers who refinance an existing loan than about borrowers who purchase a home for the first time.[16] In addition, refinance

[16] Jaffee (2008) reports that the borrower was a first-time homebuyer for one out of five home purchases in the subprime mortgage market between 2000 and 2006.

loans tend to have a lower combined loan-to-value ratio than purchase loans.[17] This implies that borrowers who refinance an existing mortgage tend to have more money invested in the home than borrowers who purchase a home. Borrowers with sizable down payments have a strong incentive to stay current on their mortgage payments, especially in situations where house prices have declined. In comparison, borrowers who lay out no or little cash at origination have less "skin in the game" and may be more heterogeneous in their attitude towards delinquency risk.

We conjecture that less housing-related information and more heterogeneity in borrower attitudes towards delinquency risk result in a stronger link between conditional fees and delinquency risk for purchase loans than for refinance loans:

Hypothesis 6. *Conditional on a set of observable characteristics, an increase in fees is associated with an increase in the log odds of delinquency that is larger for purchase loans and smaller for refinance loans.*

We reestimate the model in (8) with interaction terms between fees, documentation level, FICO score and loan purpose. We set $X_{\text{comp}} b'_{\text{comp}}$ equal to b_Y%YSP plus the product of %Fees and

$$\left(b_F^{f,l,p} 1_{\{\text{purch}\}} + b_F^{f,l,r} 1_{\{\text{refi}\}}\right) 1_{\{\text{Full doc,low FICO}\}} + \left(b_F^{f,h,p} 1_{\{\text{purch}\}} + b_F^{f,h,r} 1_{\{\text{refi}\}}\right) 1_{\{\text{Full doc,high FICO}\}}$$
$$+ \left(b_F^{l,l,p} 1_{\{\text{purch}\}} + b_F^{l,l,r} 1_{\{\text{refi}\}}\right) 1_{\{\text{Low d,low FICO}\}} + \left(b_F^{l,h,p} 1_{\{\text{purch}\}} + b_F^{l,h,r} 1_{\{\text{refi}\}}\right) 1_{\{\text{Low d,high FICO}\}}. \quad (11)$$

For full documentation loans, low FICO loans are those with a FICO score below 600. For low documentation loans, low FICO loans are those with a FICO score below 620. We interact fees with the documentation level and FICO score to condition on the screening incentives of lenders. The results are reported in Table 7 and support Hypothesis 6. For any given level of screening incentives, the coefficient estimates for percentage fees in (11) are higher for purchase loans than for refinance loans. We replace $b_F^{f,l,p} 1_{\{\text{purch}\}} + b_F^{f,l,r} 1_{\{\text{refi}\}}$ by $\tilde{b}_F^{f,l} + \tilde{b}_F^{f,l,r} 1_{\{\text{refi}\}}$ and verify that the decrease in the fees coefficient from purchase to refinance loans is statistically significant. The same holds true for the remaining combinations of documentation level and FICO score.

The bottom panel of Table 6 reports estimates for the model in (8) after stratifying the data by documentation level, FICO score and loan purpose. The coefficient estimates for percentage fees are again higher for purchase loans, offering additional support for Hypothesis 6.

[17] In our sample, refinance and purchase loans have an average CLTV of 79% and 94%, respectively.

5.4. Broker activity

We refer to brokers who have frequent interactions with a given lender—in our case New Century—as "active brokers" as opposed to "inactive brokers." Active brokers may value their relationship with the lender more than inactive brokers, and hence may be more concerned about the performance of the loans they originate. As a consequence, active brokers may transmit more precise information regarding the borrower's ability to repay the loan to the lender, and may reveal soft information they collect during their negotiations with the borrower. If closer broker-lender relationships result in mortgage rates that are higher for riskier borrowers, then the link between conditional fees and delinquency risk should be weaker for loans originated by active brokers:

Hypothesis 7. *Conditional on a set of observable characteristics, an increase in fees is associated with an increase in the log odds of delinquency that is smaller for loans originated by an active broker and larger for loans originated by an inactive broker.*

We reestimate the model in (8) with interaction terms between fees, documentation level, FICO score and broker activity. At any given point in time, active brokers are those that submitted five or more loan applications to New Century in the previous month.[18] $X_{\text{comp}}b'_{\text{comp}}$ is specified as in Section 5.3, except that the identifiers for purchase loans and for refinance loans in (11) are replaced by identifiers for inactive-broker-originated loans and for active-broker-originated loans.

The results are reported in Table 7 and support Hypothesis 7. For any given level of screening incentives, the coefficient estimates for percentage fees are higher for inactive-broker-originated loans than for active-broker-originated loans. The decrease in the fees coefficient from loans by inactive brokers to loans by active brokers is statistically significant, except for low documentation low-FICO-score loans. The bottom panel of Table 6 reports estimates for the model in (8) after stratifying the data by documentation level, FICO score and broker activity. A one standard deviation increase in percentage fees is associated with an increase in the log odds of delinquency that is smaller for loans originated by an active broker and larger for loans originated by an inactive broker, offering additional support for Hypothesis 7.

[18] About one-third of the loans in our sample are originated by active brokers. For each broker, New Century also tracked the volume of loan applications submitted, and the number and volume of loan applications funded, in the previous month. Our findings are robust to using any of these alternative measures of broker activity.

6. Estimating Marginal Broker Costs

Can the empirical link between broker charges and delinquency risk that we document be used by lenders or regulators? Consider a new broker-revenue-based rate schedule:

$$\text{Rate}(\widetilde{X}) \quad = \quad \begin{cases} r(\widetilde{X}), & \text{if \% broker revenue} \leq \bar{R}(\widetilde{X}) \\ \bar{r}(\widetilde{X}) \geq r(\widetilde{X}), & \text{if \% broker revenue} > \bar{R}(\widetilde{X}), \end{cases} \tag{12}$$

where $\widetilde{X} = \widetilde{X}_{\text{cond}}$ denotes the vector of observable characteristics excluding fees, YSP and the mortgage rate. If the threshold $\bar{R}(\widetilde{X})$ is a constant, then (12) reflects the unconditional link between percentage broker revenues and mortgage credit risk. If $\bar{R}(\widetilde{X})$ is equal to some benchmark revenue for loans with characteristics $\widetilde{X}$, then (12) reflects the conditional link between percentage revenues and delinquency risk.

Under the rate schedule (12), a borrower who pays percentage fees plus percentage YSP, if any, in excess of $\bar{R}$ would have to pay the higher rate $\bar{r}$.[19] But if $\bar{r}$ is so high that the borrower's reservation value for the fees as a percentage of loan amount falls below $\bar{R}-$%YSP, the broker would not be able to collect revenues in excess of $\bar{R}$ and may decide to originate the loan at the lower rate r. Whether or not the rate schedule (12) would be successful in charging higher rates for riskier loans depends, among other things, on the interest rate sensitivity of the borrower's valuation for the loan, of the borrower's shopping efforts and of the broker's costs.

We do not speculate how the introduction of a revenue-based rate schedule may impact the outcome of future borrower-broker interactions or how r and $\bar{r}$ should be set. Instead, we observe that given (12) borrowers would either have to pay the higher rate $\bar{r}$ or forego the loan whenever the broker's percentage costs for the low-rate loan exceed $\bar{R}$. Identifying borrowers who take out high percentage cost loans allows us to characterize a subset of borrowers who would no longer have access to low mortgage rates. Since broker costs are not observable, we outline our estimation strategy below. In Section 7, we discuss current regulatory efforts that propose a constant threshold $\bar{R}$. In Appendix B, we describe two alternative approaches to protecting lenders from unobserved borrower risk.

To derive cost estimates, consider a borrower i and a broker j who bargain over the fees for some loan (L, r). The broker's cost is given by $c_{i,j} = c_{i,j}(X_i, X_j)$, where X_i denotes the vector of observable characteristics other than fees, YSP and broker-specific variables. Broker-specific variables are collected in X_j. In our applications, X_j is a binary "active broker" variable that

[19] To keep notation simple, we drop the conditioning variable $\widetilde{X}$.

equals one if the loan is originated by an active broker as denied in Section 5.4, an zero otherwise.[20]

For the loans in our data, Equation (4) relates broker revenues to costs as a function of the borrower's shopping behavior. While we do not observe borrowers' shopping efforts, Lacko and Pappalardo (2007) and a Federal Reserve Board (2008) survey find that many but not all borrowers shop from only one broker. For a given set of observable characteristics X_i and X_j, and holding YSP fixed, the revenue distribution defined by (4) is a mixture of two unknown distributions—those of broker costs and of borrowers' valuation for the loan—with unknown proportions. Estimating costs from observed revenues therefore requires strong parametric assumptions.

As a tradeoff between the need for loan-level cost estimates and the pitfalls of model misspecification, we consider a range of cost specifications spanned by two polar cases. In the first case, the broker's cost $c_{i,j}$ is set equal to the minimum revenue observed for loans with characteristics X_i and X_j, $\underline{c}(X_i, X_j)$. Provided some loans with characteristics X_i and X_j are intermediated at cost, $\underline{c}(X_i, X_j)$ is a lower bound on conditional costs and $c_{i,j} = \underline{c}(X_i, X_j)$ is consistent with a scenario where borrowers shop from a single broker ($K = 1$) and where there is no unobserved heterogeneity in costs. We refer to the first case as the perfect rent extraction case.

In the second case, the broker's cost $c_{i,j}$ is set equal to the observed revenue. Revenues provide an upper bound on costs, as dictated by the broker's participation constraint in (1). The case $c_{i,j} = \text{revenue}_{i,j}$ is consistent with a scenario where borrowers shop from multiple brokers ($K > 1$) with the same cost. Suppose that costs for borrower i are the same across all brokers of type X_j, so that $c_{i,j} = \bar{c}(i, X_i, X_j)$. If borrowers observe broker types, have a preference for a type of broker and shop from two or more brokers of that type, loans are intermediated at cost and $c_{i,j} = \text{revenue}_{i,j} = \bar{c}(i, X_i, X_j)$. Any unobserved heterogeneity in costs stems from heterogeneity across borrowers. For example, brokers may learn about borrower attributes that are not disclosed on the loan application but are likely to affect the brokers' time costs, such as a particular borrower needing extra prodding or close supervision while preparing the loan documents.[21] That said, costs for a given borrower i may differ across brokers of different types. We refer to the second case as the perfect competition case, short for perfect competition among brokers of the same type.

We consider cost functions of the form

$$c^w_{i,j} \quad = \quad (1-w)\,\underline{c}(X_i, X_j) + w\,\bar{c}(i, X_i, X_j), \qquad \text{for } w \in [0,1], \tag{13}$$

[20] The "Broker competition" variable listed under "Broker variables" in Table 1 is measured at the zip-code level rather than the individual broker level, and is included in X_i.

[21] Woodward and Hall (2012) do not observe broker characteristics and assume that all unobserved heterogeneity in broker costs stems from heterogeneity in costs across brokers. As a result, they cannot identify broker costs in cases where the borrower shops from only one broker.

where $w = 0$ corresponds to costs under perfect rent extraction and $w = 1$ corresponds to costs under perfect competition. To visualize the range of cost distributions generated by Equation (13), Figure 4 plots the unconditional cost distributions $c^w = (1-w)\underline{c} + w\bar{c}(i)$. As w increases from 0 to 1, cost estimates shift from a narrow distribution at small values to more disperse and right-skewed distributions with some very large values.

[Figure 4 about here]

Given a set of observable characteristics (X_i, X_j), $\bar{c}(i, X_i, X_j)$ is observed directly as the broker's revenue. Minimum conditional revenues $\underline{c}(X_i, X_j)$ can be approximated in a robust fashion by a low quantile of the conditional revenue distribution, $q_\alpha(X_i, X_j)$ for α small (Chernozhukov (2000), Liu, Laporte, and Ferguson (2007)). We set $\alpha = 0.05$ and estimate $q_{0.05}(X_i, X_j)$ by fitting the quantile regression

$$q_{0.05}(X_i, X_j) \quad = \quad \gamma_0 + (X_i, X_j)\,\gamma', \tag{14}$$

where γ_0 is a scalar and γ is a row vector of coefficients. In our applications, the conditioning variables (X_i, X_j) are the loan, property, borrower and broker characteristics, neighborhood and regulation variables, market conditions, and year and location dummies listed in Table 5.[22]

Table 8 presents average cost estimates for different values of w. Average dollar costs ranged from 2.2K per loan for $w = 0$ to 5.3K for $w = 1$, whereas average percentage costs ranged from 1.4% for $w = 0$ to 3.2% for $w = 1$. While dollar costs showed a moderate increase throughout the sample period, percentage costs fell sharply. For all values of w, there were sizable costs even for the smallest loans, consistent with sizable fixed costs associated with loan origination. Dollar costs were increasing and concave in the loan amount, and percentage costs were substantially larger for smaller loans (see Scenario 1 in Section 2). Average percentage costs ranged from 2.0% for loans of 50K or less to 0.4% for loans in excess of 500K for $w = 0$, and from 5.5% to 1.6% for $w = 1$.

[Table 8 about here]

Table 9 reveals that after conditioning on the size of the loan, the variation in costs was substantially smaller. Conditional on size, it was slightly more costly to originate more complex loans, piggyback loans, cash out refinance loans, loans for borrowers of lower credit quality, and loans in neighborhoods with a higher percentage of minorities. Cost estimates were somewhat higher for

[22] Estimates for γ_0 and γ are available upon request.

primary residences than for second homes or investment properties, and for loans that are originated by active versus inactive brokers. Perhaps active brokers were larger brokerage firms with higher fixed costs per loan because they needed to spend more to provide the level of service borrowers associated with that type of broker, or because they were in markets where it was costlier to keep new brokers from entering. As a robustness check we reestimate costs for different strata of loans and verify that the estimates are similar to those based on the full sample.

[Table 9 about here]

Marginal broker profits are measured as the difference between revenues and costs. According to Table 8, average profits ranged from 3.1K per loan for $w = 0$ to zero for $w = 1$. Because the level of the cost estimates in the perfect competition case seems rather high, and in light of the evidence in Lacko and Pappalardo (2007) and Federal Reserve Board (2008), we believe that many of the observed revenues did indeed reflect positive marginal profits. For $w < 1$, Table 8 shows that borrowers who took out larger loans paid substantially higher dollar margins above costs than borrowers who took out smaller loans. Our findings suggest that brokers benefitted from steering borrowers towards larger loans, and that brokers may have been willing to expand extra efforts to attract borrowers who purchase or refinance large homes. Conditional on loan size, however, the variation in profits was substantially smaller (see Table 9).

7. The Impact of Linking Mortgage Rates to Broker Charges

We analyze a regulatory proposal that stipulates broker-revenue-based mortgage pricing and discuss its potential impact on loan performance, access to mortgage credit and broker compensation.

7.1. The QRM proposal

In response to the fallout from the subprime crisis, Congress enacted credit risk retention requirements as part of the Dodd-Frank Act. The rulemaking requires issuers of securitizations to keep "skin in the game" by retaining at least 5% of the credit risk of each securitization.[23] Dodd-Frank exempts certain securitizations from the risk retention requirements, including deals collateralized exclusively by government-backed securities or by Qualified Residential Mortgages.

A proposal for Qualified Residential Mortgage (QRM) guidelines was published in March 2011 (see Appendix C for details). One of the proposed restrictions, QRM Rule 8, stipulates that

[23] Permissible forms of risk retention include, among others, a vertical slice of the deal's interests where specified pro rate pieces of each subordination tranche are retained, or a horizontal first-loss position (Agencies (2011)).

origination charges payable by the borrower in connection with the mortgage transaction, as defined in the Federal Reserve Board's Regulation Z (12 CFR section 226.4), may not exceed 3% of the loan amount. Percentage broker revenues are a lower bound for percentage origination charges (see Appendix C), hence cannot exceed 3% for QRM loans. NAMB (2011), Freedman (2011) and Zandi and deRitis (2011) predict that borrowers who take out non-QRM loans will have to pay significantly higher mortgage rates, by as much as 2-3%. Using revenues as a proxy for origination charges, this would imply a revenue-based rate schedule as in (12), with $\bar{R}(\tilde{X})$ equal to 3%.

The broker's participation constraint (1) allows us to identify loans in our data that ex post would not have been able to qualify for QRM status based on Rule 8. Specifically, we identify loans with marginal broker costs in excess of 3% of the loan amount as non-QRM8 loans. Non-QRM8 loans would have violated QRM Rule 8 even if the broker would have foregone any marginal profits. We refer to all other loans as QRM8 loans. For QRM8 loans, 3% of the loan amount would have been sufficient to cover the broker's costs. In what follows, we describe the loan, borrower and risk characteristics of non-QRM8 loans and contrast them to those for QRM8 loans. To the best of our knowledge this offers a first insight into the potential impact of QRM Rule 8. As an extension, we consider Rule 8 in combination with other QRM rules, which are summarized in Table 10.[24]

[Table 10 about here]

7.2. The potential impact of QRM Rule 8 on loan performance and access to mortgage credit

Under rate schedule (12), borrowers constrained to non-QRM8 loans no longer have access to low mortgage rates. In fact, if $\bar{r}$ is set prohibitively high these borrowers may be barred from access to mortgage credit altogether. For a wide range of broker cost specifications, the top panel of Table 11 reports descriptive statistics for both QRM8 and non-QRM8 loans. In the perfect competition case (w=1), non-QRM8 loans account for 48% of the loans in our data. We find that non-QRM8 loans are generally taken out by borrowers with low FICO scores and a low monthly income who purchase or refinance homes in neighborhoods with a high percentage of minorities and a low percentage of college graduates. The starkest contrast between non-QRM8 and QRM8 loans, however, is in the size of the loans. While QRM8 loans have an average size of 236K, non-QRM8 loans are generally much smaller and have an average size of 140K. Given the small size of non-QRM8 loans and our discussion in Section 4.1, it is not surprising that the average 12-month delinquency rates are higher for non-QRM8 loans at 16% than for QRM8 loans at 11%.

[24] Only a few empirical studies have analyzed the potential impact of the proposed QRM rules, and none of them has focused on QRM Rule 8. The Agencies (2011) investigate QRM Rules 2, 4 and 7, whereas the U.S. Government Accountability Office (GAO (2011)) analyzes QRM Rules 1, 3 and 7.

[Table 11 about here]

Table 11 reports similar descriptive statistics for alternative cost specifications. As cost estimates shift from the perfect competition case ($w = 1$) to the perfect rent extraction case ($w = 0$), fewer and fewer loans fall into the non-QRM8 category. At the same time, the gap in loan amount, FICO scores, borrower income, neighborhood characteristics and delinquency rates between QRM8 and non-QRM8 loans widens. For $w = 0$, less than 3% of the loans are identified as non-QRM8 loans. The average size of non-QRM8 loans is very small at 58K, compared to 193K for QRM8 loans. Average 12-month delinquency rates are 25% for non-QRM8 loans and 13% for QRM8 loans.

Since smaller loans tend to have higher percentage costs than larger loans (Table 8), smaller loans are more likely to fall under the non-QRM8 category. For cost estimates $c^{0.5}$, Table 12 shows that 70% of the loans of 50K or less, 57% of the 50-75K loans and 37% of the 75-100K loans are non-QRM8 loans. In comparison, only 17% of the 100-200K loans, 4% of the 200-300K loans and less than 1% of the 300K+ loans fall under the non-QRM8 category.

[Table 12 about here]

As a result, the decrease in delinquency rates from the full sample to the subsample of QRM8 loans is more pronounced for smaller loans than for larger loans. Specifically, average 12-month delinquency rates decrease from 17.0% to 13.1% for loans of 50K or less, from 19.0% to 15.1% for 50-75K loans and from 15.1% to 13.0% for 75-100K loans. In comparison, delinquency rates decrease from 12.4% to 11.5% for 100-200K loans, from 11.4% to 11.1% for 200-300K loans, and remain nearly unchanged for 300K+ loans. Overall, average 12-month delinquency rates decrease from 13.3% for the full sample to 11.9% for the subsample of QRM8 loans.

7.3. The potential impact of QRM Rule 8 on broker compensation

While the stated goal of the proposed QRM definition is to identify low-credit-risk loans, limits on origination charges have historically been imposed to fight predatory lending. Predatory lending is broadly defined as imposing unfair or abusive loan terms on borrowers. QRM Rule 8 would enforce significantly tighter constraints on broker compensation than the existing guidelines (see Appendix D for details).

Marginal broker profits are computed as the difference between revenues and costs. Large profits indicate that the broker overcharges the borrower relative to the broker's cost of intermediating the loan. For the subsample of QRM8 loans, Table 13 reports summary statistics for broker profits based on observed revenues and also based on revenues that are capped at 3% of the loan amount.

For the perfect rent extraction case (w=0), average broker profits per loan are \$719 lower when percentage revenues are capped at 3%. The decrease in profits is more pronounced for small and medium-sized loans than for large loans, mainly because the larger the loan the less likely it is that percentage revenues exceed 3% (Table 3). As the assumption underlying the cost estimates shifts from the perfect rent extraction case to the perfect competition case, the decrease in profits when revenues are capped at 3% becomes smaller.

[Table 13 about here]

The results in Table 13 suggest that the proposed QRM Rule 8 may not be successful in reducing the profit differential between large and small loans in any significant way. Even with QRM Rule 8 in place, brokers may benefit from steering borrowers towards larger loans and may expand extra efforts to attract borrowers who purchase or refinance large homes. In Appendix E, we propose an alternative specification of QRM Rule 8 that replaces the 3% limit on origination charges by one that is concave in the loan amount, as shown in Figure 5. Our alternative proposal is motivated by the observation that broker costs are a concave rather than a linear function of loan size (Table 8). The results of our ex post analysis suggest that the alternative specification of QRM Rule 8 may be more effective than the current one in protecting large borrowers from being overcharged, thereby narrowing the profit differential between large and small loans.

[Figure 5 about here]

7.4. Interaction of Rule 8 with other QRM rules

The bottom panel of Table 11 reports descriptive statistics for QRM Rules 1 through 7, when applied to the loans in our sample.[25] Each of the proposed rules has at least some success in reducing delinquency rates. Rule 3 imposing restrictions on payment terms and Rule 7 imposing ability to repay requirements are the most restrictive rules. They are also the most effective rules in terms of reducing delinquency rates among QRM loans. Compared to Rule 8, however, no other rule creates a similar discrepancy in loan amount, borrower income or neighborhood characteristics between QRM and non-QRM loans.

Table 13 shows the average broker profits for QRM8 loans that satisfy one additional QRM rule. For the perfect rent extraction case, the lowest average profits are obtained for QRM8 loans that satisfy Rule 3—1.6K profit per loan if revenues are capped at 3%—and for QRM8 loans that satisfy Rule 7 (1.7K). While these profits are low in comparison to the average profit of 2.4K for

[25] Rule 6 is excluded because we cannot verify whether appraisals conformed to accepted standards.

QRM8 loans, the lower profits come at the expense of excluding a large fraction of loans. Similar observations apply to the alternative specification of QRM Rule 8 discussed in Appendix E.

8. Conclusion

Based on a sample of more than 600,000 brokered New Century loans, we document that brokers charge higher percentage fees for loans that turn out to be riskier ex post. Conditional on variables observed by the lender and the econometrician, a marginal increase in percentage fees by 1% is associated with 7.6% higher odds of delinquency. We interpret our findings through the lens of a simple bargaining model in which the broker learns the borrower's information and has all the bargaining power. Brokers can set fees without a feedback effect on other terms of the loan, and borrowers shop from one or more brokers according to a second-price auction process. The model implies that brokers extract high conditional fees from borrowers who shop from few brokers, including borrowers with a high conditional valuation for the loan that shop from only one broker, and from borrowers who shop from multiple brokers but for whom brokers perceive conditional costs to be high. Our findings suggest that unobserved borrower attributes such as suboptimal shopping behavior, high valuation for the loan or high borrower-specific broker costs are associated with high mortgage credit risk.

We present evidence that borrowers who pay higher conditional fees are inherently more risky, and not simply because paying a higher fee leaves them more cash constrained. We argue that the association between conditional fees and delinquency risk is stronger in cases where the lender knows less about the borrower. We support our argument by documenting a stronger association between conditional fees and delinquency risk when lenders have fewer incentives to carefully screen borrowers, for purchase rather than refinance loans, and for loans originated by brokers who have less frequent interactions with the lender.

We explore whether lenders and regulators can use broker-revenue-based rate schedules to exploit the link between broker charges and delinquency risk. We consider a revenue-based rate schedule where mortgage rates increase if percentage revenues exceed a certain threshold. If the threshold is a constant, the schedule can only reflect the unconditional link between percentage revenues and delinquency risk. If, however, the revenue threshold varies with conditioning information, the schedule can reflect the conditional link between revenues and delinquency risk.

The Dodd-Frank Act imposes credit risk retention requirements for residential mortgage securitizations. Rule 8 of the proposed QRM guidelines for loans to be exempt from risk retention is

likely to result in a revenue-based rate schedule for brokered loans with a revenue threshold of 3%. We observe that given such a schedule, borrowers would have to pay higher rates whenever the broker's percentage costs exceed 3%. We show that independent of the assumptions underlying our cost estimates, percentage costs tend to be higher for smaller loans. Hence the proposed QRM Rule 8 is likely to result in higher mortgage rates for smaller—and unconditionally riskier—loans. It is unlikely, however, to impose any constraints on mortgage rates for larger loans.

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A. Data Description and Sample Construction

The raw New Century data contains 3.2 million loans. We keep all wholesale loan applications between 1997 and 2006 that were either funded, declined or withdrawn. We require records to contain the broker id, the property zip code, a loan amount between 10K and 1,000K, a combined loan-to-value ratio between 0 and 150, a FICO score between 300 and 850, a debt-to-income ratio between 0 and 100, and a mortgage rate between 0 and 25%. This leaves us with roughly 1.5 million brokered loans which are used to compute broker variables. We then restrict the sample to include only funded loans, which yields roughly 768,000 observations.

To identify piggyback loans we search for a matching first lien for any second lien loan. We match on the funding date, the borrower's age and FICO score, the appraisal value, the loan purpose, the occupancy status, and the property city and zip code. We obtain a match for the vast majority of second liens. Second lien loans that cannot be matched are dropped, so that data is composed of free-standing first liens and piggyback loans. We do not observe whether a borrower with a free-standing first lien took out a second lien with another lender. While New Century did not typically originate free-standing second liens, this may or may not be true for other lenders and the fraction of piggybacks in our data should be viewed as a lower bound. Each match of a first and second lien is treated as one loan record. Broker fees and YSP are aggregated over the first and second lien. For all other characteristics, piggybacks are categorized based on the properties of the first lien. We require loan records to have data on all observable characteristics used in our empirical analysis. We trim the sample by excluding loans with broker revenues in excess of 17.5K, which account for less than 1% of the data. Our final sample includes 668,582 funded broker loans.

The number of loans in our sample grew exponentially, from about 3,000 loans originated in 1997 to 143,000 in 2006. Piggyback loans became popular from 2004 onwards. The average size of loans grew from about 100K in 1997 to more than 200K in 2006, with higher average amounts for piggybacks. The number of brokers used by New Century in any given year grew dramatically, from about 900 in 1997 to 26,000 in 2006. Over the sample period, about 669,000 loans were originated by 56,000 independent brokers with an average size of 190K.

Our sample represents subprime loans from all parts of the country, with California, Florida and Texas being the three biggest markets. About 90% of all loans were originated in metropolitan areas. Approximately two-thirds of the loans were taken out to refinance existing loans, and the majority of the refinance mortgages involved cash-out payments to the borrower. For the whole sample period, hybrid loans were the most common ones followed by fixed-rate loans. In the last two years, loans with balloon and interest-only payments became more popular, reaching 54% of

the loans in 2006. For most of the sample period, the 2/28 hybrid dominated the hybrid category and the 30-year fixed-rate loan the fixed-rate category. The majority of loans came with a product-specific prepayment penalty. The fraction of limited and stated documentation loans varied between 33% in 1997 and 47% in 2004.

The majority of the loans were for single-family homes that served as the borrower's primary residence. The average borrower FICO score fell by almost 30 points between 1997 and 2001, before rising again by roughly the same amount during the second half of the sample. Piggyback loans were made to borrowers with relatively high credit scores, but presumably no cash savings. The borrowers who took out low documentation loans usually had higher credit scores than those that provided full documentation. Even though the average combined monthly income rose from 5.4K in 1997 to 7.2K in 2006, debt-to-income ratios increased slightly, from 37% in 1997 to 41% in 2006. Loan amounts grew not only relative to income levels, but also relative to property values. LTV ratios rose from 73% in 1997 to 80% later in the sample, as second liens gained in popularity.

From 1999 onwards, the data contain detailed servicing records for most loans. We consider a loan to be delinquent if payments are 60 days or more late, or if the loan is in foreclosure, real estate owned or in default. For each year of origination k, let $\widehat{p}_s^k$ denote the number of vintage-k loans experiencing a first-time delinquency s months after origination, divided by the number of vintage-k loans that are still active after s months or experience a first-time delinquency at age s. The cumulative delinquency rate of vintage-k loans at age t is

$$\widehat{P}_t^k \quad = \quad 1 - \prod_{s=1}^{t} \left(1 - \widehat{p}_s^k\right), \quad \text{for } k = 1999, \ldots, 2006.$$

Figure 1 plots $\widehat{P}_t^k$ as a function of the age of the loan t and vintage k. The results in Table 5 show that after controlling for year-by-year variation in loan-level characteristics, loans originated in 2004 and 2005 were riskier than loans originated earlier in the sample.

B. Performance-based Funding Decisions and Profit Sharing

We describe two alternative approaches to protecting lenders from unobserved borrower risk. First, lenders may incentivize brokers to reveal otherwise unobserved borrower risk by tracking past broker performance, and by identifying brokers who originated loans with abnormally high delinquency rates in the past as underperforming brokers. Lenders may screen loan applications submitted by underperforming brokers more thoroughly, offer the best rates only to brokers with a good

performance record, or reject applications submitted by underperforming brokers more frequently. Lenders may also exercise more caution in interacting with new brokers for whom performance statistics are not yet available.

Second, brokers may receive only a portion of their fees at closing. The remaining fees are placed in a trust for a certain number of months or until the loan becomes delinquent, whichever occurs first. If the loan remains active throughout the waiting period, the accrued value of the remaining fees is paid to the broker, otherwise that amount goes to the lender. If the fee received at closing represents a benchmark conditional broker fee, our proposed strategy exploits the unobserved heterogeneity in fees to reduce the lender's risk exposure, without imposing additional constraints on access to mortgage credit. For loans that are sold and securitized, it is in the interest of secondary market investors to incentivize lenders to disclose broker charges and to pass along any payouts from high conditional fees in the event of an early delinquency. Recent work on securitization and mortgage default include Downing, Jaffee, and Wallace (2009), Mian and Sufi (2009), Keys, Mukherjee, Seru, and Vig (2010), Keys, Seru, and Vig (2012), Jiang, Nelson, and Vytlacil (2010), Bubb and Kaufman (2011), Bubb and Kaufman (2009), Elul (2011), Hartman-Glaser, Piskorski, and Tchistyi (2011), and Malamud, Rui, and Whinston (2011).

C. Additional Details on the QRM Proposal

The QRM term is to be defined jointly by six regulatory agencies. The "Agencies" include the Office of the Comptroller of the Currency, the Federal Reserve Board, the Federal Deposit Insurance Corporation, the Securities and Exchange Commission, the Department of Housing and Urban Development and the Federal Housing Finance Agency. In March 2011, the Agencies published a proposal of QRM guidelines for public comment. Such comments have since been submitted by the National Association of Mortgage Brokers (NABM, www.namb.org), the National Association of Realtors (NAR, www.realtor.org) and the private mortgage insurance industry (MCIA, www.micanews.com), among many others. Dodd-Frank provides that the risk retention rule for residential mortgage-backed securities will become effective one year after publication of the finalized QRM rule, which has not yet been issued.

The stated objective of the QRM proposal is to ensure that QRM loans have "low credit risk even in stressful economic environments" (Agencies (2011)). The proposed QRM rules are summarized in Table 8. Rules 1 through 7 restrict QRM eligibility to first lien loans on a one-to-four family residential property to be purchased or refinanced as a principal residence. The maturity of the

loan cannot exceed 30 years, and the borrower must have a clean credit history. The maximum permitted loan-to-value ratio is 80% in a purchase transaction, 75% in a refinance transaction, and 70% in a cash-out refinance situation. The borrower's debt-to-income ratio cannot exceed 36%, and income and financial resources must be verified and documented. Prepayment penalties are not permitted and the loan cannot have payment terms that allow for balloon payments, interest-only payments or negative amortization.

QRM Rule 8 restricts the origination charges payable by the borrower in connection with the mortgage transaction to 3% of the loan amount. "Origination charges" are defined in the Federal Reserve Board's Regulation Z (12 CFR section 226.4) and include *(i)* all compensation paid directly or indirectly by the borrower or lender to the mortgage originator, *(ii)* finance charges (sections 226.4(a) and 226.4(b)) such as appraisal and credit report fees, but excluding interest and time price differentials, *(iii)* real-estate related fees (section 226.4(c)(7)) such as title insurance and notary fees, unless reasonable, *(iv)* credit insurance premia and debt cancellation or suspension fees, and *(v)* prepayment penalties incurred by the borrower for a previous loan held by the same lender.

For the loans in our sample, the observed broker revenues are a tight lower bound for origination charges. The revenues consist of all compensation paid directly or indirectly by the borrower to the broker, and include finance charges such as appraisal and credit report fees. Our data suggest that additional fees such as credit insurance premia, debt cancellation or suspension fees, or prepayment penalties for previous loans account for only a small portion of the borrower's origination charges.

D. Existing Predatory Lending Guidelines

Predatory lending is broadly defined as imposing unfair or abusive loan terms on borrowers (see www.fdicoig.gov/reports06/06-011.pdf). Although predatory lending occurs across all demographics, subprime borrowers have been the more likely targets (see Bond, Musto, and Yilmaz (2009) and Freddie Mac (2012)). HOEPA Section 32 attempts to counteract predatory lending by enforcing strict disclosure requirements and by imposing restrictions on product features for loans with high rates or high origination charges. For a summary of HOEPA, state and agency high cost loan policies, see www.ftc.gov/bcp/edu/pubs/consumer/homes/rea19.shtm. Fannie Mae's and Freddie Mac's anti-predatory lending requirements are available online at www.efanniemae.com and www.freddiemac.com. Government-sponsored agencies do not buy Section 32 mortgages, which provides additional incentives for lenders to avoid such loans. Less than 0.2% of the loans in our data are Section 32 mortgages.

The limit on origination charges for Section 32 mortgages is generally much larger than that proposed by QRM Rule 8. HOEPA Section 32 defines high-fee loans as loans for which total origination charges exceed the larger of \$592 or 8% of the loan amount (see Footnote 3). As a result, the proposed QRM Rule 8 would impose significantly tighter restrictions on broker compensation than the existing HOEPA guidelines.

E. An Alternative Specification of QRM Rule 8

Consider an alternative specification of the proposed QRM Rule 8 that restricts origination charges to 3% for loans of size 200K or less and to 10K for loans of more than 500K. In between, maximum dollar charges grow according to a piecewise linear schedule that caps origination charges at 8K and 9K for loans 300K and 400K loans, respectively. (To propose the alternative specification, we computed average broker costs c^1 for loans of size 100K, 200K, . . . , 1,000K and used these estimates to derive a piecewise linear threshold for origination charges.) Figure 5 contrasts the alternative rule with QRM Rule 8, and highlights that the alternative specification imposes tighter restrictions on origination charges for loans in excess of 200K.

The middle panel of Table 12 shows that the tighter constraints on origination charges exclude only few additional loans, except for the most conservative cost estimates. QRM8alt loans are loans for which costs do not exceed the limit on broker revenues imposed by the alternative QRM Rule 8. The fraction of QRM8alt loans in our sample is 97.5%, 92.3%, 78.4%, 60.1% and 46.2% for cost estimates c^0, $c^{0.25}$, $c^{0.5}$, $c^{0.75}$ and c^1. This compares to 97.5%, 92.3%, 79.8%, 64.8% and 51.9% for QRM Rule 8. Average 12-month delinquency rates are no higher under the alternative specification than under QRM Rule 8. If anything, for large loans and cost estimates $c^{0.5}$, $c^{0.75}$ and c^1, delinquency rates are lower under the alternative rule than under the original rule.

Broker profits for medium-sized and especially for large loans are substantially smaller under the alternative specification of QRM Rule 8 than under the original one. For the perfect rent extraction case (w=0), Table 13 reports average broker profits of 1.8K, 3.0K, 4.1K and 5.7K for 100-200K, 200-300K, 300-500K and 500K+ QRM8alt loans when the alternative specification of limits on origination charges is applied, compared to average profits of 1.8K, 3.2K, 4.9K and 7.2K for QRM8 loans when the 3% cap on origination charges is applied. Overall, our results suggest that a limit on origination charges that is concave in the loan amount may be more effective in narrowing the profit differential between large and small loans than a linear one.

Table 1: **List of Variables**

Variable	Description
	Loan Characteristics
Rate	Initial mortgage rate in %
NC points	Upfront charges by New Century in %
Rate margin for hybrids	Rate margin that is added to an index to determine a floating rate, in %
Loan amount	Loan amount in thousands of dollars
2/28 (3/27)	Indicators for 2/28 (3/27) loans. A 2/28 loan is a 30-year loan for which the mortgage rate is fixed for the first two years, after which the rate begins to float based on an index plus a margin. For a 3/27 loan, the rate is fixed for the first 3 years.
Hybrid	Indicator for 2/28 or 3/27 loans
FRM	Indicator for 15-, 20- or 30-year fixed-rate loans
Balloon/IO	Indicator for mortgages with a balloon or interest-only payments
Piggyback	Indicator for a matched pair of a first and a second lien loan
Low documentation	Indicator for a limited or a stated documentation loan
Prepay penalty	Indicator for a loan with a prepayment penalty
Refi, cash out	Indicator for a cash-out refinancing
Refi, no cash out	Indicator for a no-cash-out refinancing
LTV	Loan-to-value ratio, i.e. the value of the loan divided by that of the house, in %
CLTV	Combined loan-to-value ratio, i.e. the value of all liens on the house divided by the value of the house, in %
	Property Characteristics
2nd home/investment prop	Indicator for second home or investment property, equals 1 minus "Primary residence" dummy
Multi unit	Indicator for 2-4 unit properties, equals 1 minus "Single unit" dummy
	Borrower Characteristics
FICO	Fair, Isaac and Company (FICO) credit score at origination
Debt-to-income	All monthly debt payments divided by monthly gross income in %, also referred to as back-end ratio
Risk grade	Risk category assigned to the loan by the lender based on the borrower's credit history, FICO score, LTV and debt-to-income ratio
Monthly income	Combined monthly borrower income in thousands of dollars
	Broker Variables
Broker competition	For a given month and zip code, broker competition is the number of brokers who submitted loan applications to New Century divided by the number of housing units (in thousands)
Active broker	Indicator for brokers with five or more loan applications submitted to New Century in previous month
	Neighborhood Characteristics
Race	% white population in zip code, based on 2000 census data
Education	% of population with a BA degree in zip code, based on 2000 census data
	Regulation Variables
Regulation (coverage)	Index of coverage of anti-predatory lending laws
Regulation (brokers, Pahl)	Pahl (2007) index of mortgage broker regulation
	Market Conditions
6mo LIBOR	6-month LIBOR rate in %
30yr fix rate - 6mo LIBOR	Spread between 30-year conventional mortgage rate and 6-month LIBOR in %
House prices	Lagged abnormal 3-year cumulative house price appreciation in % (Source: OFHEO)
	Location
Non-metro area	Indicator for non-metropolitan area, based on Rural-Urban Commuting Area (RUCA) codes

Table 2: **Descriptive Statistics** The table reports descriptive statistics for brokered loans funded by New Century. Our data include 668,582 loans originated between 1997 and 2006. Details on the sample construction are provided in Appendix A.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	All
					Broker loans funded by New Century (×1,000)						
No of first liens	3	12	16	14	26	59	107	137	151	143	669
free-standing	3	12	16	14	26	58	102	113	108	104	557
piggyback	0	0	0	0	0	1	5	24	43	39	112
Loan amt of first liens	102	101	113	127	149	158	173	194	214	217	190
free-standing	102	101	113	127	149	157	172	192	208	209	183
piggyback (total)	0	126	0	175	199	206	232	258	288	296	281
No of brokers	1	3	4	4	5	9	15	21	25	26	56
					Location (percent)						
CA	28	18	19	27	33	30	30	30	27	21	27
FL	5	8	9	10	8	9	9	9	12	12	10
TX	4	4	7	7	4	5	6	6	5	8	6
West w/o CA	22	15	13	13	12	11	10	14	14	12	13
South w/o FL, TX	4	14	15	13	12	12	11	11	11	14	12
Midwest	35	32	26	23	25	23	19	16	15	17	18
Northeast	3	8	12	7	7	10	14	15	16	17	14
Metro areas	90	90	89	90	91	91	92	91	91	90	91
					Loan characteristics (percent)						
Refi, cash out	54	48	55	57	60	62	63	56	47	47	54
Refi, no cash out	22	16	16	16	17	17	11	6	9	9	10
2/28	61	57	62	66	78	70	65	57	41	28	51
3/27	6	4	7	17	3	3	3	3	7	4	5
30yr FRM	29	34	26	15	16	23	28	20	17	13	19
20yr FRM	0	0	1	0	0	1	1	1	1	0	1
15yr FRM	4	4	4	2	2	3	3	2	1	1	2
Ballon w/ adj rate	0	0	0	0	0	0	0	0	6	36	9
Ballon w/ fixed rate	0	0	0	0	0	0	0	0	1	4	1
Interest only	0	0	0	0	0	0	0	17	27	14	12
Prepay penalty	68	72	76	85	84	81	81	79	74	72	77
Low doc	33	38	37	38	44	44	41	47	44	41	43
Rate 30yr FRM	9.7	10.1	10.3	11.2	9.7	8.4	7.5	7.1	7.3	8.5	7.9
Rate 2/28	9.9	9.8	10.0	10.7	9.6	8.5	7.6	7.3	7.7	8.9	8.1
Margin 2/28	7.0	6.1	6.1	6.2	6.6	6.6	5.8	5.6	5.8	6.2	6.0
					Property characteristics (percent)						
Primary residence	81	78	85	90	90	91	93	92	89	87	90
Single unit	92	91	92	93	93	92	93	92	93	93	93
					Borrower characteristics (percent)						
FICO	612	612	605	587	585	594	605	620	622	614	612
piggyback	–	707	–	646	666	651	647	658	655	653	654
low doc	620	620	613	597	597	606	613	633	641	634	627
LTV	73	77	77	76	78	78	80	80	80	80	80
CLTV	74	79	79	78	79	80	82	85	86	86	84
Monthly income	5.4	5.5	5.3	5.6	5.9	5.9	6.0	6.2	6.8	7.2	6.4
Debt-to-income ratio	37	36	37	39	39	39	39	40	40	41	40

Table 3: **Broker Charges** The table reports average per-loan broker fees, YSP and revenues. The top panel shows the statistics by origination year, whereas the bottom panel shows the statistics for loans sorted on loan amount and on origination period (1997-03, 2004-06), loan program (hybrid, fixed-rate, balloon/IO), level of documentation (full, low), FICO score (< 620, ≥ 620), and prepayment penalty (no PP, PP). Our data include 668,582 loans originated between 1997 and 2006.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	All
					Percent of loan amount						
Fees	3.2	3.2	3.3	3.2	2.9	2.7	2.4	2.0	2.0	2.1	2.3
YSP	1.6	1.3	1.0	1.0	0.9	1.0	0.9	1.0	0.8	0.7	0.9
Revenue	4.9	4.4	4.4	4.2	3.8	3.7	3.3	3.0	2.8	2.8	3.1
					Dollar per loan (×1,000)						
Fees	2.6	2.6	3.0	3.4	3.7	3.6	3.5	3.5	3.9	4.2	3.7
YSP	1.6	1.2	1.1	1.1	1.1	1.4	1.5	1.8	1.7	1.4	1.6
Revenue	4.2	3.7	4.1	4.5	4.8	5.0	5.0	5.4	5.6	5.6	5.3

	All	'97-03	'04-06	Hybr	FRM	B/IO	Full	Low	<620	≥620	nPP	PP
					Dollar per loan (×$1,000)							
					Loan amount ≤ 50K							
Fees	1.7	1.7	1.6	1.7	1.7	1.5	1.7	1.7	1.7	1.7	1.5	1.8
YSP	0.5	0.5	0.6	0.6	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Revenue	2.2	2.2	2.2	2.3	2.2	1.9	2.2	2.2	2.3	2.2	2.1	2.3
					Loan amount ∈ (50,75]K							
Fees	2.1	2.3	1.9	2.1	2.1	1.8	2.1	2.0	2.1	2.0	1.8	2.2
YSP	0.7	0.7	0.7	0.8	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7
Revenue	2.8	3.0	2.6	2.9	2.7	2.4	2.8	2.7	2.8	2.7	2.6	2.9
					Loan amount ∈ (75,100]K							
Fees	2.5	2.7	2.3	2.4	2.6	2.2	2.5	2.4	2.6	2.3	2.2	2.6
YSP	0.9	0.9	0.9	1.0	0.7	0.8	0.9	0.9	0.9	0.9	1.0	0.9
Revenue	3.4	3.6	3.2	3.5	3.3	3.1	3.4	3.3	3.5	3.2	3.1	3.5
					Loan amount ∈ (100,200]K							
Fees	3.3	3.5	3.2	3.3	3.6	3.3	3.3	3.3	3.5	3.1	2.8	3.5
YSP	1.3	1.3	1.3	1.5	0.9	1.2	1.3	1.3	1.4	1.3	1.4	1.3
Revenue	4.7	4.8	4.6	4.8	4.4	4.5	4.7	4.6	4.8	4.4	4.2	4.8
					Loan amount ∈ (200,300]K							
Fees	4.7	4.6	4.7	4.5	4.9	4.9	4.7	4.6	5.0	4.4	4.1	4.9
YSP	2.0	2.0	1.9	2.3	1.3	1.7	1.9	2.0	2.0	1.9	2.1	1.9
Revenue	6.6	6.7	6.6	6.8	6.2	6.6	6.7	6.6	7.0	6.4	6.2	6.8
					Loan amount ∈ (300,500]K							
Fees	5.8	5.3	5.9	5.3	5.8	6.2	5.9	5.7	6.1	5.6	5.2	6.0
YSP	2.7	2.9	2.6	3.4	1.9	2.3	2.7	2.7	2.7	2.7	3.0	2.6
Revenue	8.5	8.2	8.6	8.7	7.7	8.6	8.6	8.5	8.9	8.3	8.2	8.6
					Loan amount > 500K							
Fees	6.5	6.0	6.5	5.7	6.6	6.7	6.5	6.5	6.6	6.4	5.4	6.8
YSP	3.3	3.3	3.3	4.2	2.4	3.0	3.2	3.3	3.2	3.3	3.8	3.0
Revenue	9.7	9.3	9.7	9.9	9.0	9.8	9.7	9.7	9.8	9.7	9.2	9.9

Table 4: **Explaining Rates, Broker Revenues and Fees** The first two columns report the parameter estimates from regressing mortgage rates on percentage fees, percentage YSP and observable loan, property, borrower and broker characteristics, neighborhood and regulation variables, market conditions, and year and location dummies. Columns three though six show the parameter estimates from regressing broker revenues, in dollars per loan (columns three and four) and as a percentage of the loan amount (columns five and six), on observable characteristics. Similar results are reported for broker fees in columns seven through ten. The benchmark set of loans includes all full documentation no-prepay-penalty 2/28 loans between 100 and 200K taken out by a borrower with a risk grade of AA or better and a FICO score between 600 and 620 to purchase a single-unit primary residence in CA in 2006. Our data include 668,582 loans originated between 1997 and 2006.

	Rates (%)		Rev (×$1,000)		Rev (%)		Fees (×$1,000)		Fees (%)	
Fees (%)	0.006	(0.001)								
YSP (×$1,000)							-0.338	(0.002)		
YSP (%)	0.524	(0.001)							-0.274	(0.002)
Loan amt $\leq 50K$	0.573	(0.004)	-1.880	(0.088)	1.450	(0.009)	-1.236	(0.081)	1.521	(0.009)
Loan amt $\in (50, 75]K$	0.412	(0.003)	-1.346	(0.074)	0.806	(0.006)	-0.895	(0.068)	0.894	(0.005)
Loan amt $\in (75, 100]K$	0.149	(0.002)	-0.487	(0.092)	0.447	(0.005)	-0.251	(0.085)	0.481	(0.005)
Loan amt $\in (200, 300]K$	-0.199	(0.002)	0.602	(0.055)	-0.298	(0.004)	0.447	(0.051)	-0.370	(0.004)
Loan amt $\in (300, 500]K$	-0.300	(0.002)	3.684	(0.052)	-0.536	(0.005)	2.774	(0.048)	-0.649	(0.005)
Loan amt $> 500K$	-0.203	(0.005)	6.570	(0.141)	-0.934	(0.011)	5.382	(0.130)	-0.970	(0.010)
Loan amt			0.023	(0.000)			0.016	(0.000)		
if $\leq 50K$			0.025	(0.002)			0.017	(0.002)		
if $\in (50, 75]K$			0.015	(0.001)			0.011	(0.001)		
if $\in (75, 100]K$			0.004	(0.001)			0.002	(0.001)		
if $\in (200, 300]K$			-0.003	(0.000)			-0.002	(0.000)		
if $\in (300, 500]K$			-0.013	(0.000)			-0.009	(0.000)		
if $> 500K$			-0.019	(0.000)			-0.015	(0.000)		
Constant	3.976	(0.022)	-0.174	(0.088)	2.084	(0.046)	2.077	(0.082)	2.983	(0.043)
R^2	0.845		0.507		0.419		0.405		0.378	

Additional conditioning variables included but not reported

Loan and Property Characteristics: Rate - 6mo LIBOR, NC points, Rate margin for hybrids; Dummies for product types 3/27, 30yr FRM, 20yr FRM, 15yr FRM, Balloon w/ adj rate, Balloon w/ fixed rate and Interest only; Dummies for Prepay penalty, Low documentation, Piggyback; Dummies for Refi with cash out and Refi with no cash out; Dummies for LTV ≤ 0.65, LTV $\in (0.65, 0.70]$, $(0.70, 0.75]$, $(0.80, 0.85]$, $(0.85, 0.90]$, $(0.90, 0.95]$ and $(0.95, 1]$; 2nd home/investment property, Multi units

Borrower Characteristics: Dummies for FICO $\in [500, 525)$, $[525, 550)$, $[550, 575)$, $[575, 600)$, $[620, 640)$, $[640, 660)$, $[660, 680)$, $[680, 700)$, ≥ 700; Debt-to-income ratio; Dummies for risk grades A+, A-, B and C

Broker Variables: Broker competition, Active broker

Neighborhood and Regulation Variables: Race, Education, Regulation (coverage), Regulation (broker, Pahl)

Market Conditions: 6mo LIBOR, 30yr fix rate - 6mo LIBOR, House prices

Year and Location Dummies: Dummies for origination years 1997 through 2005; Dummies for FL, TX, West w/o CA, South w/o FL or TX, MidWest and NorthEast; Non-metro area

Table 5: **Broker Charges and Delinquency Risk** The table reports the parameter estimates for the proportional odds duration model in (8), with nonsurvival defined as 60-day delinquency or worse. Standard errors are shown in parentheses. The benchmark set of loans includes all full documentation no-prepay-penalty 2/28 loans between 100 and 200K taken out by a borrower with a risk grade of AA or better and a FICO score between 600 and 620 to purchase a single-unit primary residence in CA in 2006. Our data include 615,384 loans originated between 1999 and 2006.

	Est	Std err	Est	Std err	Est	Std err
			Broker Charges			
Revenue/loan amt (%)			0.062	(0.005)		
Fees/loan amt (%)					0.073	(0.005)
YSP/loan amt (%)					-0.002	(0.011)
			Loan and Property Characteristics			
Rate-6mo LIBOR	0.325	(0.009)	0.299	(0.009)	0.336	(0.011)
NC points	0.019	(0.014)	0.025	(0.014)	0.033	(0.014)
Rate margin for hybrids	-0.080	(0.019)	-0.078	(0.019)	-0.083	(0.019)
Loan amt $\leq 50K$	-0.001	(0.038)	-0.089	(0.039)	-0.115	(0.039)
Loan amt $\in (50K, 75K]$	0.073	(0.022)	0.026	(0.023)	0.009	(0.023)
Loan amt $\in (75K, 100K]$	0.020	(0.021)	-0.007	(0.021)	-0.014	(0.021)
Loan amt $\in (200K, 300K]$	0.149	(0.020)	0.166	(0.020)	0.175	(0.020)
Loan amt $\in (300K, 500K]$	0.399	(0.023)	0.428	(0.024)	0.444	(0.024)
Loan amt $> 500K$	0.741	(0.046)	0.794	(0.046)	0.806	(0.046)
3/27	0.039	(0.026)	0.046	(0.026)	0.042	(0.026)
30yr FRM	-0.805	(0.113)	-0.765	(0.114)	-0.835	(0.114)
20yr FRM	-0.990	(0.149)	-0.961	(0.149)	-1.036	(0.149)
15yr FRM	-1.093	(0.133)	-1.059	(0.133)	-1.129	(0.133)
Balloon w/ adjustable rate	0.075	(0.026)	0.077	(0.026)	0.061	(0.026)
Balloon w/ fixed rate	-0.481	(0.131)	-0.446	(0.131)	-0.522	(0.132)
Interest only	-0.131	(0.024)	-0.119	(0.024)	-0.132	(0.024)
Prepay penalty	0.136	(0.017)	0.110	(0.017)	0.119	(0.017)
Low documentation	0.326	(0.016)	0.353	(0.016)	0.316	(0.017)
Piggyback	0.627	(0.027)	0.650	(0.028)	0.644	(0.028)
Refi w/ cash out	-0.401	(0.016)	-0.425	(0.017)	-0.435	(0.017)
Refi w/o cash out	-0.245	(0.023)	-0.255	(0.023)	-0.261	(0.023)
LTV ≤ 0.65	-0.397	(0.031)	-0.424	(0.031)	-0.405	(0.031)
LTV $\in (0.65, 0.70]$	-0.192	(0.032)	-0.212	(0.032)	-0.201	(0.032)
LTV $\in (0.70, 0.75]$	-0.111	(0.026)	-0.122	(0.026)	-0.117	(0.026)
LTV $\in (0.80, 0.85]$	0.111	(0.021)	0.122	(0.021)	0.109	(0.021)
LTV $\in (0.85, 0.90]$	0.183	(0.023)	0.207	(0.023)	0.182	(0.023)
LTV $\in (0.90, 0.95]$	0.067	(0.037)	0.100	(0.037)	0.060	(0.038)
LTV $\in (0.95, 1]$	0.204	(0.064)	0.252	(0.064)	0.180	(0.065)
2nd home/investment prop	0.010	(0.023)	0.022	(0.023)	-0.008	(0.024)
Multi units	0.009	(0.027)	0.010	(0.027)	0.007	(0.027)
			Borrower Characteristics			
FICO $\in [500, 525)$	0.719	(0.030)	0.740	(0.030)	0.692	(0.031)
FICO $\in [525, 550)$	0.611	(0.028)	0.626	(0.028)	0.593	(0.029)
FICO $\in [550, 575)$	0.432	(0.027)	0.439	(0.027)	0.419	(0.027)
FICO $\in [575, 600)$	0.239	(0.025)	0.243	(0.025)	0.231	(0.025)
FICO $\in [620, 640)$	-0.175	(0.027)	-0.177	(0.027)	-0.172	(0.027)

Continued on next page

Table 5 – continued from previous page

	Est	Std err	Est	Std err	Est	Std err
FICO $\in [640, 660)$	-0.400	(0.030)	-0.404	(0.030)	-0.394	(0.030)
FICO $\in [660, 680)$	-0.618	(0.035)	-0.623	(0.035)	-0.610	(0.035)
FICO $\in [680, 700)$	-0.815	(0.044)	-0.823	(0.044)	-0.804	(0.044)
FICO ≥ 700	-0.997	(0.041)	-1.005	(0.041)	-0.988	(0.041)
Debt-to-income ratio	0.006	(0.001)	0.006	(0.001)	0.006	(0.001)
Risk grade A+	0.176	(0.021)	0.187	(0.021)	0.174	(0.021)
Risk grade A-	0.215	(0.025)	0.228	(0.025)	0.209	(0.025)
Risk grade B	0.506	(0.028)	0.523	(0.028)	0.493	(0.029)
Risk grade C	0.728	(0.035)	0.762	(0.035)	0.703	(0.036)
			Broker Variables			
Broker competition	0.002	(0.002)	0.002	(0.002)	0.001	(0.002)
Active broker	0.033	(0.014)	0.014	(0.014)	0.012	(0.014)
			Neighborhood and Regulation Variables			
Race	-0.003	(0.000)	-0.002	(0.000)	-0.002	(0.000)
Education	-0.009	(0.001)	-0.008	(0.001)	-0.007	(0.001)
Regulation (coverage)	-0.005	(0.003)	-0.003	(0.003)	-0.001	(0.003)
Regulation (brokers, Pahl)	-0.012	(0.003)	-0.011	(0.003)	-0.011	(0.003)
			Market Conditions			
6mo LIBOR	0.345	(0.027)	0.331	(0.027)	0.360	(0.027)
30yr fix mortg rate-6mo LIBOR	0.029	(0.028)	0.033	(0.028)	0.036	(0.028)
House prices	-0.011	(0.002)	-0.012	(0.002)	-0.012	(0.002)
			Year and Location Dummies			
1999	-0.939	(0.045)	-0.971	(0.046)	-0.993	(0.046)
2000	-1.102	(0.059)	-1.127	(0.059)	-1.162	(0.059)
2001	-0.515	(0.047)	-0.517	(0.047)	-0.550	(0.048)
2002	-0.524	(0.065)	-0.533	(0.064)	-0.544	(0.065)
2003	-0.452	(0.063)	-0.462	(0.063)	-0.455	(0.063)
2004	-0.250	(0.052)	-0.270	(0.052)	-0.244	(0.052)
2005	-0.032	(0.031)	-0.054	(0.031)	-0.027	(0.031)
FL	-0.064	(0.035)	-0.068	(0.035)	-0.060	(0.035)
TX	0.076	(0.039)	0.069	(0.039)	0.088	(0.039)
West w/o CA	0.119	(0.030)	0.127	(0.030)	0.137	(0.030)
South w/o FL or TX	0.288	(0.029)	0.279	(0.029)	0.283	(0.029)
MidWest	0.303	(0.028)	0.293	(0.029)	0.299	(0.029)
NorthEast	0.217	(0.026)	0.205	(0.027)	0.212	(0.027)
Non-metro area	-0.002	(0.022)	-0.005	(0.022)	-0.006	(0.022)

Table 6: **Robustness Checks** The top panel of the table shows average 12-month delinquency rates for a number of homogeneous loan pools. Each loan pool consists of 2/28 loans between 100 and 300K with a prepayment penalty and originated in 2004 or 2005. The loans in a given pool have the same documentation level (full versus low), are of similar credit quality (low versus high FICO), and have the same loan purpose (purchase versus refinance). For full documentation loans, low (high) FICO loans are those with a FICO score of less (no less) than 600. For low documentation loans, low (high) FICO loans are those with a FICO score of less (no less) than 620. Each of the resulting eight loan pools is divided into three equally sized subpools based on the spread between the initial mortgage rate and 6-month LIBOR (low versus medium versus high rates). Each of the resulting 24 loan pools is divided into three equally sized subpools based on the percentage broker fee (low versus medium versus high %Fee). The bottom panel shows the parameter estimates for the proportional odds duration model in (8) with $X_{\text{comp}} = (\%\text{Fees}, \%\text{YSP})$ and X_{cond} as in Table 5, for different strata of the data. The first and second rows show the coefficient estimate for percentage fees and its standard error. The third row shows the increase in the log proportional odds ratio associated with a one standard deviation increase in percentage broker fees. Our data include 615,384 loans originated between 1999 and 2006.

	12-month delinquency rates (percent) for homogeneous loan pools					
	Full documentation			Low documentation		
	Low rates	Med rates	High rates	Low rates	Med rates	High rates
			Low FICO, Purchase			
Low %Fees	18.2	19.9	23.4	5.8	6.4	13.4
High %Fees	22.3	29.9	36.2	7.2	10.5	9.4
			Low FICO, Refinance			
Low %Fees	7.8	15.4	21.2	3.0	4.8	7.4
High %Fees	12.3	19.8	23.5	6.1	3.6	9.0
			High FICO, Purchase			
Low %Fees	19.3	21.7	34.8	4.4	4.9	12.1
High %Fees	22.6	20.7	36.5	6.7	11.9	20.1
			High FICO, Refinance			
Low %Fees	10.9	17.5	20.2	3.9	4.3	8.9
High %Fees	11.4	19.9	26.1	3.2	10.6	14.7

	Loan performance results for stratified data							
	Full documentation				Low documentation			
	Low FICO		High FICO		Low FICO		High FICO	
	0.042		0.108		0.048		0.168	
	(0.008)		(0.015)		(0.010)		(0.014)	
	0.058		0.138		0.065		0.194	
Loan type	2/28	30yr FRM	2/28	30yr FRM	2/28	30yr FRM	2/28	30yr FRM
	0.040	0.034	0.087	0.125	0.046	0.081	0.176	0.131
	(0.010)	(0.021)	(0.020)	(0.035)	(0.012)	(0.030)	(0.019)	(0.045)
	0.059	0.047	0.122	0.152	0.069	0.112	0.264	0.172
Loan purpose	Purchase	Refi	Purchase	Refi	Purchase	Refi	Purchase	Refi
	0.081	0.022	0.180	0.046	0.086	0.027	0.209	0.091
	(0.015)	(0.010)	(0.023)	(0.019)	(0.019)	(0.012)	(0.019)	(0.022)
	0.106	0.024	0.228	0.045	0.124	0.038	0.296	0.120
Broker competition	Low	High	Low	High	Low	High	Low	High
	0.037	0.048	0.099	0.112	0.060	0.026	0.145	0.196
	(0.010)	(0.014)	(0.018)	(0.024)	(0.013)	(0.017)	(0.019)	(0.021)
	0.057	0.069	0.148	0.144	0.079	0.031	0.184	0.211
Broker activity	Inactive	Active	Inactive	Active	Inactive	Active	Inactive	Active
	0.051	0.023	0.136	0.055	0.055	0.031	0.165	0.171
	(0.010)	(0.015)	(0.018)	(0.027)	(0.012)	(0.019)	(0.017)	(0.027)
	0.073	0.029	0.188	0.063	0.080	0.043	0.229	0.207

Table 7: **Marginal Effect of Broker Fees on Delinquency Risk** The top three rows of the table report the parameter estimates for the proportional odds duration model in (8) when X_{comp} includes %YSP as well as %Fees interacted with documentation level (full versus low) and FICO range (< 600, $[600, 620)$, $[620, 660)$ and ≥ 660) as in (10) and X_{cond} is as in Table 5. For each combination of documentation level and FICO range, the first and second row show the coefficient estimate for percentage fees and its standard error, respectively. The third row shows the increase in the log proportional odds ratio associated with a one standard deviation increase in percentage broker fees. Standard deviations are computed conditional on documentation level and FICO range. The next set of rows reports similar results when percentage fees are interacted with documentation level, credit quality (low versus high FICO) and loan purpose (purchase versus refinance) as in (11). For full documentation loans, low (high) FICO loans are those with a FICO score of less (no less) than 600. For low documentation loans, low (high) FICO loans are those with a FICO score of less (no less) than 620. Standard deviations are computed conditional on documentation level, credit quality and loan purpose. The last set of rows reports the results when percentage fees are interacted with documentation level, credit quality and broker activity (active versus inactive). Standard deviations are computed conditional on documentation level, credit quality and broker activity. Our data include 615,384 loans originated between 1999 and 2006.

	Full documentation				Low documentation			
FICO	< 600	$[600, 620)$	$[620, 660)$	≥ 660	< 600	$[600, 620)$	$[620, 660)$	≥ 660
	0.060	0.097	0.092	0.143	0.043	0.094	0.119	0.170
	(0.007)	(0.015)	(0.014)	(0.021)	(0.009)	(0.016)	(0.013)	(0.017)
	0.084	0.124	0.117	0.183	0.059	0.121	0.142	0.190
	Low FICO		High FICO		Low FICO		High FICO	
Loan purpose	Purchase	Refi	Purchase	Refi	Purchase	Refi	Purchase	Refi
	0.116	0.044	0.139	0.058	0.081	0.035	0.146	0.110
	(0.010)	(0.008)	(0.014)	(0.012)	(0.012)	(0.009)	(0.013)	(0.013)
	0.152	0.048	0.176	0.057	0.117	0.049	0.207	0.145
Broker activity	Inactive	Active	Inactive	Active	Inactive	Active	Inactive	Active
	0.072	0.047	0.106	0.061	0.056	0.044	0.142	0.102
	(0.008)	(0.010)	(0.011)	(0.015)	(0.009)	(0.011)	(0.012)	(0.016)
	0.103	0.060	0.146	0.071	0.081	0.061	0.197	0.124

Table 8: **Broker Costs and Profits** The table reports average marginal broker costs and profits per loan, for different cost specifications c^w in Equation (13). The top panel conditions on the year of origination, whereas the bottom panel conditions on the loan amount (in $1,000). Our data include 668,582 loans originated between 1997 and 2006.

w	0	0.25	0.5	0.75	1	0	0.25	0.5	0.75
				By origination year					
		Costs (×$1,000)					*Profits (×$1,000)*		
1997	1.775	2.388	3.002	3.615	4.229	2.454	1.840	1.227	0.613
1998	1.453	2.023	2.592	3.161	3.730	2.277	1.708	1.139	0.569
1999	1.596	2.219	2.841	3.463	4.085	2.489	1.867	1.245	0.622
2000	1.841	2.518	3.194	3.870	4.546	2.705	2.029	1.352	0.676
2001	2.018	2.723	3.428	4.133	4.838	2.819	2.114	1.410	0.705
2002	2.197	2.898	3.599	4.299	5.000	2.804	2.103	1.402	0.701
2003	2.223	2.929	3.635	4.341	5.047	2.824	2.118	1.412	0.706
2004	2.295	3.071	3.847	4.624	5.400	3.105	2.329	1.553	0.776
2005	2.384	3.207	4.031	4.854	5.678	3.294	2.470	1.647	0.823
2006	2.330	3.169	4.007	4.845	5.684	3.353	2.515	1.677	0.838
All	2.248	3.017	3.787	4.556	5.326	3.078	2.308	1.539	0.769
		Percentage costs					*Percentage profits*		
1997	2.013	2.737	3.461	4.186	4.910	2.897	2.172	1.448	0.724
1998	1.546	2.277	3.008	3.739	4.470	2.924	2.193	1.462	0.731
1999	1.591	2.289	2.987	3.685	4.383	2.792	2.094	1.396	0.698
2000	1.700	2.334	2.968	3.602	4.237	2.537	1.903	1.268	0.634
2001	1.584	2.140	2.695	3.251	3.806	2.223	1.667	1.111	0.556
2002	1.634	2.145	2.656	3.168	3.679	2.045	1.534	1.023	0.511
2003	1.484	1.937	2.390	2.843	3.296	1.812	1.359	0.906	0.453
2004	1.339	1.762	2.185	2.608	3.031	1.692	1.269	0.846	0.423
2005	1.270	1.668	2.066	2.463	2.861	1.591	1.193	0.795	0.398
2006	1.256	1.642	2.029	2.415	2.802	1.546	1.160	0.773	0.387
All	1.384	1.829	2.274	2.720	3.165	1.780	1.335	0.890	0.445
				By loan amount (×$1,000)					
		Costs (×$1,000)					*Profits (×$1,000)*		
≤ 50	0.828	1.182	1.536	1.889	2.243	1.415	1.061	0.707	0.354
(50,75]	1.271	1.655	2.039	2.423	2.807	1.536	1.152	0.768	0.384
(75,100]	1.577	2.034	2.492	2.950	3.408	1.831	1.373	0.915	0.458
(100,200]	2.148	2.782	3.416	4.051	4.685	2.537	1.903	1.269	0.634
(200,300]	2.835	3.800	4.764	5.729	6.693	3.858	2.894	1.929	0.965
(300,500]	3.243	4.575	5.908	7.240	8.573	5.330	3.997	2.665	1.332
>500	2.528	4.338	6.148	7.958	9.768	7.240	5.430	3.620	1.810
		Percentage costs					*Percentage profits*		
≤ 50	1.968	2.849	3.731	4.612	5.493	3.525	2.644	1.762	0.881
(50,75]	2.006	2.615	3.225	3.834	4.443	2.437	1.827	1.218	0.609
(75,100]	1.753	2.263	2.773	3.283	3.794	2.041	1.531	1.020	0.510
(100,200]	1.449	1.873	2.297	2.721	3.145	1.697	1.272	0.848	0.424
(200,300]	1.116	1.493	1.871	2.249	2.627	1.511	1.133	0.755	0.378
(300,500]	0.836	1.174	1.512	1.851	2.189	1.353	1.015	0.677	0.338
>500	0.417	0.707	0.998	1.288	1.578	1.161	0.871	0.581	0.290

Table 9: **Broker Costs and Profits for Different Loan Types** The table reports average marginal broker costs per loan for different types of loans and different cost specifications c^w in Equation (13), conditional on the size of the loan. Columns labeled "prft^0" report average marginal broker profits per loan for the perfect rent extraction case. Costs and profits are shown in $1,000. Our data include 668,582 loans originated between 1997 and 2006.

	Loan amt $\leq$ 100K			Loan amt 100-300K			Loan amt > 300K		
	c^0	c^1	prft^0	c^0	c^1	prft^0	c^0	c^1	prft^0
				Loan and property characteristics					
2/28	1.455	3.132	1.677	2.476	5.491	3.015	3.326	8.863	5.536
3/27	1.340	2.973	1.633	2.302	5.138	2.836	3.153	8.661	5.508
30yr FRM	1.191	2.859	1.668	2.213	4.996	2.783	3.060	7.883	4.823
20yr FRM	1.321	2.993	1.673	2.202	4.829	2.626	3.224	8.028	4.803
15yr FRM	1.214	2.756	1.542	2.155	4.722	2.566	3.119	7.781	4.661
Balloon w/ adj rate	1.424	2.861	1.437	2.495	5.662	3.167	3.237	9.150	5.913
Balloon w/ fixed rate	1.329	2.642	1.313	2.335	5.448	3.112	3.132	9.271	6.139
Interest only	1.159	2.932	1.774	2.246	5.477	3.231	2.949	8.629	5.680
No prepay penalty	1.174	2.730	1.555	2.162	4.993	2.831	2.953	8.391	5.439
Prepay penalty	1.417	3.109	1.692	2.450	5.495	3.045	3.225	8.819	5.594
Full documentation	1.411	3.032	1.621	2.416	5.322	2.906	3.228	8.742	5.513
Low documentation	1.240	2.970	1.730	2.352	5.474	3.122	3.107	8.694	5.587
Stand-alone first lien	1.346	3.006	1.660	2.420	5.436	3.016	3.181	8.675	5.494
Piggyback	1.459	3.075	1.617	2.251	5.179	2.928	3.085	8.836	5.751
Purchase	1.181	2.810	1.629	2.136	4.988	2.852	2.955	8.469	5.514
Refi, cash out	1.485	3.129	1.644	2.590	5.718	3.128	3.338	8.953	5.615
Refi, no cash out	1.274	3.067	1.794	2.193	5.021	2.828	3.047	8.423	5.375
Primary residence	1.431	3.064	1.633	2.426	5.442	3.016	3.184	8.762	5.579
2nd home/investment property	0.960	2.741	1.782	1.986	4.816	2.830	2.839	8.112	5.273
One unit	1.355	3.014	1.659	2.367	5.352	2.985	3.133	8.604	5.471
Multi units	1.357	2.965	1.608	2.684	5.898	3.214	3.334	9.495	6.161
				Borrower characteristics					
FICO $<$ 600	1.469	3.090	1.621	2.542	5.591	3.049	3.442	9.075	5.634
FICO $\in [600, 620)$	1.388	3.006	1.618	2.426	5.359	2.933	3.252	8.852	5.600
FICO $\in [620, 660)$	1.254	2.938	1.684	2.319	5.262	2.943	3.133	8.631	5.497
FICO $\geq$ 660	1.008	2.802	1.794	2.132	5.140	3.008	2.923	8.453	5.530
AAA or AA	1.339	2.932	1.593	2.318	5.268	2.950	3.092	8.657	5.564
A+	1.274	3.019	1.744	2.431	5.426	2.995	3.284	8.689	5.405
A−	1.418	3.123	1.705	2.522	5.588	3.066	3.398	9.029	5.632
B	1.482	3.177	1.695	2.633	5.823	3.191	3.556	9.268	5.712
C	1.388	3.034	1.647	2.567	5.917	3.350	3.411	9.505	6.094
				Broker variables					
Low broker competition	1.313	2.985	1.673	2.268	5.104	2.836	3.077	8.608	5.531
High broker competition	1.449	3.070	1.621	2.499	5.650	3.151	3.209	8.780	5.571
Active broker	1.628	3.259	1.631	2.636	5.890	3.254	3.365	9.261	5.896
Inactive broker	1.248	2.914	1.667	2.261	5.129	2.869	3.049	8.425	5.376
				Neighborhood and regulation variables					
Race, $\leq$ 75% white	1.431	3.033	1.602	2.568	5.757	3.190	3.271	9.016	5.745
Race, $>$ 75% white	1.279	2.990	1.711	2.221	5.043	2.822	2.990	8.266	5.276
Education, $\leq$ 12.5% w/ BA	1.389	2.993	1.604	2.478	5.490	3.012	3.344	9.026	5.682
Education, $>$12.5% w/ BA	1.283	3.049	1.766	2.306	5.294	2.989	3.065	8.557	5.493
Baseline anti-predatory regulation	1.327	3.106	1.779	2.249	5.161	2.912	3.082	8.413	5.331
Stricter state anti-pred regulation	1.405	2.838	1.433	2.509	5.585	3.076	3.179	8.795	5.616
				Location					
Metro area	1.362	3.035	1.674	2.396	5.424	3.029	3.159	8.726	5.567
Non-metro area	1.317	2.887	1.570	2.300	4.946	2.646	3.137	8.433	5.296

Table 10: **Proposed QRM Guidelines** The table summarizes the QRM requirements, as proposed by the Agencies in March 2011. In addition to the main criteria listed below, certain assumability prohibitions and default mitigation commitments apply. For details, see Agencies (2011).

Rule	Reference name	Description
1	Eligible loans	First liens on a one-to-four family residential property Home purchased or refinanced has to be the principal residence Piggyback loans are prohibited for purchases, maturity $\leq$ 30 years
2	Borrower credit history	Borrower is not currently $\geq$ 30 days past due on any debt, has not been $\geq$ 60 days late within the past 2 years Borrower has not been a debtor in a bankruptcy proceeding, has not had property repossessed or foreclosed upon, did not engaged in a short sale or deed-in-lieu of foreclosure, and has not been subject to a Federal or State judgment for collection of any unpaid debt in the past 3 years
3	Payment terms	Balloon or interest-only payments, or negative amortization, not allowed Regular P&I payments may not result in increase of unpaid principal, do not allow borrower to defer payment of interest or repayment of principal Increases in rates after closing of adjustable-rate loans may not exceed 2% in any 12-month period, or 6% over the life of the mortgage transaction Prepayment penalties are not permitted
4	Loan-to-value ratio	LTV $\leq$ 80% for purchases CLTV $\leq$ 75% for no-cash-out refinance mortgages CLTV $\leq$ 70% for cash-out refinance mortgages
5	Down payment	Financing of closing costs is not permitted For purchases, the minimum cash down payments are closing costs, plus 0.2 $\times$ min(appraisal value, purchase price), plus max(purchase price-appraisal value, 0) Funds used by the borrower must come from certain acceptable sources
6	Qualifying appraisal	Written appraisals conforming to generally accepted appraisal standards are required
7	Ability to repay	Borrower's front-end ratio (mortgage payment/gross income) $\leq$ 28% Borrower's back-end ratio (all debt payments/gross income) $\leq$ 36% Full documentation of monthly gross income, housing debt and total debt
8	Origination charges	Origination charges paid by borrower $\leq$ 3% of the loan amount Charges include (i) compensation paid directly or indirectly to originator (ii) finance charges (12 CFR section 226.4(a)(b), except 226.4(b)(1)) (iii) real-estate related fees (12 CFR section 226.4(c)(7)), unless reasonable (iv) credit insurance premia, debt cancellation or suspension fees (v) prepayment penalties on a previous loan with the same lender

Table 11: **Descriptive Statistics for QRM and Non-QRM Loans** For each proposed QRM rule, the table reports average loan, borrower, broker and neighborhood characteristics for the set of loans that satisfy a particular rule (first row) and the set of loans that do not (second row). The first row for QRM8 (c^w) refers to the set of loans for which broker costs c^w defined in Equation (13) do not exceed 3% of the loan amount, whereas the second row refers to loans for which percentage costs exceed 3%. "Inco" stands for combined monthly borrower income and "Comp" for broker competition. Our data include 668,582 loans originated between 1997 and 2006. The last four columns show 12-month delinquency rates for loans originated in 2003, 2004, 2005 and between 1999 and 2005, respectively.

Restr			Loan characteristics					Borrower		Broker		Neighborhood			Delinquency rates			
	% loans	Size	Hybr	FRM	Refi	LTV	CLTV	FICO	Inco	Comp	Active	Race	Educ	Inco	2003	2004	2005	'99-05
None	100.0	190	55.3	22.2	63.9	79.6	83.8	612	6.4	0.66	0.33	67.1	14.1	3.8	8.7	10.2	12.8	13.3
QRM8 (c^0)	97.5	193	55.0	22.0	63.2	79.7	84.0	613	6.5	0.66	0.32	67.5	14.3	3.8	8.4	9.9	12.5	13.1
	2.5	58	68.6	29.8	87.8	73.3	74.6	567	3.3	0.41	0.53	49.5	8.5	2.7	21.1	24.4	29.4	24.7
QRM8 ($c^{0.25}$)	92.3	199	54.1	21.8	62.2	80.0	84.4	615	6.7	0.68	0.31	67.9	14.5	3.9	7.9	9.5	12.0	12.6
	7.7	71	70.1	27.8	83.3	75.0	76.4	573	3.6	0.41	0.46	57.5	9.8	3.0	19.0	22.2	27.8	22.6
QRM8 ($c^{0.5}$)	79.8	213	52.3	21.0	59.9	80.4	85.2	619	7.0	0.70	0.31	68.2	14.9	3.9	7.1	8.8	11.4	11.9
	20.2	97	67.1	27.2	79.6	76.3	77.9	582	4.2	0.48	0.40	62.7	11.2	3.2	15.2	17.5	21.5	19.3
QRM8 ($c^{0.75}$)	64.8	227	50.5	20.1	57.2	80.8	86.2	623	7.3	0.72	0.29	68.6	15.2	4.0	6.4	8.2	10.9	11.4
	35.2	121	64.2	26.1	76.1	77.4	79.3	590	4.7	0.53	0.38	64.3	12.1	3.4	12.7	14.8	18.0	17.1
QRM8 (c^1)	51.9	236	48.9	19.7	55.4	80.9	86.7	626	7.6	0.74	0.29	68.9	15.5	4.1	5.8	7.8	10.5	11.0
	48.1	140	62.2	24.9	73.0	78.2	80.5	596	5.2	0.56	0.37	65.1	12.6	3.5	11.7	13.3	16.3	16.0
QRM1	71.1	190	56.7	25.9	82.0	79.1	79.9	600	5.8	0.62	0.35	67.9	14.3	3.9	8.3	10.0	12.2	12.4
	29.0	189	51.8	13.2	19.4	80.6	93.1	641	7.8	0.74	0.27	65.0	13.8	3.7	10.8	10.6	13.8	15.3
QRM2	78.5	199	51.5	22.4	55.8	80.7	86.1	624	6.7	0.70	0.33	67.0	14.1	3.8	6.7	8.7	11.3	11.6
	21.5	180	64.4	20.1	91.1	76.3	77.0	571	5.8	0.62	0.37	67.2	14.0	3.8	15.7	16.9	20.0	20.0
QRM3	4.8	123	2.0	98.0	85.7	75.9	77.2	604	5.4	0.39	0.33	65.8	14.2	3.6	6.4	9.8	10.6	10.9
	95.2	193	58.0	18.4	62.8	79.8	84.1	612	6.5	0.67	0.33	67.2	14.1	3.8	8.9	10.2	12.8	13.4
QRM4	37.0	188	47.7	22.7	42.3	70.6	79.7	620	6.5	0.72	0.32	67.0	14.6	3.9	8.0	9.4	11.7	12.8
	63.0	190	59.8	21.9	76.6	84.9	86.1	607	6.4	0.62	0.33	67.1	13.9	3.7	8.9	10.7	13.6	13.6
QRM5	30.4	203	41.9	31.3	71.7	79.1	82.3	615	6.4	0.68	0.36	63.9	13.6	3.8	6.4	8.4	11.5	11.8
	69.6	184	61.2	18.3	60.4	79.8	84.4	610	6.4	0.64	0.31	68.5	14.4	3.8	9.8	10.8	13.2	14.0
QRM7	13.8	142	55.1	31.2	73.3	78.6	81.4	600	7.0	0.56	0.32	69.3	13.6	3.7	7.1	9.1	10.7	10.7
	86.2	197	55.4	20.7	62.0	79.9	84.4	614	6.4	0.67	0.33	66.8	14.2	3.8	8.9	10.3	13.0	13.7

Table 12: **Delinquency Rates under QRM Rules** In the top panel, the first column shows the distribution of loans across different size bins and the second column reports the average 12-month delinquency rates for each size bin. For each size bin, the third column shows the percentage of QRM8 loans in that size bin for the perfect rent extraction case (w=0 in Equation (13)), and the fourth column reports the average 12-month delinquency rate of these QRM8 loans. Columns 5 through 12 report similar statistics after replacing $w = 0$ by $w = 0.25, 0.5, 0.75, 1$. The middle panel recomputes the statistics from the top panel after replacing QRM Rule 8 by the alternative specification described in Appendix E. Small discrepancies between the top and middle panel for 100-200K loans are due to the fact that size bins are formed on the loan amount of the first lien whereas limits on origination charges for piggybacks are computed as a function of the total loan amount. For each size bin, the bottom panel shows the percentage of loans in that size bin that satisfy some other QRM rule, together with their average 12-month delinquency rates.

	Full sample		QRM8 (c^0)		QRM8 ($c^{0.25}$)		QRM8 ($c^{0.5}$)		QRM8 ($c^{0.75}$)		QRM8 (c^1)	
size bin	loans	delq	in bin	delq	in bin	delq	in bin	delq	in bin	delq	in bin	delq
(0,50]	3.4	17.0	77.4	15.9	56.7	14.3	30.0	13.1	14.9	11.9	9.6	12.6
(50,75]	10.6	19.0	86.8	18.0	67.4	16.4	43.3	15.1	27.6	15.3	19.2	16.1
(75,100]	12.0	15.1	97.4	14.9	85.5	14.1	62.6	13.0	43.6	12.7	31.9	12.7
(100,200]	37.2	12.4	99.9	12.3	97.3	12.1	83.0	11.5	64.4	10.9	49.8	10.5
(200,300]	20.0	11.4	100.0	11.4	100.0	11.4	95.7	11.1	82.1	10.6	66.6	10.2
(300,500]	14.7	11.8	100.0	11.8	100.0	11.8	99.5	11.8	93.3	11.5	80.3	10.9
>500	2.0	13.8	100.0	13.8	100.0	13.8	100.0	13.8	100.0	13.8	98.0	13.8
All	100.0	13.3	97.5	13.1	92.3	12.6	79.8	11.9	64.8	11.4	51.9	11.0

Alternative specification of QRM Rule 8

	c^0		$c^{0.25}$		$c^{0.5}$		$^{0.75}$		c^1	
size bin	in bin	delq	in bin	delq	in bin	delq	in bin	delq	in bin	delq
(0,50]	77.4	15.9	56.7	14.3	30.0	13.1	14.9	11.9	9.6	12.6
(50,75]	86.8	18.0	67.4	16.4	43.3	15.1	27.6	15.3	19.3	16.1
(75,100]	97.4	14.9	85.5	14.1	62.6	13.0	43.6	12.7	31.9	12.7
(100,200]	99.9	12.3	97.3	12.1	83.0	11.5	64.3	10.9	49.6	10.5
(200,300]	100.0	11.4	99.9	11.4	92.9	10.9	75.7	10.4	60.0	9.9
(300,500]	100.0	11.8	100.0	11.8	93.7	11.3	74.1	10.2	57.6	10.0
>500	100.0	13.8	100.0	13.8	98.7	13.7	72.8	11.8	52.2	11.2
All	97.5	13.1	92.3	12.6	78.4	11.8	60.1	11.0	46.2	10.7

Other QRM Rules

	QRM1		QRM2		QRM3		QRM4		QRM5		QRM7	
size bin	in bin	delq	in bin	delq	in bin	delq	in bin	delq	in bin	delq	in bin	delq
(0,50]	66.5	16.5	46.0	15.6	18.6	14.5	54.3	17.6	25.5	13.4	27.5	15.7
(50,75]	68.2	17.7	64.6	19.0	10.4	14.8	32.5	17.6	26.4	16.4	23.4	15.8
(75,100]	70.6	14.0	68.8	14.4	7.7	9.5	36.4	13.5	27.1	13.0	19.8	12.2
(100,200]	72.4	11.8	71.4	10.6	3.9	9.4	37.4	11.3	29.2	10.9	13.9	8.9
(200,300]	72.6	10.7	75.6	9.4	2.4	5.6	37.0	11.0	33.1	10.5	8.2	6.9
(300,500]	69.7	10.5	80.3	10.2	1.6	6.3	35.7	13.2	35.4	11.4	5.8	5.6
>500	65.7	9.5	84.0	13.4	0.9	5.1	37.5	19.3	39.3	11.6	6.0	8.6
All	71.0	12.4	71.9	11.6	4.8	10.9	37.0	12.8	30.4	11.8	13.6	10.7

Table 13: **Broker Profits under QRM Rules** For different measures of broker costs, the top panel reports the percentage of QRM8 loans in our sample (columns labeled "%"), the average broker profits for the QRM8 loans in \$1,000 (columns labeled "No cap"), and the average broker profits for the QRM8 loans in \$1,000 if revenues are capped at 3% (columns labeled "Cap"). The second set of rows shows the fraction of loans in our sample that are QRM8 loans and satisfy an additional QRM rule, the average broker profits for these loans, and the average broker profits for these loans if revenues are capped at 3%. Results in the bottom panel replicate those in the top panel after replacing the proposed QRM Rule 8 by the alternative specification of QRM Rule 8 described in Appendix E.

	%	No cap	Cap	%	No cap	Cap	%	No cap	Cap	%	No cap	Cap
Size	QRM8 (c^0)			QRM8 ($c^{0.25}$)			QRM8 ($c^{0.5}$)			QRM8 ($c^{0.75}$)		
(0,50]	2.6	1.569	0.609	1.9	1.104	0.369	1.0	0.560	0.220	0.5	0.178	0.117
(50,75]	9.2	1.588	0.689	7.1	1.070	0.444	4.6	0.554	0.285	2.9	0.202	0.145
(75,100]	11.7	1.834	0.969	10.3	1.259	0.622	7.5	0.680	0.394	5.2	0.263	0.199
(100,200]	37.2	2.538	1.753	36.2	1.858	1.157	30.9	1.082	0.710	24.0	0.444	0.351
(200,300]	20.0	3.858	3.170	20.0	2.892	2.206	19.2	1.815	1.329	16.5	0.773	0.635
(300,500]	14.7	5.330	4.914	14.7	3.997	3.582	14.7	2.646	2.263	13.8	1.232	1.080
>500	2.0	7.240	7.222	2.0	5.430	5.412	2.0	3.620	3.602	2.0	1.810	1.792
All	97.5	3.127	2.408	92.3	2.357	1.732	79.8	1.533	1.155	64.8	0.709	0.598
					Interaction of QRM Rule 8 with other QRM rules							
QRM		c^0			$c^{0.25}$			$c^{0.5}$			$c^{0.75}$	
1 & 8	68.9	3.158	2.337	64.8	2.382	1.663	54.8	1.536	1.102	43.1	0.694	0.570
2 & 8	70.6	3.163	2.544	67.9	2.386	1.833	60.4	1.563	1.213	50.3	0.729	0.624
3 & 8	4.6	2.242	1.614	4.3	1.701	1.145	3.5	1.095	0.777	2.6	0.504	0.416
4 & 8	36.9	3.054	2.405	36.4	2.294	1.666	35.1	1.525	0.945	33.1	0.748	0.223
5 & 8	30.3	2.646	2.193	29.8	1.988	1.558	27.4	1.286	1.008	23.5	0.586	0.506
7 & 8	13.0	2.518	1.705	11.8	1.881	1.212	9.4	1.181	0.821	7.2	0.529	0.433
					Alternative specification of QRM Rule 8							
Size	QRM8alt (c^0)			QRM8alt ($c^{0.25}$)			QRM8alt ($c^{0.5}$)			QRM8alt ($c^{0.75}$)		
(0,50]	2.6	1.569	0.609	1.9	1.104	0.369	1.0	0.560	0.220	0.5	0.178	0.117
(50,75]	9.2	1.588	0.689	7.1	1.070	0.444	4.6	0.554	0.285	2.9	0.202	0.145
(75,100]	11.7	1.834	0.969	10.3	1.259	0.622	7.5	0.680	0.394	5.2	0.263	0.199
(100,200]	37.2	2.538	1.750	36.2	1.858	1.154	30.9	1.081	0.707	23.9	0.443	0.349
(200,300]	20.0	3.858	2.973	20.0	2.889	2.011	18.6	1.744	1.183	15.2	0.708	0.564
(300,500]	14.7	5.330	4.104	14.7	3.997	2.772	13.8	2.454	1.586	10.9	0.958	0.768
>500	2.0	7.240	5.722	2.0	5.430	3.912	2.0	3.578	2.132	1.4	1.369	1.003
All	97.5	3.127	2.213	92.3	2.357	1.527	78.4	1.466	0.949	60.1	0.596	0.470
					Interaction of alternative QRM Rule 8 with other QRM rules							
QRM		c^0			$c^{0.25}$			$c^{0.5}$			$c^{0.75}$	
1 & 8alt	68.9	3.158	2.149	64.8	2.381	1.464	53.6	1.457	0.904	39.8	0.580	0.449
2 & 8alt	70.6	3.163	2.333	67.9	2.385	1.614	59.4	1.500	0.996	46.7	0.615	0.489
3 & 8alt	4.6	2.242	1.573	4.3	1.701	1.101	3.5	1.083	0.727	2.6	0.477	0.379
4 & 8alt	36.9	3.054	2.208	36.4	2.294	1.466	35.0	1.503	0.745	31.9	0.687	0.061
5 & 8alt	30.3	2.646	2.053	29.8	1.988	1.415	27.1	1.244	0.868	22.4	0.510	0.421
7 & 8alt	13.0	2.518	1.626	11.8	1.881	1.125	9.3	1.144	0.727	6.9	0.471	0.370

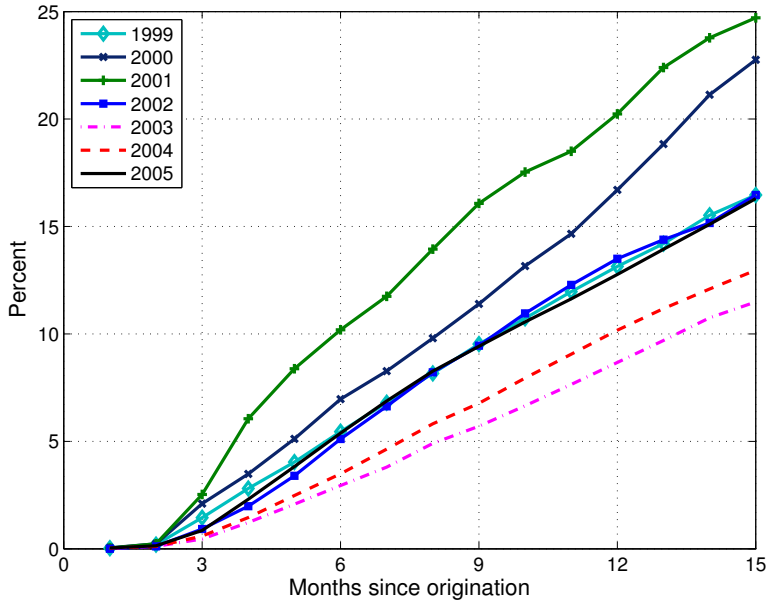

Figure 1: **Delinquency Rates** The figure shows the fraction of loans delinquent as a function of months from origination, by year of origination. The delinquency rate is defined as the cumulative fraction of loans that are past due 60 days or more, in foreclosure, real-estate owned or defaulted, at or before a given age.

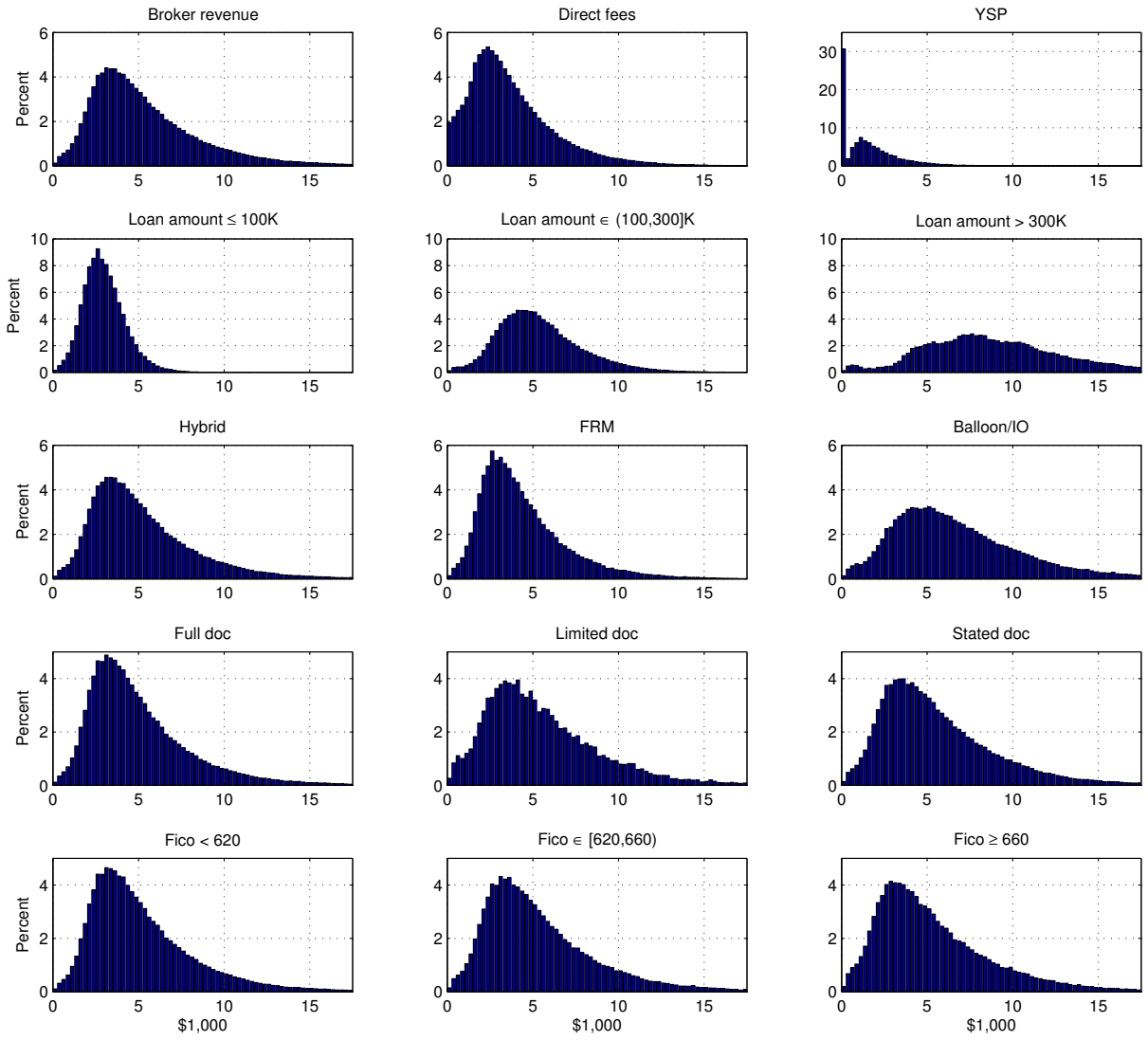

Figure 2: **Broker Revenues, Fees and YSP** The top panel shows the unconditional distribution of dollar broker revenues, fees and yield spread premia. The next four panels plot the distribution of dollar broker revenues conditional on loan size, loan type, documentation level or the borrower's FICO score.

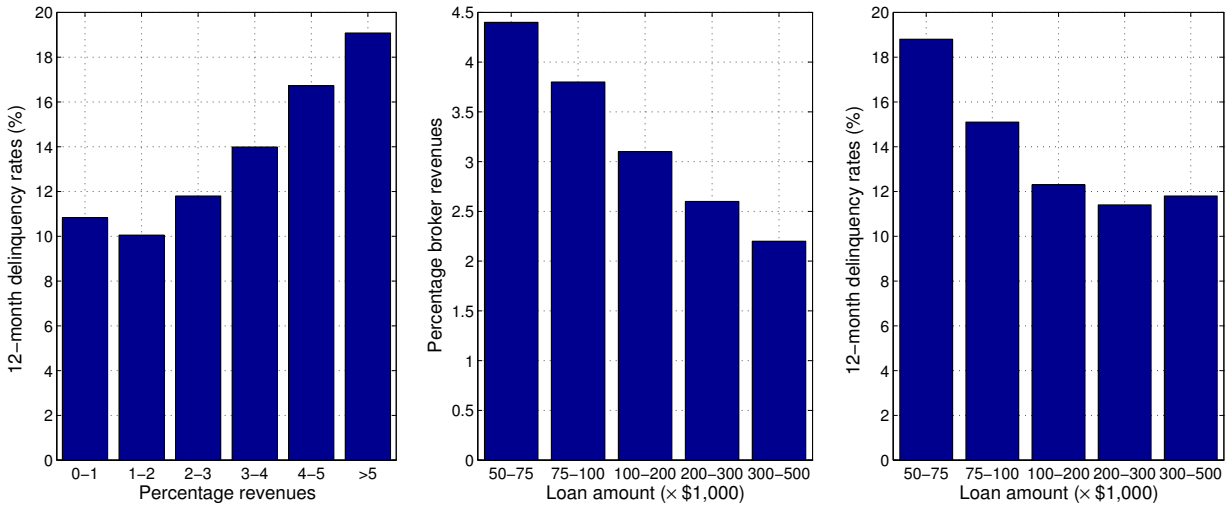

Figure 3: **Delinquency Risk, Loan Size and Percentage Broker Revenues** The left figure displays average 12-month delinquency rates as a function of percentage broker revenues. The middle and right figure show, respectively, average percentage revenues and average 12-month delinquency rates for loans in different size bins.

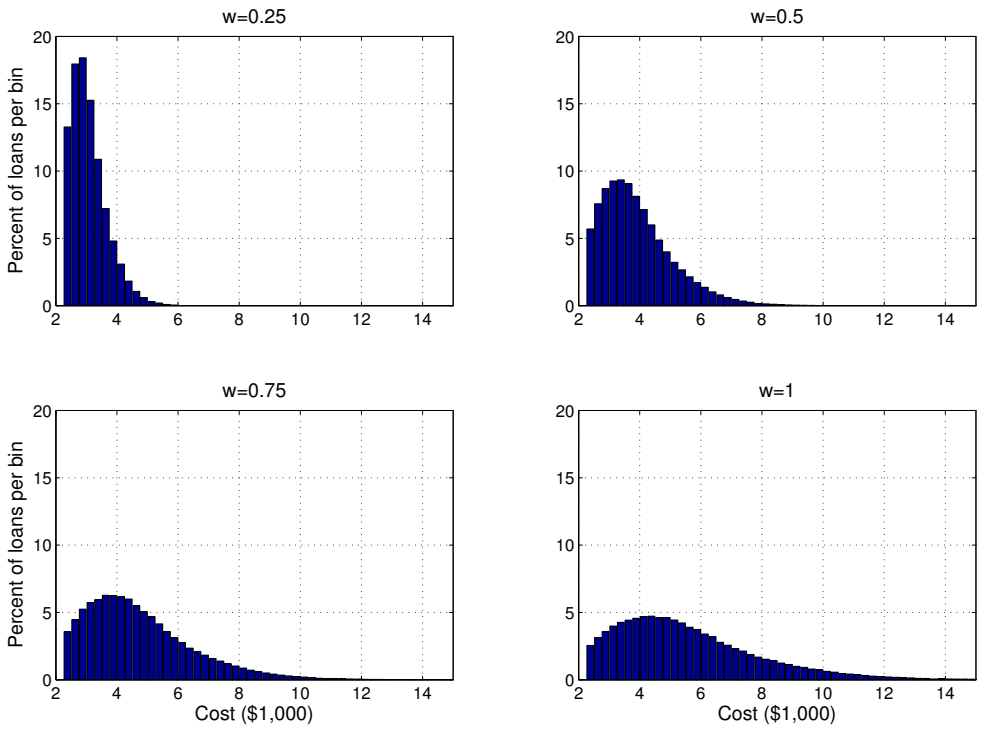

Figure 4: **Conditional Cost Distributions** The figure shows the empirical cost distribution, conditional on a loan amount between 100 and 300K, for different levels of w in Equation (13). Loans with revenues at or below the 5% quantile (2.3K) are not shown.

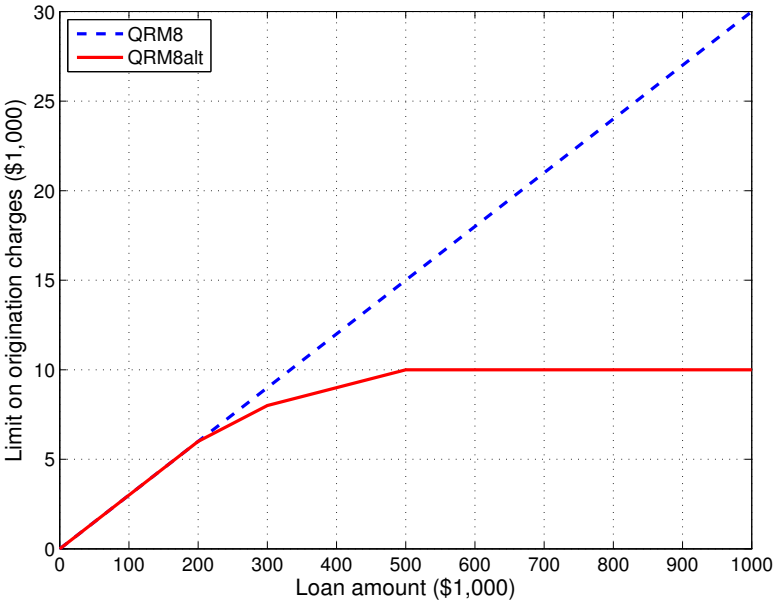

Figure 5: **Proposed and Alternative QRM Rule 8** The Agencies (2011) proposed a cap of 3% on percentage origination charges. The alternative rule described in Appendix E restricts loan origination charges to 3% of the loan amount for loans of 200K or less, and to 10K for loans of more than 500K. In between, maximum dollar charges grow according to a piecewise linear schedule, which caps origination charges at 8K and 9K for 300K and 400K loans.