# What Broker Charges Reveal about Mortgage Risk*

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**Abstract**

Prior to the subprime crisis, mortgage brokers charged higher fees for loans that turned out to be riskier ex post, even when conditioning on other characteristics that predict mortgage default. The proposed 3% limit on origination charges enacted in the Dodd-Frank Act exploits the unconditional link between higher broker charges and higher mortgage risk. The limit restricts access to mortgage credit for smaller loans, but it is less effective in protecting lenders or investors from unobserved mortgage risk. Losses incurred due to unobserved risk are reduced if brokers receive excess fees only after a waiting period, and only if there is no credit event, in which case these fees would go to the lender or investor.

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Long after the height of the 2007-8 subprime crisis, the number of homes in foreclosure and of homeowners in financial distress remained at historically high levels. In the first quarter of 2011, over 3.5 million residential mortgages were 90 or more days delinquent or in the foreclosure process, and one in five borrowers owed more on their mortgage than their home was worth (GAO (2011)). In response to the ongoing foreclosure crisis, Congress enacted credit risk retention requirements as part of the Dodd-Frank Wall Street Reform and Consumer Protection Act. The requirements mandate securitizers of mortgage-backed securities to retain an economic interest of at least five percent of the aggregate credit risk of non-government-backed loans collateralizing such securities, with exceptions made for so-called Qualified Residential Mortgages (QRMs). Many observers predict that as a result of the risk retention requirement, non-QRM loans will be significantly more costly for borrowers or not be available at all (Freedman (2011), Zandi and deRitis (2011)).

The QRM term is to be defined jointly by the OCC, Board of Governors, FDIC, SEC, FHFA and HUD, collectively referred to as the "Agencies". In April 2011, the Agencies published a proposal of QRM guidelines for public comment. The stated objective is to ensure that QRM loans have "low credit risk even in stressful economic environments" (Department of Treasury (2011)). One of the proposed restrictions stipulates that total mortgage origination charges paid by the borrower cannot exceed 3% of the loan amount.

While limits on origination charges have historically been imposed to fight predatory lending practices (HUD (2000)), the link between loan originator compensation and subsequent loan performance is less understood.[1] Our paper attempts to fill this gap in the literature. We first establish that higher origination charges are indeed associated with higher mortgage credit risk. Our data include all broker-originated loans funded by, formerly, one of the largest subprime lenders, New Century Financial Corporation, between 1996 and 2006. For each loan we observe detailed origination and servicing records, as well as the broker revenues charged which provide us with a tight lower bound on total origination charges.[2] Figure 1 shows a dramatic increase in average 12-month delinquency rates, from about 10% for loans with broker revenues of 1-2% of the loan amount to over 19% for those with percentage revenues of more than 5%.

[1]Most recent studies, such as Demyanyk and 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.

[2]Additional charges to the borrower may include credit insurance premia, debt cancellation or suspension fees, or prepayment penalties for a previous loan held by the same lender.

[Figure 1 about here]

The link between percentage broker revenues and mortgage credit risk can in part be explained by the fact that revenues proxy for other known risk characteristics. For example, as long as there are certain fixed broker costs associated with originating a loan, percentage broker revenues are likely to be larger for smaller loans. In our data, average percentage revenues decline steadily as the loan size increases, from 4.4% for a 50-75K loan to 2.2% for loans between 300 and 500K. At the same time, we find that small loans are generally also the riskier ones. The average 12-month delinquency rate for loans of 100K or less is 17%, compared to 12% across medium-sized and larger loans. Small loans are usually taken out by lower-income borrowers purchasing or refinancing homes in neighborhoods with a larger percentage of minorities and a lower percentage of college graduates. Therefore, small loan size—and hence high percentage revenues—serve as strong unconditional indicators of high delinquency risk.

While variables such as size predict broker revenues, we find substantial heterogeneity in broker charges even after controlling for observable loan, property, borrower and broker characteristics. A main contribution of our paper is to offer comprehensive evidence that conditional broker revenues reflect unobserved heterogeneity in mortgage credit risk. Using a proportional odds duration model for the probability of first-time delinquency, we find that a marginal increase in broker revenues by 1% of the loan amount is associated with a 6% higher odds ratio.

The mortgage brokers in our sample operate as independent service providers that match borrowers with lenders. They are compensated by charging a direct fee to the borrower and by earning an indirect fee—known as the yield spread premium—from the lender. The marginal predictive power of broker revenues for future delinquency risk stems, almost exclusively, from the direct fee component. Less than 40% of the variation in direct broker fees, measured as a percentage of the loan amount, are explained by observable loan, property, borrower and broker characteristics, and the yield spread premium. In addition to being widely dispersed, residual fees are skewed to the right, indicating that a sizable fraction of borrowers paid high excess fees.

Based on a model of borrower-broker interactions where the broker learns the borrower's reservation value of the fees and has all the bargaining power (Woodward and Hall (2011)), brokers are able to charge excess fees for a number of reasons, including situations where the borrower shops from too few brokers and is confused about the terms of the loan, is overly optimistic about future resale or refinancing opportunities, underestimates personal

bankruptcy costs, or has negative private information about his future financial situation. Even a borrower who shops around may be charged higher fees if brokers believe that the borrower needs extensive prodding or close supervision while preparing the loan documents. In each scenario, the broker learns about borrower characteristics that are not disclosed on the loan application but are likely to reflect unobserved mortgage credit risk. And indeed, we find that an increase in excess percentage broker fees by 1% is associated with a 7% higher odds ratio of first-time delinquency.

Having established that higher broker revenues reflect higher delinquency risk, both conditionally and unconditionally, we now address the question of whether this link can be used in practice to differentiate riskier from safer loans. The answer is not as straightforward as one might expect. Consider two borrowers that apply for the same 100K mortgage through the same broker and provide identical information on their respective loan applications. Let us assume that the broker's reservation value, which is her cost, is \$3,000 for either borrower. The first borrower shops around for the best deal and his reservation value of the fees is 3K. The second borrower does not shop from any other brokers and is confused about the terms of the loan, resulting in a higher reservation value of 4.5K. Our empirical evidence is consistent with the second borrower being riskier than the first, even though the characteristics that the lender observes are the same for both borrowers.

As long as there are no feedback effects from broker fees to mortgage pricing, our model dictates that the fees for the first and second borrower are set at 3K and 4.5K, respectively. If, however, as a result of the proposed QRM regulation interest rates were to increase significantly for loans with fees in excess of 3% of the loan amount, or 3K in our example, the second borrower may no longer be able or willing to pay \$4,500 in fees. Since the broker is paid only if the loan closes, she in turn may be willing to give up 1.5K in profit and offer the second borrower the lower-rate loan for a fee of 3K. As a result, the fee-based rate schedule may prevent the broker from pocketing all gains from trade with the second borrower. But a separation of riskier from safer loans is not warranted as both loans may still be originated at the same rate.

The proposed limit on origination charges necessarily precludes only those loans from QRM status for which the broker's costs of originating the mortgage exceed the maximum permissible charge. We use the term broker costs to mean the costs the broker expects to incur after she strikes a deal with the borrower, and until closing documents are signed. In our example, the implied fee-based rate schedule is effective only if the broker perceives costs to be higher for the second borrower than for the first. More generally, the proposed cap on origination charges is guaranteed to be effective in isolating riskier loans among mortgages

with a given set of observed characteristics only in the presence of significant unobserved heterogeneity in conditional broker costs across borrowers, and if, all else the same, higher origination costs are associated with higher delinquency risk.

If, on the other hand, brokers perceive origination costs to be the same for loans with the same observed characteristics, then QRM status could be defined and mortgage rates could be set based on those characteristics but not as a function of broker compensation. Take the simple view that broker costs are $3,000 per loan, no matter what its size or type. Then only loans of 100K or more could be originated under the proposed QRM definition. The limit on origination charges would simply act as a size rule that prevents small borrowers from having access to low mortgage rates. The credit risk among QRM loans would likely be lower, simply due to the fact that small loans are generally the riskier ones.

Since the potential impact of the proposed QRM restriction on origination charges is closely tied to the cost of broker services, and since we cannot observe these costs directly, we derive loan-level estimates for different sets of assumptions regarding borrowers' shopping behavior and the degree of heterogeneity in conditional cost distributions. For the case where borrowers shop from only one broker and there is no unobserved heterogeneity in costs, broker costs can be approximated by a low quantile of the conditional cost distribution. Estimated costs are about $2,250, which leaves an average marginal profit of almost $3,100 per loan. Over 97% of the loans in our sample could have been originated under the 3% cap on origination charges. The proposed restriction would act a a size rule as virtually all of the loans that are precluded from QRM status by the 3% ceiling are small loans with a size of 100K or less. The average 12-month delinquency rates among loans with percentage costs above 3% is 24.7%, compared to 13.1% across all other loans.

A prime example for heterogeneity in conditional costs across loans with the same observable characteristics would be the case of a perfectly competitive broker market where revenues are equal to the broker's marginal cost of originating the loan. Perfect competition among brokers is consistent with a scenario where all brokers perceive costs to be the same for a given borrower, and where borrowers shop from two or more brokers by using the brokers' initial quotes to extract better and better offers. As a result, the ultimate bid will be the broker's cost (Woodward and Hall (2011)). Broker revenues may equal costs even if we allow for heterogeneity in costs across brokers. Consider a number of different types of brokers, such as high-volume vs low-volume, rookie vs seasoned or local vs national brokers, and assume that costs for a given borrower are the same among brokers of the same type but not necessarily across broker types. As long as borrowers prefer a certain type of broker and shop from two or more brokers of that type, the observed distribution of broker revenues is

the same as the distribution of costs.

If broker revenues were equal to costs, only 52% of the loans in our sample could have been originated for 3% of the loan amount or less. The average cost to originate a 100-200K mortgage would have been \$4.7K, plus an additional \$2,000 and \$4,000 for loans between 200 and 300K and loans between 300 and 500K, respectively. Both the level of these cost estimates and their increase along the size spectrum seem rather high, considering that, to a large extent, the only cost incurred is the value of the broker's time. In addition to the fact that the perfect competition assumption yields unrealistic cost estimates, it is also contradicted in a recent survey by the Board of Governors (2009) which finds that the majority of borrowers only shops from one broker. This leads us to believe that many of the observed revenues do indeed reflect sizable broker profits. We therefore offer benchmark cost estimates, and analyze the potential impact of the proposed QRM restriction, for mixtures of the perfect-competition and the no-shopping conditional cost distributions.

Since the proposed limits on origination charges may not be effective in exploiting the conditional link between broker revenues and delinquency risk that we uncover, we offer a proposal for discussion that would ensure at least some degree of risk sharing between the broker and the lender.[3] Consider a scenario where the broker discloses the fee $f$ she is charging the borrower to the lender. Instead of setting rates as a function of $f$, the broker receives only a portion $f^{\max}$ of $f$ at the time closing documents are signed. The remaining amount, $f - f^{\max}$, is held in trust by the lender or a third party for $m$ months or until the loan becomes delinquent for the first time, whichever occurs first. If the loan does not become delinquent within $m$ months of origination, the accrued value of $f - f^{\max}$ is paid to the broker, otherwise that amount goes to the lender. The waiting period of $m$ months can be set as a function of the broker's past performance with the lender, among other variables. By setting $f^{\max}$ equal to a benchmark conditional broker fee, this approach exploits the unobserved heterogeneity in broker charges to reduce the lender's risk exposure. For loans that are sold and securitized, it is in the interest of secondary market investors to incentivize lenders to disclose origination charges together with other observable characteristics, and/or to pass along payouts from the excess fees in the event of an early delinquency.[4]

Lastly we revisit the view that the limits on origination charges were proposed to coun-

[3]Even if broker markets were to move closer to perfect competition in the future, it is unclear how much unobserved credit risk would indeed be revealed through the conditional cost distributions.

[4]Recent work on securitization and mortgage default include Mian and Sufi (2009), Keys, Mukherjee, Seru, and Vig (2010), Keys, Seru, and Vig (2010), Jiang, Nelson, and Vytlacil (2010), Bubb and Kaufman (2011a), Bubb and Kaufman (2011b), Elul (2011), Hartman-Glaser, Piskorski, and Tchistyi (2011), and the references cited therein.

teract predatory lending practices and to protect borrowers from being overcharged. These objectives are consistent with our finding that marginal broker profits would be reduced by as much as $700 per loan as a result of the 3% cap, depending on the broker cost estimates. However, we show that the reduction in dollar profits for medium-sized and large loans would be comparable, if not smaller, than that achieved for small loans. As a result, the proposed restriction does not reduce the profit differential between large and small loans in any significant way. Unless it is significantly more costly for brokers to find borrowers buying larger homes, larger loans would remain substantially more profitable compared to smaller ones, and incentives would still exist for brokers to steer borrowers towards larger homes, or to cater to the large home buyer.

We offer a roadmap for stress testing alternative specifications of limits on origination charges. For example, consider a concave ceiling that restricts charges to 3% of the loan amount for loans of 100K 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 6K, 8K and 9K for loans of size 200K, 300K and 400K. The alternative ceiling to origination charges yields substantially lower marginal broker profits for medium-sized and large loans. Independent of the assumptions underlying the cost estimates, large borrower are now better protected from leaving too much money on the table. This is achieved while keeping access to mortgage credit and delinquency risk at the same level as for the proposed QRM restriction.

# 1. The Mortgage Origination Process

To better understand what origination charges may reveal about mortgage credit risk, we develop a model of the mortgage origination process. We focus on loans originated in the wholesale market, where independent mortgage brokers act as financial intermediaries that match borrowers with lenders. They 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.

Let us consider some borrower that arrives at a broker requesting a mortgage.[5] The broker evaluates the 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

[5]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. In any case, we do not model borrower-broker interactions prior to the time that a deal is made.

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 such a list of financing options, the broker reviews wholesale rate sheets distributed by potential lenders. These rate sheets state the minimum rate as a function of loan, borrower and property characteristics at which a given lender is willing to finance a loan. We refer to this rate as the lender's base rate. Until recently, rate sheets also informed the broker about the yield spread premium 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 yield spread premium at the time of closing.

In what follows, we explore the simple view 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 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 net benefit the borrower derives from her contact with the broker is $\overline{f} - f$, where $\overline{f}$ denotes the borrower's reservation value of the fees. It is given by

$$\overline{f} \;=\; \nu - o,$$

where $\nu$ is defined as the borrower's dollar valuation for the loan $(L, r)$ and $o$ denotes the dollar value of the borrower's outside options, as perceived at the time the deal is made. We use $y$ to denote the yield spread paid by the lender, and $c$ for the broker's cost of originating the loan. Broker costs are meant to be the costs the broker expects to incur after she strikes a deal with the borrower, and until closing documents are signed. 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 of the fees, $\underline{f}$, is equal to

her cost minus any YSP received,

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

The broker's net surplus from originating the loan is $f - \underline{f}$, and the borrower's and broker's joint surplus from their interactions 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 surplus $f + y - c$ by choosing the lender and $(L, r, f)$, subject to the borrower's participation constraint, $f \leq \nu - o$, and the broker's participation constraint, $f \geq c - y$.

For the remainder of this section, we assume that fees $f$ can be set without a feedback effect on other terms of the loan. We note that throughout our sample period, the Home Ownership and Equity Protection Act of 1994 (HOEPA), which amends the Truth in Lending Act (TILA), imposed a number of rules for certain loans, including those with high fees. High fee loans are defined as loans for which total origination charges exceed the larger of $592 or 8% of the loan amount.[6] The rule for high-fee loans are listed in Section 32 of Regulation Z, which implements the TILA. "Section 32 mortgages" are banned from balloon payments, negative amortization, and most prepayment penalties, among other features.

### *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, that is $f = \overline{f}$ or

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

Equation (3), together with (1), allows us to write the broker's net surplus as $\nu - o + y - c$. In other words, the broker captures all of the joint gains from trade in Equation (2). The terms of the loan and interest rate are set so as to maximize those gains from trade, provided that the broker's revenues cover the costs, $\nu - o \geq c - y$.

[6]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.

In this case, the broker's total revenues are given by

$$f + y \;\; = \;\; c + (\nu - o + y - c)\,.$$

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 margins do not immediately inform about potential profits a new entrant to the mortgage broker business may obtain as they do not control for the costs of identifying and attracting prospective borrowers.

*1.2. Borrower shopping behavior*

In line with Woodward and Hall (2011), 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. In the case of a single bid, the outside option is no mortgage, meaning that the broker can extract the entire net surplus from purchasing the house or refinancing the mortgage. If $K \geq 2$, the observed revenue is the cost of the second-lowest-cost broker, as long as the associated fee does not exceed the borrower's net surplus from obtaining the mortgage. 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,

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

Woodward and Hall (2011) assume that all unobserved heterogeneity in broker revenues stems from heterogeneity in broker costs. As a result of this assumption, they cannot identify the broker costs in cases where the borrower shops from only one broker. This is problematic as the Board of Governors (2009) reports that over half of the borrowers shop from only a single broker. We depart from Woodward and Hall (2011) by assuming that there are a number of different types of brokers, such as high-volume vs low-volume, rookie vs seasoned or local vs national brokers, and that costs for a given borrower are the same across brokers of the same type. This reflects the notion that brokers may learn about borrower characteristics that are not disclosed on the loan application but are likely to affect the brokers' time costs, such as the borrower needing extensive prodding or close supervision while preparing the loan documents. That said, we still allow for heterogeneity in costs across different types of brokers.

*1.3. Unobserved heterogeneity in broker fees*

To some extent, broker fees can certainly be predicted from other observable characteristics, such as the yield spread premium, the size of the loan, and the type of property and borrower. But what could be the reason for fees to differ across loans, even when conditioning on other observable characteristics?

According to Equation (4), we first consider a borrower that shops from only one broker. In this case, $f = \nu - o(\text{no mortgage})$, where $o(\text{no mortgage})$ measures the borrower's perceived net benefits from staying in his current house or rental or, for a mortgage refinance, from keeping the same mortgage terms. The borrower's valuation of a loan, $\nu$, measures the wealth equivalent benefits that the borrower expects to receive from the loan. It is given by

$$\nu \;=\; H - V,$$

where $H$ denotes the dollar value of the benefits the borrower expects to draw from owning the home, and $V$ is the expected present discounted value of current and future mortgage payments. $H$ can be higher than the appraisal value or the actual purchase price for the house in cases where the borrower derives extra utility from the home, perhaps because it is located in a particular neighborhood, is of a particular size, or is close to work or certain services. Under such circumstances, the borrower may be willing to pay a higher than average fee, but is not necessarily more likely to become delinquent. On the other hand, if the borrower is overly optimistic about the resale value of the home, and as a result consumes above his means, then an abnormally high value of $H$ may indeed reflect unobserved mortgage risk.

Unobserved heterogeneity in fees may also stem from unexplained variation in $V$. 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, $V$ is computed as

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

where $\delta_m$ is the borrower-specific discount factor for spending or receiving one dollar $m$ months from now. The mortgage is terminated early if either prepayment or default occur 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. $F_m$ stands for the costs the borrower incurs from becoming delinquent, other than having to give up the house. Expectations are taken with regard to the joint probability distribution of $\{\delta_m\}, \{p_m\}$, $B_{T_P}$, $F_{T_D}$, $T_P$ and $T_D$.

Given a set of observable characteristics, $V$ could be abnormally low if the borrower underestimates future payments $\{p_m\}$. This is conceivable for hybrid mortgages with adjustable rates or complex mortgages with negative amortization, where the actual distribution of potential future interest payments is wide and skewed to the right. Alternatively, the borrower may assign a higher than average probability to an early default time $T_D$, and/or expect the costs incurred from becoming delinquent, $F_{T_D}$, to be relatively low. Or he may underestimate the payments $B_{T_P}$ associated with refinancing the loan at a later date.

In addition, the borrower could have negative information about his future financial situation that is not disclosed on the loan application, such as the knowledge that a household member is likely to loose or quit his job in the near future. As a result, the borrower's personal discount factors $\{\delta_m\}$ may be abnormally high for future periods $m$, resulting in high values of $\nu$ as long as there are positive net benefits from owning the home in future months. Brokers that learn about negative private borrower information may also be better able to discourage borrower form shopping from additional brokers.

If the borrower shops from more than one broker, observed revenues equal the costs of the second-lowest-cost broker. Given a set of observed characteristics that includes the yield spread premium, the only source of unobserved heterogeneity in broker fees is unexplained variation in costs. All else the same, brokers may perceive costs to be higher for borrowers that need extra prodding or close supervision while preparing the loan documents.

No matter what the borrower's shopping strategy, many of the reasons for high conditional broker fees are consistent with borrowers being less informed when compared to the average borrower, and more risky relative to the information provided on the loan application. It suggests that, holding all else the same, borrowers may pay higher fees for loans that turn out to be riskier ex post. In what follows, we investigate whether the data support this hypothesis.

# 2. The New Century Loan Pool

Our empirical analysis is based on data obtained from IPRecovery, Inc. The dataset 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 home mortgage loans designed for subprime borrowers. Increased rates of early delinquencies in late 2006 and early 2007, together with inadequate reserves for such losses, led to New Century's Chapter 11 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 origination pattern observed for the broader subprime market, where prior to the subprime crisis mortgage brokers had become the predominant channel for loan origination. For example, in 2005 independent brokers originated about 65% of all subprime loans.[7] Focusing on broker-originated loans allows us to abstract from differences in the compensation structure for 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, and Appendix A describes the steps we take to clean the raw data. A detailed description of New Century's origination and service data can be found in Appendix B. In what follows we compare the New Century loan pool to the broader subprime market.

[Table 1 about here]

### *2.1. Origination data and loan performance*

Table 2 reports descriptive statistics for our sample of broker originated loans that were funded by New Century between 1997 and 2006. We compare these statistics to the First American CoreLogic LoanPerformance (LP) data which offers loan-level origination and servicing records of roughly 85% of all securitized subprime mortgages. Securitization shares of subprime mortgages ranged between 54% and 76% during our sample period (Mortgage Market Statistical Annual (2007)). While the LP dataset offers the widest coverage of subprime loans available, it does not identify broker-originated loans or report broker compensation. Nevertheless, we use the LP data—as described in Demyanyk and Hemert (2011)—as a

[7] Detailed information is available at the National Association of Mortgage Brokers website at www.namb.org.

benchmark to compare New Century's origination activity to the broader subprime market. 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.

[Table 2 about here]

Average 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 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 include limited documentation loans, the fraction would fall from 64% to 60% in the New Century data. 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, margins, and the fraction of loans with prepayment penalties. In summary, the origination statistics of New Century's loan pool are in line with those of the broader subprime market.

From 1999 onwards, the data obtained from IPRecovery 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 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.

We compare the cumulative delinquency rates in Figure 2 with those reported by Demyanyk and 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 reason that New Century delinquency rates are 1-2 percentage points higher is likely linked to the fact that the LP data include retail as well as broker loans whereas we consider only the latter. Jiang, Nelson, and Vytlacil (2011) show that, all else equal, broker loans are riskier than retail loans. The only two years with larger differences in delinquency rates are 2001 and 2002, precisely the

years during which a sizable portion of New Century's loan are missing from the servicing data. Because of this lack of data, we put less weight on the 2001 and 2002 estimates.

[Figure 2 about here]

*2.2. Broker compensation*

Until recently, independent mortgage brokers earned revenues from two sources: a direct fee paid by the borrower and an indirect fee—known as the yield spread premium—paid by the lender. The direct fee consisted of all compensation paid by the borrower directly to the broker, including finance charges such as appraisal and credit report fees. The yield spread premium, or YSP, rewarded the broker for originating loans with a higher interest rate, holding other things equal. Table 3 shows that total broker revenues per loan, as a percentage of the loan amount, declined steadily, from 4.9% in 1997 to 2.8% 2006. The decline in percentage revenues was almost equally split between a decline in percentage fees and YSPs. Dollar revenues, on the other hand, increased over time, from $4,200 to $5,600 per loan. This increase in dollar revenues corresponds to an annual compound rate of 3.3% which, depending on the benchmark, is on par with the rate of inflation. The lower percentage revenues and relatively modest growth in dollar revenues may reflect increased competition with more brokers doing business with New Century.

[Table 3 about here]

The top panel in Figure 3 shows the unconditional distribution of broker revenues and its two components.[8] All the distributions are disperse and quite skewed—there are some extremely large fees and yield spreads paid out to the brokers. The right skewness in the revenue distribution appears to be a robust characteristic across different loan and borrower characteristics, as documented in the remaining panels in Figure 3.

[Figure 3 about here]

Brokers are generally rewarded more for originating larger loans. This can be seen from the first column in the bottom panel of Table 3, where we report compensation statistics

[8] About 27% of the YSP entries in our data are left blank. All else the same, loans with lower Fico scores, worse risk grades and less documentation are more likely to have no YSP entry. Such loans usually have high base rates, leaving less room for charging borrowers rates that are higher than the base rate. Moreover, while a marginal increase in YSP is usually linked to a decrease in direct fees, we find no statistical significance for the missing-YSP dummy when regressing broker fees on loan-level 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%. Robustness checks that exclude missing-YSP loans from the sample are provided in the online appendix.

across different size bins. For loans of 50K or less, brokers earn an average $2,200 per loan. For loans in excess of 500K, however, brokers make $9,700 per loan. Both compensation channels contribute to this increase. After controlling for the size of the loan, the variation in revenues is substantially smaller. Nevertheless, hybrid loans usually generate lower revenues than fixed-rate, balloon and interest-only loans. Borrowers with lower Fico scores usually pay higher fees and yield spread premia than borrowers with a good credit history. Loans with a prepayment penalty generally offer higher broker revenues, mainly due to higher fees.

During our sample period, we observe almost 56,000 different brokerage firms doing business with New Century. Each company consists of one or more individuals working out of the same office. The median broker company has only sporadic contact with New Century, and originates about 4 loans or $734,000 for this particular lender between 1997 and 2006. The top three loan originators were 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.

There are two recent empirical studies that report data on broker fees and yield spread premia. Woodward and Hall (2011) consider about 1,500 FHA fixed-rate loans originated during a 6-week period in 2001 and report average broker revenues of about $4,100 per loan, and an average loan size of about $113,000. 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 the revenues ($4,800) and the loan size (149K). Garmaise (2009) analyzes a sample of almost 24,000 residential single-family mortgages originated between 2004 and 2008. He reports average broker revenues of about 2.1% of the loan amount. Neither study, however, focuses on subprime loans. As for the popular press, a recent news release by 360 Mortgage Group (Reuters (2011)) on mortgage broker compensation states that brokers generated an average per-loan revenue of 2.25% in recent years.[9] This figure is consistent with the compensation statistics reported in Table 3 and points to a continued decline in percentage broker revenues beyond 2006.

In summary, we consider New Century's loan pool to be largely representative of the broader subprime market. Since its bankruptcy in 2007, New Century has received widespread attention in the popular press, mainly because it was the largest subprime lender to default to date. A closer look at New Century's main competitors reveals, however, that by 2009 virtually all of them had either declared bankruptcy, had been absorbed into other lenders,

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

or had otherwise unwound their lending activities.[10]

# 3. Broker Charges and Mortgage Credit Risk

We begin our analysis by studying the variation in broker compensation, after controlling for other observable characteristics. Table 4 shows that only 40.5% of the variation in dollar broker fees can be explained with the information that the lender observes. For percentage broker fees, that fraction is even lower at 37.8%. Most of the variation in broker fees is explained by size, with and $R^2$ of 32.4% for dollar fees and 25.4% for percentage fees. The standardized residuals from regressing broker fees on the loan, property, borrower and broker characteristics in Table 1, and on YSP, are plotted in Figure 4. They are skewed to the right, with a skewness coefficient of 0.50 for dollar fees and 0.53 for percentage fees. As a result, our data exhibits substantial unobserved heterogeneity in fees, with a sizable fraction of borrowers paying high excess fees.

[Table 4 and Figure 4 about here]

We are interested to understand whether the unexplained variation in broker fees informs about delinquency risk. While the recent literature agrees on the definition of delinquency as the borrower being 60 days behind in payments or worse, different specifications have been used to model delinquency risk. A large number of studies follow in the footsteps of Deng (1997), Ambrose and Capone (2000) and Deng, Quigley, and Van Order (2000) and rely on Cox proportional hazard models, sometimes with flexible baselines following Han and Hausman (1990), Sueyoshi (1992) and McCall (1996).[11] The model is convenient both because it allows for a flexible default pattern over time and because it allows us to work with our full sample of loans despite some observations being censored. Another, albeit less frequently used, approach is to estimate a probit model. Recent examples include Jiang, Nelson, and Vytlacil (2011), Danis and Pennigton-Cross (2005) and Geradi, Goette, and Meier (2010).

[10]New Century was joined on the OCC's 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 Corp, BNC Mortgage, Fieldstone Mortgage, Decision One Mortgage and Delta Funding.

[11]Recent applications 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).

*3.1. Broker compensation and loan performance*

To formally establish a link between broker compensation and the ex-post riskiness of loans, we perform a proportional odds duration analysis with 60-day delinquency as non-survival.[12] Let $T_D$ denote the number of months until a loan becomes 60 days delinquent or worse for the first time. The probability that, for some loan $i$ with covariates $X_t^i$, $T_D$ equals $t$ is defined as

$$P_t^i \quad = \quad \Pr\left(T_D = t | T_D \geq t, X_t^i\right).$$

As in Demyanyk and Hemert (2011), we use the discrete-time analogue to the Cox proportional hazard model and assume that the log proportional odds of delinquency at time $t$ are affine in $X_t^i$. In particular,

$$\log \frac{P_t^i}{1 - P_t^i} \quad = \quad a_t + b' X_t^i, \tag{6}$$

where $a_t$ captures age effects and $b$ is a column vector of coefficients. The model in (6) is estimated via maximum likelihood techniques, using the LOGIT procedure in STATA.

As for the vector of covariates, $X_t$, many conditioning variables have been shown to affect loan performance. We therefore organize the conditioning variables into six groups: demographic and time variables, loan and property information, borrower characteristics, neighborhood statistics, indices reflecting differences in anti-predatory lending laws and broker licensing laws across states, and broker variables. Demographic and time controls include annual dummies, state dummies, and whether or not the property is in a metro area. Loan and property information is collected on the loan type, loan size, documentation level, LTV, CLTV, risk grade, rate margins for hybrids, and the length of the prepay penalty period. Some of the variables are transformed into bins to add flexibility to the log-linear specification of the hazard rate in (6). Borrower characteristics such as the borrower's Fico score, debt-to-income ratio, and the risk score assigned by New Century which is based on whether the borrower is currently late, or has been later on debt payments in recent years. Motivated by the findings in Jiang, Nelson, and Vytlacil (2011), we interact the debt-to-income ratio with the documentation level. Neighborhood characteristics include zip-code race, education, income and ethnicity variables. Regulatory variables include deviation of state predatory lending laws from federal law, broker occupational licensing laws and bro-

[12]While the paper only presents results from the duration analysis, and did run several probit model specifications to ensure that our qualitative findings are robust.

ker entry barriers. Broker information is computed in the form of broker competition and broker-lender relationship variables.

The recent literature differs as to whether or not the initial mortgage rate should be included as a conditioning variable. While Demyanyk and Hemert (2011) control for interest rates, Jiang, Nelson, and Vytlacil (2011) do not. Our decision to control for mortgage rates reflects the mechanics of the loan origination process during our sample period. Recall that lenders like New Century would distribute wholesale rate sheets that set the minimum mortgage rate based on a large number of risk characteristics. If this base rate were the rate charged on the loan, it could be considered somewhat endogenous to the default hazard rate. But because brokers earned a YSP for originating loans at rates higher than the base rate, observed rates at which the loans were funded often exceeded that base rate. Hence mortgage rates may reflect information about future delinquency risk, even after controlling for observable risk characteristics.

The estimation results are presented in Table 5. We find that a marginal increase in broker revenues by 1% of the loan amount is associated with a 6% higher odds ratio. And even after controlling for the yield spread premium paid by the lender, an increase in direct broker fees by 1% of the loan amount is associated with a 7% higher odds ratio. The sample standard deviation of percentage broker revenues and percentage broker fees are 1.46% and 1.33%, respectively. A one standard deviation increase in percentage broker revenues yields a 9.1% marginal increase in the log proportional odds ratio, whereas a one standard deviation increase in percentage broker fees results in a 9.7% increase in the log proportional odds ratio. In other words, broker fees reveal information about future delinquency risk even after controlling for the loan, property, borrower and broker characteristics that are observed by the lender. In particular, our results suggest that prior to the subprime crisis, mortgage pricing did not fully account for the risk-based information contained in abnormally high broker fees.

[Table 5 about here]

### *3.2. Credit score cutoffs*

Rubb and Kaufman (2011) argue that many mortgage lenders employed Fico score cutoff rules that required increased scrutiny of loan applications below certain thresholds. Freddie Mac (1995) established Fico scores of 620 and 660 as key cutoffs. Keys, Mukherjee, Seru, and Vig (2009) find a credit score of 600 to be a significant threshold for full documentation loans. If lenders screen loan applications with Fico scores below these thresholds more thoroughly for soft information before deciding whether or not to fund the loan, then after increased

scrutiny by the lender there should be less additional information contained in fees. We verify this hypothesis by interacting broker fees with documentation level and Fico scores. Specification IV in Table 5 presents the fitted log proportional odds model when broker fees are interacted with documentation level and Fico scores. We find that across different documentation levels and Fico score ranges, all else the same, an increase in unexplained fees is associated with significantly higher delinquency risk.

Our goal is to understand whether a marginal increase in broker fees has a different effect on delinquency risk depending on the screening effort by the lender as measured by the intersection of documentation level and Fico score. The results also show that the marginal impact of a 1% increase in percentage broker fees has a larger impact on the log odds for loans with higher Fico scores, and a substantially smaller effect on loans with lower Fico scores, both for full documentation loans and those with limited or stated docs. This is consistent with the notion of less screening for soft information for higher Fico score loans. All else the same, however, an increase in percentage broker fees by 1% may be more or less likely depending on the documentation level and Fico score of the loan. For example, the standard deviation of percentage broker fees for full doc loans with a Fico score of less than 600 is 1.40%, whereas it is 1.28% for full doc loans with Fico of 660 or higher. For stated doc loans, the figures are 1.38% and 1.12%. In Table 6 we report the product $\beta_f \sigma_f$, where $\beta_f$ are the coefficient estimates reported for Specification IV in Table 5 and $\sigma_f$ is the standard deviation of percentage broker fees conditional on the associate documentation level and Fico score.

The column labeled "All" in Table 6 shows that among full documentation loans with a Fico score of less than 600, a one standard deviation increase in percentage broker fees translates in to a 0.084 increase in log proportional odds ratio, or roughly into a 8.7% higher proportional odds ratio. Similarly, among full documentation loans with a Fico score of 660 or higher, a one standard deviation increase in percentage broker fees translates in to a 0.183 increase in log proportional odds ratio, or roughly into a 20.1% higher proportional odds ratio. In that sense, higher broker fees have a stronger effect on delinquency risk for higher-Fico-score loans. The same can be observed for limited or stated doc loans. While 600 and 660 appear to be important thresholds for full doc loans, all three thresholds 600, 620 and 660 lead to substantial increases in marginal effects.

[Table 6 about here]

We also report the marginal effects after conditioning on the loan amount. Generally, there is more variation in percentage fees for smaller loans, hence they reveal more informa-

tion about future delinquency risk. Within each size bin, however, we observe an increase in the marginal effect with the Fico score of the loan.

### *3.3. Implication for lenders and investors*

Our results suggest that even after controlling for mortgage pricing, higher-fee loans were more risky. In that sense, our data does not support the notion that New Century's interest rate scheme adequately priced mortgage delinquency risk. While the dataset we obtained from New Century did contain information on mortgage broker compensation, none of the sample rate sheets that we have access to indicate that broker fees had any direct impact on the base rate set by the lender. The final mortgage rate that the borrower has to pay may be higher than the lender's base rate, in which case the broker received as YSP from the lender. To see if there were any feedback effects from broker fees to mortgage rates we estimate the regression

$$\text{rate} \quad = \quad \alpha + \beta_f \,\%\text{Fees} + \beta_y \,\%\text{YSP} + \beta_X' X + \varepsilon$$

The vector $X$ includes all observable control variables listed in Tables 4 and 5.[13] Setting $\beta_f = \beta_y =$ yields an $R^2$ of 0.78. Since YSP reflects whether or not the broker achieves a rate higher than the lender's base rate, which is a function of the observables in our control vector $X$, a high YSP should be indicative of a higher rate. Including YSP in regression, while still keeping $\beta_f$ at 0, raises the $R^2$ to 0.85. All else the same, a 1% higher percentage YSP indicates a 52 basis points higher initial rate. Including fees in the regression, we estimate $\beta_f$ to be 0.0056, implying that a 1% increase in percentage broker fees yields a 0.56 basis point increase in rates. The standard deviations for percentage YSP and fees are 0.76% and 1.38% respectively. A one-standard deviation increase in percentage YSP (fees) leads to a 40 (0.78) basis point increase in rates. In summary, both anecdotal and and data-driven evidence support the notion that for lender like New Century, there was no feedback effect from the fees a broker charged to mortgage rates. This fact is further supported by anecdotal evidence that some brokers added more to their fees just before closing, and long after mortgage rates were determined.

In other words, it appears that mortgage rates at which New Century funded high-fee loans were no different than rates for low-fee but otherwise equivalent loans, even though higher fees in these cases indicate higher delinquency risk. While we do not make a statement

[13]The set of control variables $X$ includes the loan size dummies but excludes of course the variable Rate-6mo LIBOR. To conserve space, we do not tabulate the full regression results, and only summarize our main findings.

as to whether the compensation was appropriate for the risk assumed in absolute terms, our results do suggest that the holder of high-fee loans was compensated less relative to equivalent low fee loans. For loans that the lender retained and held the ultimate risk in, our results suggest that New Century set mortgage rates for high-fee loans too low relative to equivalent but low-fee loans. If our finding pertains to loans that were securitized, our findings suggest that secondary market investors received too little compensation for pools with high-fee loans. While we do not observe pricing in the secondary market, conversations with market participants confirmed that the broker fee information is not disclosed to secondary market investors. Moreover, Ashcraft and Schuermann (2008) describe a New Century securitization deal arranged by Goldman Sachs, GSAMP Trust 2006-NC2, in detail. Scanning the deals' prospectus and other available filings reveals no mention of which of the loans are broker originated, let alone the fees brokers charges on their loans. Unless New Century retained all high-fee loans, which we believe to be highly unlikely, secondary market investors did receive too little compensation for high-fee loans relative to low-fee but otherwise equivalent loans.

### *3.4. Remaining coefficient estimates*

While our focus is on the link between origination and delinquency risk, it is important to note that the remaining estimates in Table 5 are consistent with the existing literature on modeling mortgage delinquency risk in the years prior to the subprime crisis (see, for example, Demyanyk and Hemert (2011) and Jiang, Nelson, and Vytlacil (2011)). In particular, interest rates and loan-to-value ratios have a positive marginal effect on delinquency rates. Hybrid loan products, piggyback loans, limited or stated documentation loans, and loans with prepay penalties are more likely to become delinquent, all else the same. Refinance, and especially refinance cash-out mortgages, have a negative marginal effect. Table 5 also shows that, everything else being equal, borrowers with higher credit scores and lower debt-to-income ratios default less frequently on their obligations. We find that loans that were originated in neighborhoods with a higher fraction of white population or higher educational attainment exhibit marginally lower delinquency rates. We find lower marginal delinquency rates for loans originated in states that cover a wider range of loans with anti-predatory lending laws and states with a higher Pahl index of mortgage broker regulation. After controlling for these loan, borrower and broker characteristics, we find that the adjusted delinquency rate increased throughout much of our sample period, peaking in 2006.

# 4. Broker Fees as an Input to Mortgage Pricing?

Having established that broker fees reveal otherwise unobserved mortgage credit risk, we now address the question whether this link can be used in practice to distinguish conditionally riskier from less risky loans. Consider two borrowers that apply for the same mortgage through the same broker and provide identical information on their respective loan applications. At a given rate $r$, the first borrower has a benchmark reservation value for the fees, $(\nu(r) - o(r))_{\text{BM}}$. The second borrower does not shop from any other brokers and is confused about the terms of the loan, and his reservation value $\nu(r) - o(r)$ exceeds the benchmark reservation value. To keep things simple, yield spread premia are not permitted.

### *4.1. Limits to broker charges*

We first consider a strategy where high-fee loans are not funded. Assume that the broker's cost for both borrowers is less than the benchmark reservation value, $c < (\nu - o)_{\text{BM}}$, and that the maximum permissible fee is $f^{\max}$. If $f^{\max} < c$, neither loan will be originated since the broker cannot recover her marginal costs. But as long as $c \leq f^{\max}$, both loans may be originated. If $c \leq f^{\max} < f_{\text{BM}}$, both loans are originated at $f^{\max}$, yielding a net broker surplus of $f^{\max} - c$. In this scenario, fees no longer reveal unobserved mortgage risk. If $f^{\max} \geq f_{\text{BM}}$, the first borrower's loan will be originated at $(\nu - o)_{BM}$ whereas the second borrower's loan will be originated at $\min(f^{\max}, \nu - o)$. As shown in Figure 5, either both or neither loan will be originated, assuming similar costs for both borrowers. A necessary condition for a scenario in which it is possible to exclude only the second borrower from access to mortgage credit is that it is more costly for the broker to work with the second borrower.

[Figure 5 about here]

While the exclusion of high-fee loans is unlikely to guarantee that loans with unobserved mortgage risk will not enter the loan pool, such restriction may very well lead to lower marginal broker profits. In the scenario depicted in the left panel of Figure 5, a broker that originates the second borrower's loan no longer obtains all of the joint surplus. Instead, a portion equal to $\nu - o - f^{\max}$ now goes to the borrower. A similar result would apply for the first borrower if $(\nu - o)_{\text{BM}} - f^{\max} > 0$. From an anti-predatory lending point of view, setting $f^{\max}$ so that $c < f^{\max} < \nu - o$ would effectively lower the broker's bargaining power, and protect borrowers form being overcharged.

*4.2. Setting mortgage rates as a function of fees*

The second approach we consider sets rates as a function of broker fees. Assume that, all else the same,

$$\text{mortgage rate} \quad = \quad \begin{cases} r, & \text{if fee} \leq f^{\max} \\ r_h > r, & \text{if fee} > f^{\max}. \end{cases}$$

The broker learns the borrower's reservation values $\nu(r) - o(r)$ and $\nu(r_h) - o(r_h)$. If the borrower only shops from one broker, it is likely that his reservation value of the fees is larger at $r$ than at $r_h$.[14]

The right panel of Figure 5 describes two different scenarios. In one case, there is a moderate increase in interest rates, $r_h = r_{h,1}$ that yields $\nu(r) - o(r) > \nu(r_{h,1}) - o(r_{h,1}) > f^{\max}$. In this case, the loan gets originated at the higher rate $r_{h,1}$ and a fee of $\nu(r_{h,1}) - o(r_{h,1})$. But if the jump in rate $r_h = r_{h,2}$ is such that $\nu(r) - o(r) > \nu(r_{h,1}) - o(r_{h,1}) > f^{\max}$, then the loan is originated with the lower rate $r$ and fee $f^{\max}$, as long as the difference in reservation values, $f^{\max} - (\nu(r_{h,2}) - o(r_{h,2}))$ is not offset by a lower marginal cost for the high-rate loan. In this case, the broker cannot achieve all of the borrower's reservation value of the fees, but at most a portion $f^{\max}$ of it. The lender or investor does receive no additional compensation for loans that are riskier than the benchmark loan.[15] In other words, setting mortgage rates as a function of broker fees does not necessarily preclude brokers from originating the same loans as before. As a result, such a proposal would not necessarily benefit to the lender or investor.

*4.3. Performance based funding decisions for brokered loans*

An alternative way for lenders to incentivize mortgage brokers to reveal otherwise unobserved mortgage risk would be to track past broker performance and deny loan applications submitted by brokers with abnormally high default rates in the past. While such a rule may in theory prevent brokers from originating conditionally riskier loans, it may be difficult to enforce. In our data, the average broker originated a loan for New Century only four times over a 10-year period. That does not seem to leave enough time for lenders to build broker-by-broker performance statistics.

[14] In this case, the outside option of not getting the house remains the same, but now the value of future mortgage payments increases.

[15] In each case, we assume that marginal costs are covered.

*4.4. Profit sharing*

Since limits on origination charges, ee-based rate schedule or performance-based funding decisions may not be effective in exploiting the conditional link between broker revenues and delinquency risk that we uncover, we offer a proposal for discussion that would ensure at least some degree of risk sharing between the broker and the lender. Consider a scenario where the broker discloses the fee $f$ she is charging the borrower to the lender. Instead of setting rates as a function of $f$, the broker receives only a portion $f^{\max}$ of $f$ at the time closing documents are signed. The remaining amount, $f - f^{\max}$, is held in trust by the lender or a third party for $m$ months or until the loan becomes delinquent for the first time, whichever occurs first. If the loan does not become delinquent within $m$ months of origination, the accrued value of $f - f^{\max}$ is paid to the broker, otherwise that amount goes to the lender. The waiting period of $m$ months can be set as a function of the broker's past performance with the lender, among other variables. By setting $f^{\max}$ equal to a benchmark conditional broker fee, this approach exploits the unobserved heterogeneity in broker charges to reduce the lender's risk exposure. For loans that are sold and securitized, it is in the interest of secondary market investors to incentivize lenders to disclose origination charges together with other observable characteristics, or to pass along payouts from the excess fees in the event of an early delinquency.

# 5. The QRM Proposal

Given that broker charges inform about delinquency risk, and in light of our discussion on how lenders and investors may use that information, we are now interested to understand how effective recent regulatory proposals that limit loan origination charges are in reducing delinquency risk. In April 2011, the Agencies released a joint notice of their proposed Qualified Residential Mortgage definition. The main goal was to establish stringent guidelines to ensure that QRM loans have "low credit risk even in stressful economic environments that combine high unemployment with sharp drops in house prices" (Department of Treasury (2011)). The proposed QRM definition can be summarized in the form of eight rules that are listed in Table 7.

[Table 7 about here]

QRM Rule 8 is the one of interest to us. It stipulates that origination charges payable by the borrower in connection with the mortgage transaction may not exceed 3% of the

loan amount. The term "origination charges" includes *(i)* all compensation paid directly or indirectly by the borrower or lender to the mortgage originator, *(ii)* finance charges as defined under Regulation Z (12 CFR 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 (12 CFR 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 the origination charges defined in Regulation Z (12 CFR section 226.4). 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. We believe that the observed broker revenues account for the vast majority of the borrower's origination charges. Our data suggests that additional fees, such as credit insurance premia, debt cancellation or suspension fees, or prepayment penalties for a previous loan held by the same lender, account—when reported—for only a small portion of the borrower's cash charges.

In addition, QRM Rules 1 through 7 restrict QRM eligibility to mortgages secured by a first lien on a one-to-four family residential property to be purchased or refinanced by an owner making the property his 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.

The QRM rules have not yet been written into law.[16] Only few empirical results are available regarding the potential impact of the proposed restrictions. The initial proposal by the Agencies (Department of Treasury (2011)) investigates the potential impact of restrictions 2, 4, and 7 as stand-alone rules, whereas the U.S. Government Accountability Office (GAO (2011)) performs a similar analysis for Rules 1, 3 and 7. Our paper is the first to study the implications of QRM Rule 8—both as a stand-alone rule and in association with QRM Rules 1 through 7—on loan performance and access to mortgage credit.

[16]The Agencies have actively been seeking public comments on their proposal. Such comments have 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.

# 6. Estimating Marginal Broker Costs

An integral part to understanding the potential impact of the proposed QRM restrictions is messuring the brokers reservation value, that is, her costs. In what follows, we consider a borrower $i$ and a broker $j$. The broker's cost is given by $c_{i,j} = c(i, j|X_i, X_j)$, where $X_i$ denotes the row vector of observable loan, property and borrower characteristics, and $X_j$ that of observable broker characteristics. As for the latter, New Century tracked past broker activity by recording the broker-specific number of loan applications submitted in the previous month, as well as the volume of submitted loans. Similarly, the number and volume of funded loans was recorded. Such variables measure the strength of the relationship between the lender and a wholesale broker. In our empirical analysis, we use a time-variant binary variable to distinguish between two types of brokers. At any point in time, "active brokers" are those who submitted three or more loan applications in the previous month and "inactive brokers" are those who submitted no more than two applications. Our results are robust, however, to alternative specifications of broker-lender relationship variables.

Equation (4) relates observed broker revenues to costs, conditional on the borrower's shopping behavior. Borrower shopping efforts, however, cannot be observed directly. A recent survey by the Board of Governors (2009) finds that many but not all borrowers shop from only one broker. Given $X_i$, $X_j$ and the lender's yield spread schedule, the broker revenue distribution should therefore be thought of as a mixture of two unknown distributions—those of broker costs and of the borrower's net surplus from obtaining the mortgage—with unknown proportions. Isolating broker costs from revenues on a loan-by-loan basis would require strong parametric assumptions. In an attempt to trade off the need for cost estimates against the pitfalls of potential model misspecification, we offer results for a range of specifications.

Specifically, we consider cost functions

$$c(i, j|X_i, X_j) \quad = \quad (1 - \alpha)\, c_0(X_i, X_j) + \alpha\, c_1(i|X_i, X_j), \qquad \text{for } \alpha \in [0, 1], \tag{7}$$

where $c_0(X_i, X_j)$ corresponds to the conditional cost estimate for the case where borrowers shop from only one broker and there is no unobserved heterogeneity in broker costs, and $c_1(i, X_i, X_j)$ corresponds to cost estimates for the case where borrowers shop from two or more brokers of the same type. As noted in Section 1.2, we assume that broker costs for borrower $i$ are the same across brokers of type $X_j$. Given $X_i$ and $X_j$, Equation (7) allows for unobserved heterogeneity in broker costs across borrowers.

In the absence of any measurement errors, $c_0(X_i, X_j)$ is less or equal to the minimum

broker revenue observed for a given $X_i$ and $X_j$. A robust estimation strategy is to identify $c_0(X_i, X_j)$ as a low quantile of the conditional broker revenue distribution (Liu, Laporte, and Ferguson (2007)). We set $c_0(X_i, X_j) = q_{0.05}(X_i, X_j)$, where $q_{0.05}(X_i, X_j)$ denotes the $5^{th}$ quantile of the conditional broker revenue distribution. It is estimated by fitting

$$q_{0.05}(X_i, X_j) \quad = \quad \gamma_0 + (X_i, X_j)\,\gamma', \tag{8}$$

where $\gamma_0$ is a scalar and $\gamma$ is a row vector of coefficients. Using the quantile regression in (8) to estimate broker costs can be regarded as a compromise between non-parametric data envelopment analysis (DEA, see Behr (2010)) and purely parametric stochastic frontier analysis (SFA). Quantile regression is a semi-parametric approach, which requires an assumption about the structural form of the cost function (like SFA but unlike DEA), but does not require the imposition of a particular form on the profit distribution (like DEA but unlike SFA).

The cost estimates for $c_1(i|X_i, X_j)$ are equal to observed broker revenues. Results for $\alpha = 0, 0.25, 0.5, 0.75$ and 1 are presented in Tables 8 and 9. Table 8 shows that average dollar cost estimates range from 2.2K per loan for $\alpha = 0$ to 5.3K for $\alpha = 2$, whereas average percentage costs range from 1.4% for $\alpha = 0$ to 3.2% for $\alpha = 1$. Independent of $\alpha$, costs are increasing and concave in the loan amount. These results support the notion that there are certain fixed costs associated with loan originating, as we observe sizable costs even for the smallest loans. After controlling for loan amount, Table 9 reveals that it is slightly more costly to originate cash out refi loans, more complex loans, piggyback loans, loans for borrowers of lower credit quality, and loans originated in neighborhoods with a higher percentage of minorities. Costs are estimated to be somewhat higher for primary residences than for second homes or investment properties, and for loans that are originated by active vs inactive brokers. We believe that the latter is due to the fact that active brokerage firms are often larger firms with more overhead.

[Tables 8 and 9 about here]

As a robustness check we re-estimate broker costs conditional on different strata of loans. We form subsets of loans for active vsinactive brokers originating small ($\leq$ 100K), medium ($(100, 300]$) and large ($>$ 300K) loans.[17] The (untabulated) results show a similar distribution of cost estimates whether of not the model is estimated on the full sample or on the stratified

[17]For small-loan subsamples, the benchmark loan has a size between 75 and 100K. For large-loan subsamples, the benchmark loan has a size between 300 and 500K.

sample. This indicates that our model specification is robust to including interaction terms with loan size and broker activity.

# 7. The Potential Impact of QRM Rule 8

The top panel of table 10 reports descriptive statistics for two sets of loans: those with broker costs of 3% or less of the loan amount, and those with costs in excess of 3%. For the case where borrowers shop from two or more brokers, 52% of the loans have costs below the 3% cutoff. Higher percentage cost loans were more likely to become delinquent when compared to lower percentage cost loans, with average 12-month delinquency rates of 16% and 11% respectively. Low cost loans are generally associated with borrowers with higher Fico scores and higher income who purchase or refinance homes in less diversified neighborhoods with a higher percentage of college graduates. The most dramatic difference, however, comes from a comparison across the size of the loans. Mortgages with costs in excess of 3% of the loan amount have an average loan size of 140K, whereas lower percentage cost loans have an average size of over 236K.

[Table 10 about here]

The top panel of Table 10 reports similar descriptive statistics for alternative cost estimates. As $\alpha$ in Equation (7) shifts from one to zero, fewer and fewer loans are estimated to have costs in excess of the 3% cap. At the same time, the gap in loan size, Fico scores, borrower income, neighborhood characteristics and delinquency rates for QRM8 vs non-QRM8 loans widens. For the case where borrowers shop from only one broker and there is no unobserved heterogeneity in broker costs, the average loan size is 193K for QRM8 loans compared to 58K for non-QRM8 loans.

The bottom panel of Table 10 reports descriptive statistics for QRM Rules 1 through 7. Each of the proposed rules has at least some success in reducing delinquency rates. Rules 3 and 7 are the most restrictive ones. Rule 3 alone would have kicked out more than 95% of the loans, largely due to the fact that is prohibits prepayment penalties (which were found for almost 80% of the loans), and because it requires hybrid loans to have a lifetime cap on rate increases of 6%, whereas that cap was set equal to 7% for most of the hybrid loans originated by New Century. Interestingly, when compared to Rule 8, none of these other rules create the same kind of spread in loan size, borrower income and neighborhood characteristics between QRM and and non-QRM loans.

*7.1. QRM Rule 8 acts mainly as a size rule*

Our initial findings in Table 10 motivate us to analyze the link between percentage revenue, loan amount and delinquency risk more closely. The middle plot in Figure 1 shows that the smallest loans are generally the riskiest ones. There appears to be a U-shape across the size dimension, with medium-sized loans being significantly less risky than smaller mortgages and somewhat less risky than larger ones. The right figure shows that smaller loans usually pay higher percentage broker revenues than larger ones. As a result, we observe significant variation in credit risk across loans with different percentage broker revenues. While the average delinquency rate across all loans in our sample is 13.3%, the left panel of Figure 1 shows that delinquency rates are lowest at about 10% for loans with low revenues (1-2% of loan amount), and are highest at over 19% for loans with high revenues (more than 5% of loan amount). Interestingly, the average delinquency rate for loans with percentage revenues of less than 1% is slightly higher than that for loans with revenues of 1-2%, which is consistent with somewhat higher delinquency rates among very large, low percentage revenue loans. It may also be due to some extremely cash constrained borrowers obtaining small-cost loans.

Table 11 shows that any risk reduction that is achieved by QRM Rule 8 is achieved by restricting access to mortgage credit for small loans. Limiting percentage revenues to 3% of the loan amount is more binding for small loans than for medium or large loans. Using the $25^{th}$ percentile of the conditional broker revenue distribution as a benchmark, we find that the restriction is violated for 58% of all loans between 75 and 100K, but for less than 8% of the medium-sized and large loans. As a result, the decrease in delinquency rates when restricting the sample to loans with revenues of no more than 3% is more pronounced for small loans. For example, 12-month delinquency rates for loans between 75 and 100K fall from 18.8% to 14.8% when loans with percentage revenues in excess of 3% are excluded, whereas they remain nearly unchanged for loans of 100K or more.

[Table 11 about here]

Overall, excluding loans with percentage revenues in excess of 3%, that is loans that ex post did not satisfy QRM Rule 8, lowers 12-month delinquency rates from 13.3% to 12.2% for the benchmark $q_{0.25}^{\text{Rev}}$ cost estimates. At least in retrospect for the New Century loan pool, QRM8 as a stand-alone rule would have been only moderately successful in reducing credit risk. Any reduction in risk that would have been achieved would largely have been due to restricting access to mortgage credit for small loans. In that sense, QRM Rule 8 acts mainly

as a size rule. After controlling for size, it is ineffective in identifying loans with negative soft information and does not warrant that these will not enter the loan pool.

For comparison purposes, we also report the effect of other proposed QRM rules on delinquency rates. The lower panel in Table 11 shows, for each size bin, the fraction of loans that satisfy certain other QRM rules, together with the average 12-month delinquency rates among those loans. While QRM rules 3 and 7 seem to be most effective in reducing average delinquency rates, none of these other rules introduce a comparable bias against small loans when compared to QRM8.

### *7.2. Profit contraction for QRM8 loans*

While the stated goal of the QRM criteria is to identify low-credit-risk loans, limits on origination charges have historically been imposed to fight predatory lending practices and protect borrowers from being overcharged.[18] 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), among others). Table 12 shows that QRM8 reduces average marginal broker profits by as much as $719 per loan, depending on the broker cost estimates used. As the assumption underlying the cost estimates shifts from borrowers shopping form only one broker and no unobserved heterogeneity in broker costs ($c_0$) to all borrowers shopping from at least two brokers ($c_1$), loans below 100K show a smaller and smaller reduction in profits due to Rule 8. For medium size and especially for larger loans, the achieved reduction in profits is less sensitive to the cost estimate and simply stems from the difference between realized and maximum permissible revenues. This is due to the fact that almost no large loans are banned from the loan pool, and that their revenue is simply capped. For smaller loans, the effects of limiting revenues are compounded by excluding higher cost loans from the sample.

[Table 12 about here]

The reduction in dollar profits for medium-sized and large loans is comparable, if not smaller, than that achieved for small loans. Imposing QRM8 therefore does not reduce the profit differential between large and small loans in any significant way. Unless it is significantly more costly for brokers to identify borrowers buying larger homes, larger loans would remain substantially more profitable when compared to smaller ones, and incentives

[18] For a summary of HOEPA, state and agency high cost loan policies, see Community Mortgage Funding (2010). Freddie Mac's anti-predatory lending requirements are available at http://www.freddiemac.com/learn/pdfs/uw/Pred_requirements.pdf.

would still exist for brokers to steer borrowers towards larger homes, or to cater to the large home buyer.

*7.3. Stress testing alternative specifications for QRM Rule 8*

Finally, we consider an alternative specification of the Proposed QRM Rule 8. It restricts loan origination charges to 3% of the loan amount for loans of size 100K 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 6K, 8K and 9K for loans of size 200K, 300K and 400K.

As shown in Figure 7, the alternative specification is identical to the Proposed Rule for loans of 100K or less. Delinquency rates among small loans that satisfy the alternative restriction will therefore be the same as those reported in the top panel of Table 11. Medium-sized and large loans face a tighter constraint under the alternative specification when compared to the Proposed Rule. But as the results in the bottom panel of Table 11 show, the lower cap on origination charges excludes only few additional loans, except for the most conservative cost estimates. Specifically, the fraction of loans that satisfy the alternative QRM8 rule 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 $c_1$, respectively. This compares to 97.5%, 92.3%, 79.8%, 64.8% and 51.9% for the Proposed Rule. Average 12-month delinquency rates are no higher under the alternative QRM8 specification than under the Proposed Rule. If anything, for cost estimates $c_{0.5}$, $c_{0.75}$ and $c_1$, they are somewhat lower at 11.8%, 11.0% and 10.7% for the alternative rule compared to 11.9%, 11.4% and 11.0% for the original rule.

[Figure 7 about here]

While our concave ceiling to origination charges is unlikely to limit access to mortgage credit beyond the restrictions imposed by QRM Rule 8, and while it will keep delinquency risk at similar if not lower levels, it yields substantially lower marginal broker profits for medium-sized and large loans. The bottom panel in Table 12 shows that the reduction in broker profits achieved by the alternative QRM8 specification is more equally spread out across loans of all sizes. For the case where borrowers only shop from one broker and there is no unobserved heterogeneity in broker costs, i.e. for cost estimate $c_0$, percentage broker profits are reduced by 56, 35, 32 and 24 basis points for loans of $(100, 200]$K, $(200, 300]$K, $(300, 500]$K and more than 500K as a results of the alternative QRM8 specification, compared to a 56, 28, 12 and 0 basis point reduction for the Proposed QRM Rule 8. Whereas the latter rule is not effective in narrowing the profit differential between large and small loans, our

alternative specification is. Using the $c_0$ cost estimate, under QRM8 average per-loan profits are reduced by 0.960K from 1.569K to 0.609K for the smallest loans and by 0.018K from 7.240K to 7.222K for the largest loans.[19] Under the alternative specification profits are reduced by 0.960K from 1.569K to 0.609K for the smallest loans and by 1.518K from 7.240K to 5.722K for the largest loans. Under the alternative specification, borrowers of large loans are now better protected from leaving too much money on the table.

# 8. Conclusion

Based on a sample of more than 600,000 subprime loans that were originated by independent mortgage brokers and funded by New Century, we show that borrowers were charged higher broker fees for loans that turned out to be riskier ex post. All else the same, an increase in broker fees by 1% of the loan amount is associated with a 7% higher odds ratio of early delinquency. Brokers may charge abnormally high fees in situations where the borrower shops from too few brokers and is confused about the terms of the loan, is overly optimistic about the potential resale value of the house, underestimates the costs of refinancing the loan or of declaring bankruptcy, or has negative private information about his future financial situation. We discuss several approaches designed to incorporate fee-based information into the loan contract—including imposing limits on origination charges—but voice our concerns as to their effectiveness in terms of identifying loans with unobserved mortgage risk. Instead, we propose a strategy where the borrower and broker agree on a fee $f$ but only a portion $f^{\max}$ of that fee is paid at closing. Excess fees $f - f^{\max}$ are placed in a trust for a certain number of months or until delinquency, whichever occurs first. If there is no default, the accrued value of $f - f^{\max}$ is paid to the broker, otherwise that amount goes to the lender or investor. This approach ensures some degree of risk-sharing between the broker and the lender or investor, and does so without imposing additional constraints on access to mortgage credit.

The relationship between broker compensation and mortgage credit risk that we uncover is especially relevant in light of recent regulatory proposals that aim to establish guidelines for identifying low credit risk loans. The Qualified Residential Mortgage definition proposed jointly by several government agencies in April 2011 stipulates in Rule 8 that origination charges payable by the borrower in connection with the mortgage transaction may not exceed 3% of the loan amount. While we believe that such restriction is unlikely to identify loans with abnormally high broker fees—and hence is unlikely to exploit the relationship

[19] To conserve space, Table 12 only reports the reduction in profits, but not the profits with and without restrictions. Average profits achieved in the absence of any restrictions are reported in Table 8.

between unobserved variation in broker fees and mortgage risk that we uncovered—it may still decrease mortgage credit risk as long as high broker fees are indicative of certain other risk characteristics. Indeed, we find that the proposed 3% limit acts mainly as a size rule. It achieves some success in reducing delinquency risk by restricting access to mortgage credit for small loans. Small loans are more prevalent among borrowers with low income that purchase or refinance homes in neighborhoods with a higher percentage of minorities and a lower percentage of college graduates. After controlling for size, QRM Rule 8 is less effective in identifying loans with unobserved mortgage risk.

Limits on origination charges have historically been imposed to fight predatory lending, and to protect borrowers from being overcharged. We show that QRM Rule 8 reduces marginal broker profits by as much as $700 per loan, depending on the broker cost estimates. It does not, however, reduce the profit differential between large and small loans. Unless it is significantly more costly for brokers to identify borrowers buying bigger houses, larger loans remain substantially more profitable when compared to smaller ones, and incentives would still exist for brokers to steer borrowers towards larger homes, or to cater to the large home buyer. We offer a roadmap for stress testing alternative specifications for QRM Rule 8, and show that a concave ceiling on origination charges would be more effective in protecting large borrowers from overpaying.

While the subprime mortgage market came to a virtual standstill following the 2007-8 crisis, recent forecasts predict regained allure of mortgage backed securities. Money is starting to flow back into mortgage securities, and trading is surging again (Ahmed (2012)). The link between broker compensation and mortgage credit risk that we uncover contributes to the ongoing discussion of the proposed credit risk retention rules and the QRM exemption criteria. While excess fees indicate that the borrower is being overcharged relative to the average borrower, they also reveal a higher likelihood of mortgage default. If the objective is to fight predatory lending, a concave ceiling to origination charges is more effective than the proposed linear cap. If the goal is reduce exposure to mortgage risk, a delay in the payment of excess broker fees is recommended.

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Table 1: **List of Variables**

| Variable | Description |
|---|---|
| | *Loan Characteristics* |
| Rate | Initial mortgage rate in % |
| Loan amount | Loan amount in thousands of dollars |
| Hybrid | Indicator for 2/28 or 3/37 loans |
| FRM | Indicator for 15-, 20- or 30-year fixed-rate mortgages |
| Balloon/IO | Indicator for mortgages with a balloon or interest-only payments |
| Piggyback | Indicator for a matched pair of a 1st and a 2nd lien loan* |
| Limited or stated doc | Indicator for a limited or 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 first lien 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 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* |
| Housing per broker | Number of housing units in zip code (in thousands) divided by the number of brokers with loan applications in zip |
| Active broker | Indicator for brokers with three or more loan applications in previous month |
| | *Neighborhood Characteristics* |
| Race | % white population in zip code |
| Education | % of population with a BA degree |
| | *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) |

* For details, see Appendix A.

** Obtained from the St. Louis Fed data website at research.stlouisfed.org/fred2/series/MORTG/.

Table 2: **Descriptive Statistics** The table reports descriptive statistics for our sample of broker originated loans that were funded by New Century 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 (×1000)* | | | | | | |
| 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 |
| Limited or stated 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 |
| limited or stated 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 Compensation** The table reports average per-loan broker fees, YSP and revenues. The top panel reports 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), documentation style (full, limited/stated), Fico score ($< 620$, $\geq 620$), and prepayment penalty (no PP, PP).

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | All | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | *Percent of loan amount* | | | | | | |
| Direct 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)* | | | | | | |
| Direct 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 | L/Std | <620 | ≥620 | nPP | PP |
| | | | | | | *Dollar per loan (×$1,000)* | | | | | | |
| | | | | | | *Loan amount ≤ 50K* | | | | | | |
| Direct 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* | | | | | | |
| Direct 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* | | | | | | |
| Direct 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* | | | | | | |
| Direct 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* | | | | | | |
| Direct 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* | | | | | | |
| Direct 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* | | | | | | |
| Direct 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 Broker Revenues and Fees** The table reports the parameter estimates for regressions of broker revenues, in dollars per loan (first column) and as a percentage of the loan amount (second column), on observable loan, property, borrower and broker characteristics. SImilar results are reported for direct broker fees in columns three and four. The benchmark set contains all full documentation no-prepay-penalty 2/28 loans between 100 and 200K taken out by a borrower with risk grade AA or better and a Fico score between 600 and 620 to purchase a single unit primary residence, originated in CA in 2006. Our data include 668,582 loans originated between 1997 to 2006.

| | Revenues (×$1,000) | | Revenues (%) | | Fees (×$1,000) | | Fees (%) | |
|---|---|---|---|---|---|---|---|---|
| YSP (×$1,000) | | | | | -0.338 | (0.002) | | |
| YSP (%) | | | | | | | -0.274 | (0.002) |
| Loan amt $\leq 50K$ | -1.880 | (0.088) | 1.450 | (0.009) | -1.236 | (0.081) | 1.521 | (0.009) |
| Loan amt $\in (50K, 75K]$ | -1.346 | (0.074) | 0.806 | (0.006) | -0.895 | (0.068) | 0.894 | (0.005) |
| Loan amt $\in (75K, 100K]$ | -0.487 | (0.092) | 0.447 | (0.005) | -0.251 | (0.085) | 0.481 | (0.005) |
| Loan amt $\in (200K, 300K]$ | 0.602 | (0.055) | -0.298 | (0.004) | 0.447 | (0.051) | -0.370 | (0.004) |
| Loan amt $\in (300K, 500K]$ | 3.684 | (0.052) | -0.536 | (0.005) | 2.774 | (0.048) | -0.649 | (0.005) |
| Loan amt $> 500K$ | 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 | -0.174 | (0.088) | 2.084 | (0.046) | 2.077 | (0.082) | 2.983 | (0.043) |
| $R^2$ | 0.507 | | 0.419 | | 0.405 | | 0.378 | |

*Additional control 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, Limited or stated doc, Piggyback, Dummies for Refi with cash out and Refi with no cash out, Dummies for LTV $\leq 0.65$, LTV $\in (0.65, 0.70]$, $(0.70, 0.75]$, $(0.80, 0.85]$, $(0.85, 0.90]$, $(0.90, 0.95]$ and $(0.95, 1]$, Dummies for 2nd home/investment prop and Multi units

*Borrower Characteristics:* Dummies for Fico $\in [500, 525)$, $[525, 550)$, $[550, 575)$, $[575, 600)$, $[620, 640)$, $[640, 660)$, $[660, 680)$, $[680, 700)$, $\geq 700$, Back-end 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 1997 through 2005, Dummies for FL, TX, West w/o CA, South w/o FL and TX, MidWest, NorthEast and Non-metro area

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

| Specification | I | | II | | III | | IV | |
|---|---|---|---|---|---|---|---|---|
| | Est | Std dev | Est | Std dev | Est | Std dev | Est | Std dev |
| | | | | *Broker Compensation* | | | | |
| Revenue/loan amt (%) | | | 0.062 | (0.005) | | | | |
| Fees/loan amt (%) | | | | | 0.073 | (0.005) | | |
| full doc & Fico $< 600$ | | | | | | | 0.060 | (0.007) |
| full doc & Fico $\in [600, 620)$ | | | | | | | 0.097 | (0.015) |
| full doc & Fico $\in [620, 660)$ | | | | | | | 0.092 | (0.014) |
| full doc & Fico $> 660$ | | | | | | | 0.143 | (0.021) |
| low doc & Fico $< 600$ | | | | | | | 0.043 | (0.009) |
| low doc & Fico $\in [600, 620)$ | | | | | | | 0.094 | (0.016) |
| low doc & Fico $\in [620, 660)$ | | | | | | | 0.119 | (0.013) |
| low doc & Fico $> 660$ | | | | | | | 0.170 | (0.017) |
| YSP/loan amt (%) | | | | | -0.002 | (0.011) | 0.000 | (0.011) |
| | | | | *Loan and Property Characteristics* | | | | |
| Rate-6mo LIBOR | 0.325 | (0.009) | 0.299 | (0.009) | 0.336 | (0.011) | 0.334 | (0.011) |
| NC points | 0.019 | (0.014) | 0.025 | (0.014) | 0.033 | (0.014) | 0.031 | (0.014) |
| Rate margin for hybrids | -0.080 | (0.019) | -0.078 | (0.019) | -0.083 | (0.019) | -0.084 | (0.019) |
| Loan amt $\leq 50K$ | -0.001 | (0.038) | -0.089 | (0.039) | -0.115 | (0.039) | -0.109 | (0.039) |
| Loan amt $\in (50K, 75K]$ | 0.073 | (0.022) | 0.026 | (0.023) | 0.009 | (0.023) | 0.012 | (0.023) |
| Loan amt $\in (75K, 100K]$ | 0.020 | (0.021) | -0.007 | (0.021) | -0.014 | (0.021) | -0.014 | (0.021) |
| Loan amt $\in (200K, 300K]$ | 0.149 | (0.020) | 0.166 | (0.020) | 0.175 | (0.020) | 0.178 | (0.020) |
| Loan amt $\in (300K, 500K]$ | 0.399 | (0.023) | 0.428 | (0.024) | 0.444 | (0.024) | 0.452 | (0.024) |
| Loan amt $> 500K$ | 0.741 | (0.046) | 0.794 | (0.046) | 0.806 | (0.046) | 0.834 | (0.047) |
| 3/27 | 0.039 | (0.026) | 0.046 | (0.026) | 0.042 | (0.026) | 0.043 | (0.026) |
| 30yr FRM | -0.805 | (0.113) | -0.765 | (0.114) | -0.835 | (0.114) | -0.832 | (0.114) |
| 20yr FRM | -0.990 | (0.149) | -0.961 | (0.149) | -1.036 | (0.149) | -1.038 | (0.149) |
| 15yr FRM | -1.093 | (0.133) | -1.059 | (0.133) | -1.129 | (0.133) | -1.130 | (0.133) |
| Balloon w/ adjustable rate | 0.075 | (0.026) | 0.077 | (0.026) | 0.061 | (0.026) | 0.061 | (0.026) |
| Balloon w/ fixed rate | -0.481 | (0.131) | -0.446 | (0.131) | -0.522 | (0.132) | -0.522 | (0.131) |
| Interest only | -0.131 | (0.024) | -0.119 | (0.024) | -0.132 | (0.024) | -0.121 | (0.024) |
| Prepay penalty | 0.136 | (0.017) | 0.110 | (0.017) | 0.119 | (0.017) | 0.116 | (0.017) |
| Limited or stated doc | 0.326 | (0.016) | 0.353 | (0.016) | 0.316 | (0.017) | 0.336 | (0.028) |
| Piggyback | 0.627 | (0.027) | 0.650 | (0.028) | 0.644 | (0.028) | 0.667 | (0.028) |
| Refi w/ cash out | -0.401 | (0.016) | -0.425 | (0.017) | -0.435 | (0.017) | -0.433 | (0.017) |
| Refi w/o cash out | -0.245 | (0.023) | -0.255 | (0.023) | -0.261 | (0.023) | -0.260 | (0.023) |
| LTV $\leq 0.65$ | -0.397 | (0.031) | -0.424 | (0.031) | -0.405 | (0.031) | -0.398 | (0.031) |
| LTV $\in (0.65, 0.70]$ | -0.192 | (0.032) | -0.212 | (0.032) | -0.201 | (0.032) | -0.195 | (0.032) |
| LTV $\in (0.70, 0.75]$ | -0.111 | (0.026) | -0.122 | (0.026) | -0.117 | (0.026) | -0.115 | (0.026) |
| LTV $\in (0.80, 0.85]$ | 0.111 | (0.021) | 0.122 | (0.021) | 0.109 | (0.021) | 0.106 | (0.021) |
| LTV $\in (0.85, 0.90]$ | 0.183 | (0.023) | 0.207 | (0.023) | 0.182 | (0.023) | 0.182 | (0.023) |
| LTV $\in (0.90, 0.95]$ | 0.067 | (0.037) | 0.100 | (0.037) | 0.060 | (0.038) | 0.069 | (0.038) |

Continued on next page

**Table 5 – continued from previous page**

| Specification | I | | II | | III | | IV | |
|---|---|---|---|---|---|---|---|---|
| | Est | Std dev | Est | Std dev | Est | Std dev | Est | Std dev |
| LTV $\in (0.95, 1]$ | 0.204 | (0.064) | 0.252 | (0.064) | 0.180 | (0.065) | 0.195 | (0.065) |
| 2nd home/investment prop | 0.010 | (0.023) | 0.022 | (0.023) | -0.008 | (0.024) | -0.006 | (0.024) |
| Multi units | 0.009 | (0.027) | 0.010 | (0.027) | 0.007 | (0.027) | 0.007 | (0.027) |
| *Borrower Characteristics* | | | | | | | | |
| Fico $\in [500, 525)$ | 0.719 | (0.030) | 0.740 | (0.030) | 0.692 | (0.031) | 0.807 | (0.046) |
| Fico $\in [525, 550)$ | 0.611 | (0.028) | 0.626 | (0.028) | 0.593 | (0.029) | 0.706 | (0.044) |
| Fico $\in [550, 575)$ | 0.432 | (0.027) | 0.439 | (0.027) | 0.419 | (0.027) | 0.530 | (0.042) |
| Fico $\in [575, 600)$ | 0.239 | (0.025) | 0.243 | (0.025) | 0.231 | (0.025) | 0.331 | (0.040) |
| Fico $\in [620, 640)$ | -0.175 | (0.027) | -0.177 | (0.027) | -0.172 | (0.027) | -0.200 | (0.045) |
| Fico $\in [640, 660)$ | -0.400 | (0.030) | -0.404 | (0.030) | -0.394 | (0.030) | -0.427 | (0.046) |
| Fico $\in [660, 680)$ | -0.618 | (0.035) | -0.623 | (0.035) | -0.610 | (0.035) | -0.738 | (0.054) |
| Fico $\in [680, 700)$ | -0.815 | (0.044) | -0.823 | (0.044) | -0.804 | (0.044) | -0.931 | (0.060) |
| Fico $\geq 700$ | -0.997 | (0.041) | -1.005 | (0.041) | -0.988 | (0.041) | -1.115 | (0.057) |
| Debt-to-income ratio | 0.006 | (0.001) | 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) | 0.169 | (0.022) |
| Risk grade A- | 0.215 | (0.025) | 0.228 | (0.025) | 0.209 | (0.025) | 0.210 | (0.025) |
| Risk grade B | 0.506 | (0.028) | 0.523 | (0.028) | 0.493 | (0.029) | 0.496 | (0.029) |
| Risk grade C | 0.728 | (0.035) | 0.762 | (0.035) | 0.703 | (0.036) | 0.711 | (0.036) |
| *Broker Variables* | | | | | | | | |
| Broker competition | 0.002 | (0.002) | 0.002 | (0.002) | 0.001 | (0.002) | 0.002 | (0.002) |
| Active broker | 0.033 | (0.014) | 0.014 | (0.014) | 0.012 | (0.014) | 0.012 | (0.014) |
| *Neighborhood and Regulation Variables* | | | | | | | | |
| Race | -0.003 | (0.000) | -0.002 | (0.000) | -0.002 | (0.000) | -0.002 | (0.000) |
| Education | -0.009 | (0.001) | -0.008 | (0.001) | -0.007 | (0.001) | -0.007 | (0.001) |
| Regulation (coverage) | -0.005 | (0.003) | -0.003 | (0.003) | -0.001 | (0.003) | -0.001 | (0.003) |
| Regulation (brokers, Pahl) | -0.012 | (0.003) | -0.011 | (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) | 0.359 | (0.027) |
| 30yr fix mortg rate-6mo LIBOR | 0.029 | (0.028) | 0.033 | (0.028) | 0.036 | (0.028) | 0.037 | (0.028) |
| House prices | -0.011 | (0.002) | -0.012 | (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) | -0.989 | (0.046) |
| 2000 | -1.102 | (0.059) | -1.127 | (0.059) | -1.162 | (0.059) | -1.152 | (0.059) |
| 2001 | -0.515 | (0.047) | -0.517 | (0.047) | -0.550 | (0.048) | -0.543 | (0.048) |
| 2002 | -0.524 | (0.065) | -0.533 | (0.064) | -0.544 | (0.065) | -0.540 | (0.065) |
| 2003 | -0.452 | (0.063) | -0.462 | (0.063) | -0.455 | (0.063) | -0.452 | (0.063) |
| 2004 | -0.250 | (0.052) | -0.270 | (0.052) | -0.244 | (0.052) | -0.243 | (0.052) |
| 2005 | -0.032 | (0.031) | -0.054 | (0.031) | -0.027 | (0.031) | -0.027 | (0.031) |
| FL | -0.064 | (0.035) | -0.068 | (0.035) | -0.060 | (0.035) | -0.058 | (0.035) |
| TX | 0.076 | (0.039) | 0.069 | (0.039) | 0.088 | (0.039) | 0.084 | (0.039) |
| WestnoCA | 0.119 | (0.030) | 0.127 | (0.030) | 0.137 | (0.030) | 0.137 | (0.030) |
| SouthnoFLTX | 0.288 | (0.029) | 0.279 | (0.029) | 0.283 | (0.029) | 0.281 | (0.029) |
| MidWest | 0.303 | (0.028) | 0.293 | (0.029) | 0.299 | (0.029) | 0.299 | (0.029) |
| NorthEast | 0.217 | (0.026) | 0.205 | (0.027) | 0.212 | (0.027) | 0.211 | (0.027) |
| Nonmetro area | -0.002 | (0.022) | -0.005 | (0.022) | -0.006 | (0.022) | -0.005 | (0.022) |

Table 6: **Marginal Effect of Broker Fees on Loan Performance** The table shows the increase in the log proportional odds ratio associated with a one standard deviation increase in percentage broker fees, based on the estimates in the last two columns of Table 5. Standard deviations are computed conditional on loan amount, Fico score and documentation level. Our data include 668,582 loans originated between 1999 to 2006.

| | Loan amount (×$1,000) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $\leq 50$ | $(50, 75]$ | $(75, 100]$ | $(100, 200]$ | $(200, 300]$ | $(300, 500]$ | $> 500$ | All |
| Fico | *Full documentation* | | | | | | | |
| $< 600$ | 0.113 | 0.089 | 0.081 | 0.072 | 0.064 | 0.058 | 0.042 | 0.084 |
| $[600, 620)$ | 0.194 | 0.142 | 0.123 | 0.109 | 0.097 | 0.090 | 0.064 | 0.124 |
| $[620, 660)$ | 0.177 | 0.138 | 0.120 | 0.104 | 0.093 | 0.083 | 0.064 | 0.117 |
| $\geq 660$ | 0.299 | 0.224 | 0.184 | 0.163 | 0.144 | 0.127 | 0.098 | 0.183 |
| Fico | *Limited or stated documentation* | | | | | | | |
| $< 600$ | 0.078 | 0.065 | 0.060 | 0.053 | 0.047 | 0.041 | 0.031 | 0.059 |
| $[600, 620)$ | 0.184 | 0.136 | 0.123 | 0.110 | 0.097 | 0.088 | 0.066 | 0.121 |
| $[620, 660)$ | 0.227 | 0.173 | 0.151 | 0.132 | 0.117 | 0.102 | 0.079 | 0.142 |
| $\geq 660$ | 0.324 | 0.246 | 0.214 | 0.180 | 0.160 | 0.140 | 0.109 | 0.190 |

Table 7: **Proposed QRM Criteria** This tables summarizes the qualified residential mortgage requirements, as proposed by the Agencies in April 2011. In addition to the main criteria listed below, certain assumability prohibitions and default mitigations commitments apply. For details, see Department of Treasury (2011).

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

Table 8: **Broker Costs and Profits** The table reports average marginal broker costs and profits per loan. Columns labeled $\alpha = 0$ correspond to the case where borrowers shop from only one broker and there is no unobserved heterogeneity in broker costs. In this case, costs $c_0$ are estimated as the $5^{th}$ quantile of the conditional broker revenue distribution. The columns labeled $\alpha = 1$ correspond to the case where borrowers shop from at least one other broker of the same type as the originating broker. In this case, costs $c_1$ are equal to observed revenues. Columns labeled $\alpha$, $0 < \alpha < 1$, correspond to the case where costs are given by $(1-\alpha)c_0 + \alpha c_1$. The top panel conditions on the year of origination, whereas the bottom panel conditions on the loan size.

| $\alpha$ | 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)* | | | |
| $\leq 50$ | 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* | | | |
| $\leq 50$ | 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 and profits per loan for the case where borrowers shop from only one broker and there is no unobserved heterogeneity in broker costs ($\alpha = 0$) and the case where borrowers shop from at least one other broker of the same type as the originating broker ($\alpha = 1$).

| | Loan amt $\leq$ 100K | | | Loan amt 100-300K | | | Loan amt $>$ 300K | | |
|---|---|---|---|---|---|---|---|---|---|
| | $c_0$ | $c_1$ | $\text{prft}_0$ | $c_0$ | $c_1$ | $\text{prft}_0$ | $c_0$ | $c_1$ | $\text{prft}_0$ |
| *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 |
| Limited or stated doc | 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 |
| *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 |
| *Broker variables* | | | | | | | | | |
| Low broker competition | 1.315 | 2.987 | 1.671 | 2.273 | 5.115 | 2.842 | 3.082 | 8.621 | 5.539 |
| High broker competition | 1.317 | 2.887 | 1.570 | 2.300 | 4.946 | 2.646 | 3.137 | 8.433 | 5.296 |
| 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 |
| *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: **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 group of loans that does not (second row). The first row for restriction QRM8-$c_\alpha$ refers to the set of loans for which broker costs estimated as $(1-\alpha)c_0 + \alpha c_1$ do not exceed 3% of the loan amount, whereas the second row refers to loans for which percentage costs exceed 3%. 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 11: **Delinquency Rates for QRM Loans** In the top panel, the first two columns report the distribution of loans across different size bins and the 12-month delinquency rates for each size bin, respectively. The third column shows the percentage of loans with percentage costs $c_0$ of 3% or less within each size bin, whereas the fourth column shows the average delinquency rate for those loans. Columns 5 through 12 report similar results, but with $c_0$ replaced by $(1-\alpha)c_0 + \alpha c_1$, for $\alpha = 0.25, 0.5, 0.75, 1$. The middle panel shows, for each size bin, the fraction of loans that satisfy certain other QRM rules, together with their average 12-month delinquency rates. The bottom panel shows the same statistics as in the top panel when QRM Rule 8 is replaced by the alternative specification described in Section 7.3.

| | Full sample | | QRM8-$c_0$ | | QRM8-$c_{0.25}$ | | QRM8-$c_{0.50}$ | | QRM8-$c_{0.75}$ | | QRM8-$c_1$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % 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 |

*Other QRM Rules*

| | QRM1 | | QRM2 | | QRM3 | | QRM4 | | QRM5 | | QRM7 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % 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 |

*Alternative QRM8 Specification*

| | QRM8alt-$c_0$ | | QRM8alt-$c_{0.25}$ | | QRM8alt-$c_{0.50}$ | | QRM8alt-$c_{0.75}$ | | QRM8alt-$c_1$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % 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 |

Table 12: **Profit Contraction for QRM Loans** The first eight rows report, for different measures of broker costs, the fraction of loans originated as QRM8 loans within each size bin, and the decrease in average dollar and in average percentage broker profits as a result of imposing QRM Rule 8. The next six rows show the fraction of loans originated, the decrease in average dollar broker profits and the decrease in average percentage broker profits as a result of jointly imposing two QRM rules. Results in the top panel pertain to the proposed QRM Rule 8, whereas results in the bottom panel are for the alternative specification described in Section 7.3.

| | % loans | $1,000 | % | % loans | $1,000 | % | % loans | $1,000 | % | % loans | $1,000 | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | QRM8-$c_0$ | | | QRM8-$c_{0.25}$ | | | QRM8-$c_{0.5}$ | | | QRM8-$c_{0.75}$ | | |
| (0,50] | 2.6 | 0.960 | 2.41 | 1.9 | 0.734 | 1.86 | 1.0 | 0.340 | 0.85 | 0.5 | 0.061 | 0.74 |
| (50,75] | 9.2 | 0.899 | 1.43 | 7.1 | 0.626 | 0.99 | 4.6 | 0.269 | 0.42 | 2.9 | 0.056 | 0.98 |
| (75,100] | 11.7 | 0.864 | 0.98 | 10.3 | 0.637 | 0.72 | 7.5 | 0.286 | 0.31 | 5.2 | 0.064 | 0.07 |
| (100,200] | 37.2 | 0.785 | 0.56 | 36.2 | 0.701 | 0.49 | 30.9 | 0.371 | 0.25 | 24.0 | 0.093 | 0.06 |
| (200,300] | 20.0 | 0.688 | 0.28 | 20.0 | 0.685 | 0.28 | 19.2 | 0.485 | 0.19 | 16.5 | 0.138 | 0.05 |
| (300,500] | 14.7 | 0.416 | 0.12 | 14.7 | 0.416 | 0.12 | 14.7 | 0.383 | 0.11 | 13.8 | 0.152 | 0.04 |
| >500 | 2.0 | 0.018 | 0.00 | 2.0 | 0.018 | 0.00 | 2.0 | 0.018 | 0.00 | 2.0 | 0.018 | 0.00 |
| All | 97.5 | 0.719 | 0.61 | 92.3 | 0.625 | 0.47 | 79.8 | 0.378 | 0.23 | 64.8 | 0.110 | 0.06 |
| | *Interaction with other QRM rules* | | | | | | | | | | | |
| QRM | | $c_0$ | | | $c_{0.25}$ | | | $c_{0.5}$ | | | $c_{0.75}$ | |
| 1 & 8 | 68.9 | 0.821 | 0.66 | 64.8 | 0.719 | 0.51 | 54.8 | 0.434 | 0.25 | 43.1 | 0.125 | 0.06 |
| 2 & 8 | 70.6 | 0.619 | 0.49 | 67.9 | 0.552 | 0.40 | 60.4 | 0.349 | 0.21 | 50.3 | 0.106 | 0.05 |
| 3 & 8 | 4.6 | 0.629 | 0.81 | 4.3 | 0.557 | 0.66 | 3.5 | 0.319 | 0.32 | 2.6 | 0.088 | 0.07 |
| 4 & 8 | 36.9 | 0.649 | 0.61 | 36.4 | 0.628 | 0.58 | 35.1 | 0.580 | 0.52 | 33.1 | 0.526 | 0.49 |
| 5 & 8 | 30.3 | 0.453 | 0.38 | 29.8 | 0.430 | 0.34 | 27.4 | 0.279 | 0.18 | 23.5 | 0.080 | 0.04 |
| 7 & 8 | 13.0 | 0.813 | 0.85 | 11.8 | 0.669 | 0.62 | 9.4 | 0.360 | 0.27 | 7.2 | 0.096 | 0.06 |
| | *Alternative QRM8 specification* | | | | | | | | | | | |
| | % loans | $1,000 | % | % loans | $1,000 | % | % loans | $1,000 | % | % loans | $1,000 | % |
| | QRM8alt-$c_0$ | | | QRM8alt-$c_{0.25}$ | | | QRM8alt-$c_0$.5 | | | QRM8alt-$c_{0.75}$ | | |
| (0,50] | 2.6 | 0.960 | 2.41 | 1.9 | 0.734 | 1.86 | 1.0 | 0.340 | 0.85 | 0.5 | 0.209 | 0.15 |
| (50,75] | 9.2 | 0.899 | 1.43 | 7.1 | 0.626 | 0.99 | 4.6 | 0.269 | 0.42 | 2.9 | 0.143 | 0.09 |
| (75,100] | 11.7 | 0.864 | 0.98 | 10.3 | 0.637 | 0.72 | 7.5 | 0.286 | 0.31 | 5.2 | 0.133 | 0.07 |
| (100,200] | 37.2 | 0.788 | 0.56 | 36.2 | 0.704 | 0.49 | 30.9 | 0.374 | 0.25 | 23.9 | 0.154 | 0.06 |
| (200,300] | 20.0 | 0.885 | 0.35 | 20.0 | 0.879 | 0.35 | 18.6 | 0.561 | 0.22 | 15.2 | 0.200 | 0.06 |
| (300,500] | 14.7 | 1.226 | 0.32 | 14.7 | 1.226 | 0.32 | 13.8 | 0.868 | 0.22 | 10.9 | 0.238 | 0.05 |
| >500 | 2.0 | 1.518 | 0.24 | 2.0 | 1.518 | 0.24 | 2.0 | 1.446 | 0.23 | 1.4 | 0.426 | 0.06 |
| All | 97.5 | 0.913 | 0.66 | 92.3 | 0.830 | 0.52 | 78.4 | 0.517 | 0.26 | 60.1 | 0.186 | 0.06 |
| | *Interaction with other QRM rules* | | | | | | | | | | | |
| QRM | | $c_0$ | | | $c_{0.25}$ | | | $c_0$.5 | | | $c_{0.75}$ | |
| 1 & 8alt | 68.9 | 1.009 | 0.71 | 64.8 | 0.918 | 0.56 | 53.6 | 0.554 | 0.28 | 39.8 | 0.131 | 0.06 |
| 2 & 8alt | 70.6 | 0.830 | 0.55 | 67.9 | 0.771 | 0.45 | 59.4 | 0.504 | 0.24 | 46.7 | 0.125 | 0.06 |
| 3 & 8alt | 4.6 | 0.670 | 0.82 | 4.3 | 0.601 | 0.68 | 3.5 | 0.356 | 0.33 | 2.6 | 0.098 | 0.07 |
| 4 & 8alt | 36.9 | 0.846 | 0.66 | 36.4 | 0.828 | 0.62 | 35.0 | 0.758 | 0.56 | 31.9 | 0.626 | 0.53 |
| 5 & 8alt | 30.3 | 0.593 | 0.42 | 29.8 | 0.573 | 0.38 | 27.1 | 0.376 | 0.21 | 22.4 | 0.089 | 0.05 |
| 7 & 8alt | 13.0 | 0.892 | 0.87 | 11.8 | 0.756 | 0.64 | 9.3 | 0.417 | 0.29 | 6.9 | 0.100 | 0.06 |

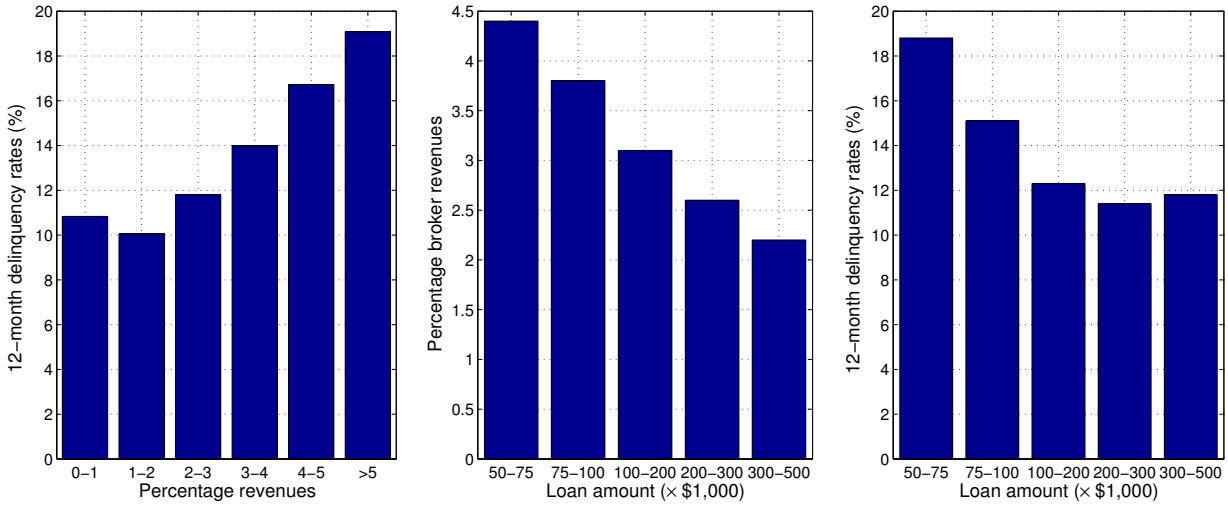


Figure 1: **Delinquency risk, loan size and percentage broker revenues** The left figure displays average 12-month delinquency rates as a function of percentage broker revenues. The middle and right figure show, respectively, average percentage revenues and 12-month delinquency rates for loans in different size bins.

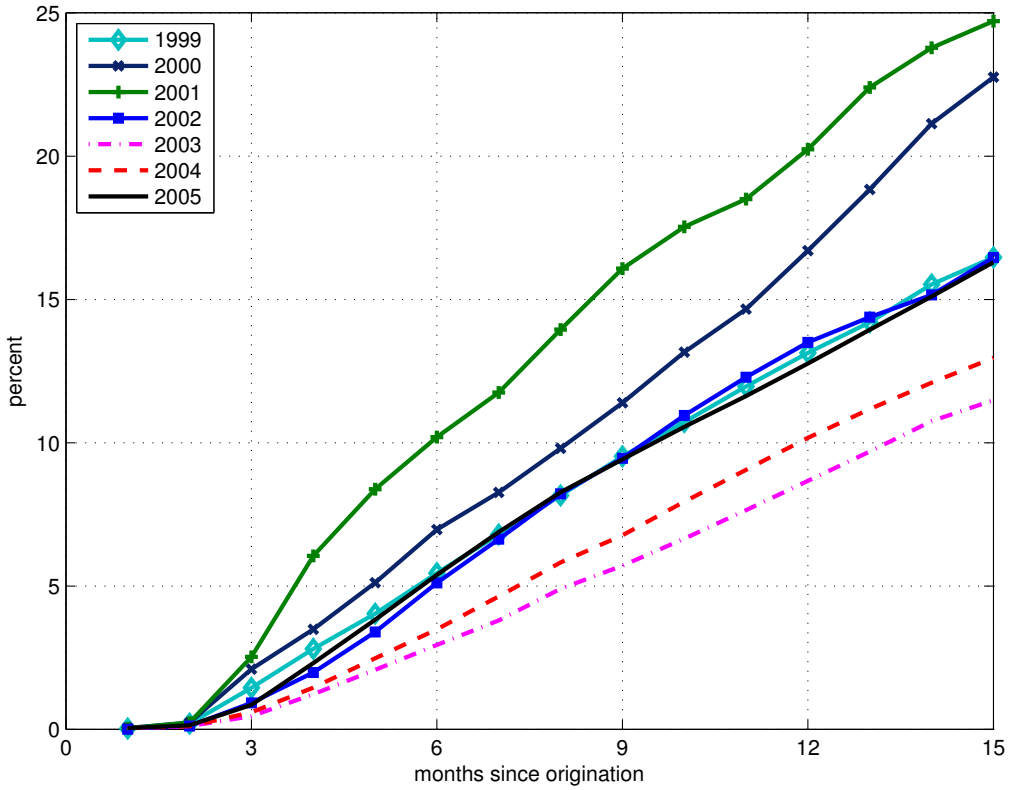


Figure 2: **Delinquency rates** The figure shows the fraction of loans delinquent as a function of months from origination, by year of origination. The delinquency rate is defined as the cumulative fraction of loans that were past due 60 or more days, in foreclosure, real-estate owned, or defaulted, at or before a given age.

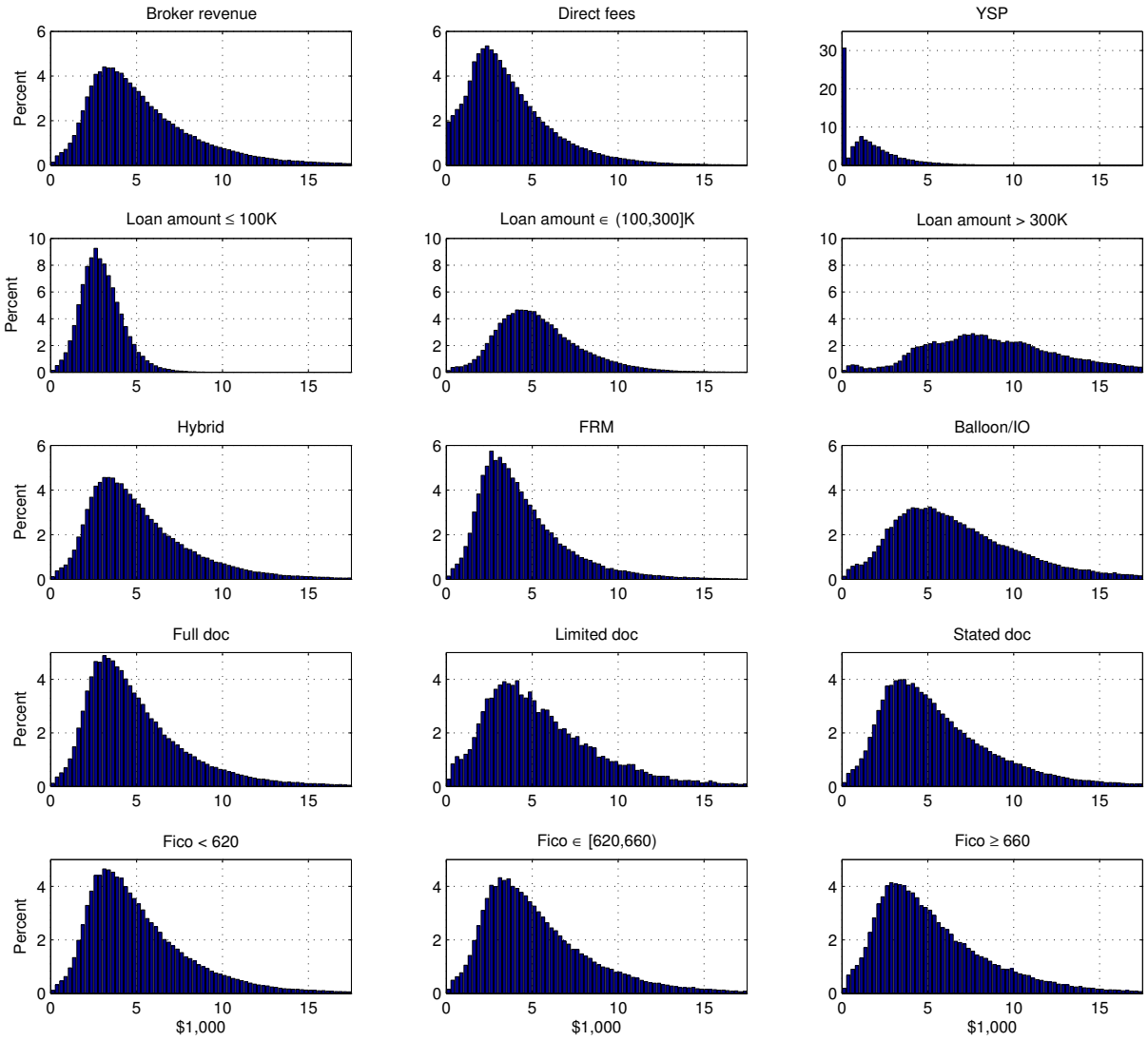


Figure 3: **Broker revenues, fees and YSP** The top panel shows the unconditional distribution of broker revenues, fees and yield spread premia. The next four panels plot the distribution of broker revenues across loan size, loan type, documentation level and the borrower's credit score.

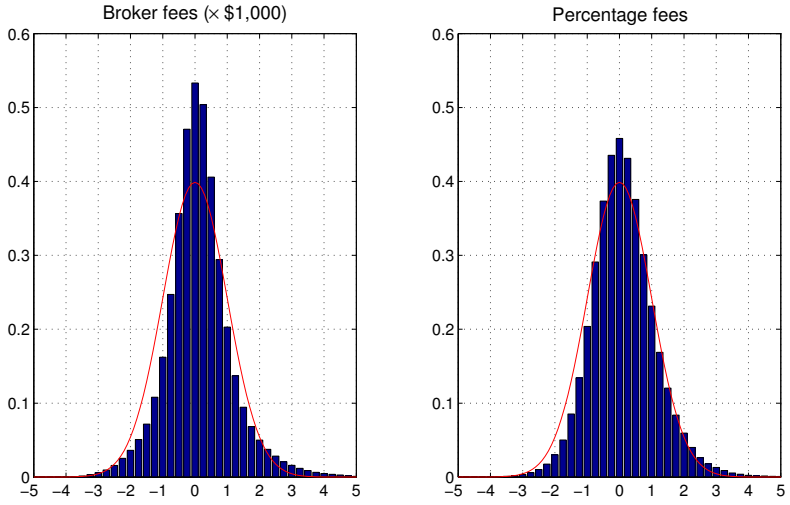


Figure 4: **Standardized residual fees** The left panel of the figure plots the histogram of the residuals from regressing dollar broker fees on the characteristics in Table 1, including dollar YSP, divided by their sample standard deviation. The right panel of the figure shows the histogram of the standardized residual fees from regressing percentage broker fees on the characteristics in Table 1, including percentage YSP. The solid red line in each plot shows the standard normal pdf.

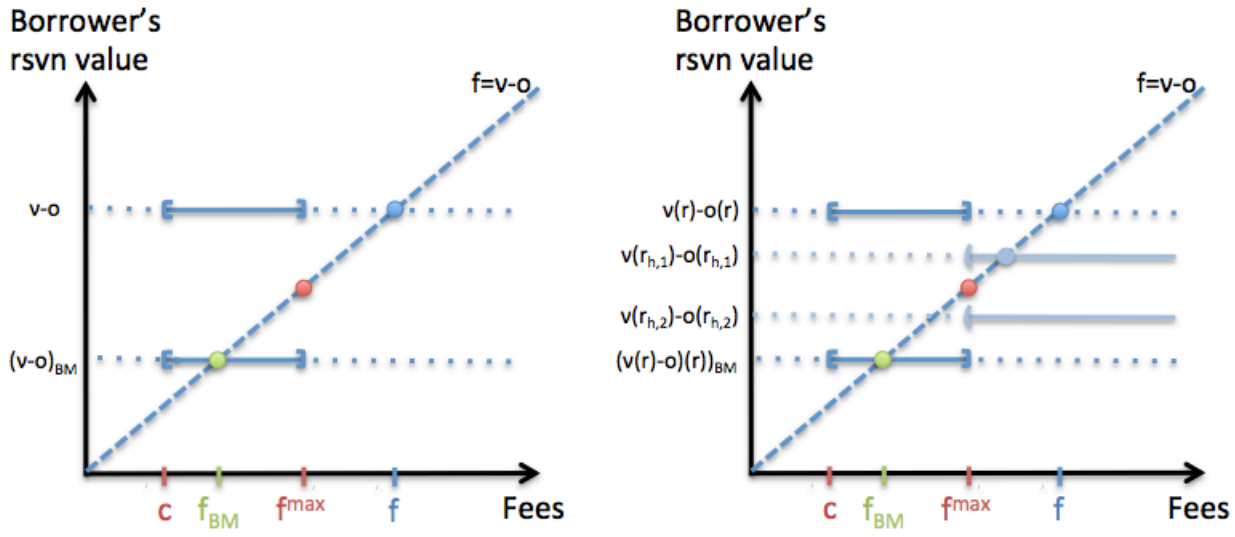


Figure 5: **Broker's maximization problem** The figure depicts the broker's maximization problem. The left panel shows the scenario where loans with fees in excess of $f^{\max}$ are not funded, and the right panel shows the case where interest rates are set as a function of broker fees.

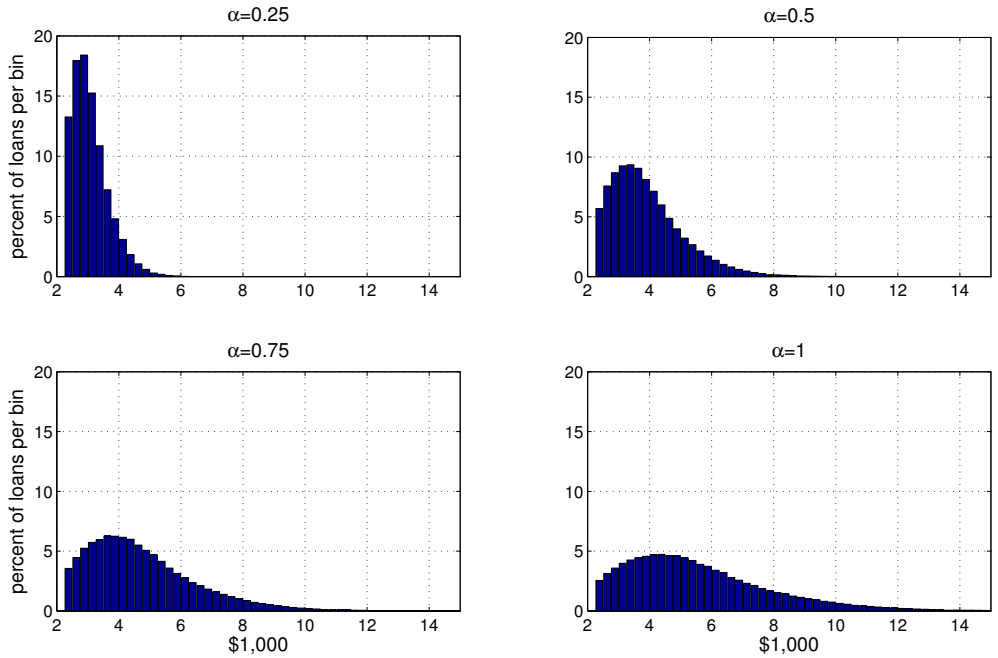


Figure 6: **Conditional cost distributions** The figures show the assumed cost distribution, conditional on a loan amount between 100 and 300K, for different levels of $\alpha$. Loans with revenues at or below the $5^{th}$ percentile are not included.

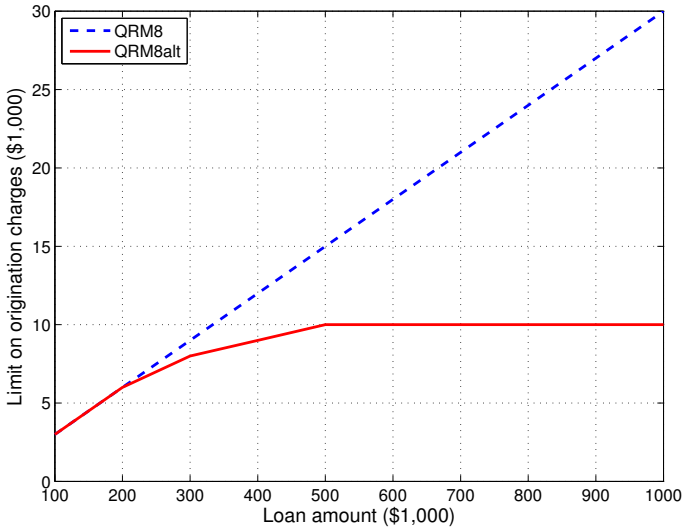


Figure 7: **Proposed and alternative QRM Rule 8** The Agencies proposed a constant cap of 3% on percentage origination charges. The alternative rule described in Section 7.3 restricts loan origination charges to 3% of the loan amount for loans of size 100K or less, and to 10K for loans of more than 500K. In between, maximum dollar charges grow according to a piecewise linear schedule, which caps origination charges at 6K, 8K and 9K for loans of size 200K, 300K and 400K.

# A. Sample Construction

We started from the approximately 3.2 million loans in the NCEN data base. We select all wholesale loan applications between 1997 and 2006 that have a valid funding decisions, that is, the decision was either "funded", "declined", or "withdrawn". We require a valid broker number, property zip code, a loan amount that is between $10,000 and $1,000,0000, a combined loan-to-value ratio between 0 and 150, a Fico score between 300 and 850, we dropped loans with missing Fico score loans, a debt-to-income ratio between 0 and 100, and a mortgage rate greater than 0 and less than 25%. This step reduces the sample by approximately 46% to approximately 1.5 million observations.

We use this "pre-sample" to compute broker variables such as the indicator for an "Active Broker", which depends on whether a given broker submitted a loan application during the previous month and the Broker Fund Rate which takes the ratio of funded loan applications to all applications. We identify brokers by the broker numbers and in a second step we combine multiple broker numbers that appears to refer to the same broker firm based on the broker name and the location of properties.

To identify piggyback loans among our funded loans we look for matching first lien loan for any valid funded second lien loan. We match on the funding date, the borrower's age, the Fico score, the appraisal value for the property, the purpose of the loans, the occupancy status, and the property city and zip. Using this scheme we can match the vast majority of the funded second lien loans in our sample. Note that we cannot observe if a borrower with a free-standing first lien loan in our sample took out a second lien loan with another lender. In our sample, the majority of second lien loans can be matched with a first lien, suggesting that New Century did not typically originate free-standing second lien loans. This may or may not be true for other lenders. In any case, the percentage of piggyback loans in our data may be viewed as a lower bound for such loans.

We construct regulation variables following the definitions used in Ho and Pennington-Cross (2005), Ho and Pennington-Cross (2006), Pahl (2007), and Kleiner and Todd (2007), and extending the variables when necessary to our sample period. All these variables are defined by year and state. We collect zip code level census variables on race, ethnicity, and education. We match these variables with our loan records and drop loan records that have no match potentially because of an incorrect zip code.

In constructing our final sample of funded loans we include only funded loans that are either free-standing first lien loans or a match of a first lien and a second lien loan that forms an observation of a piggyback loan. We drop any second lien loans that were not matched.

We trim the sample by dropping loans with revenues in excess of 17.5K, which account for less than 1% of the data. These steps generate a sample size of roughly 669,000 loans.

# B. The New Century Data

In this appendix, we give a detailed overview of New Century's origination and service data. Table 2 shows that the number of loans in our sample grew exponentially, from about 3,000 loans originated in 1997 to 143,000 in 2006. Each loan is identified by a first lien. We refer to loans where the first lien can be matched with a second lien in our data as piggyback loans, and to all other first liens as free-standing.[20] Piggyback loans became popular later in the sample, from 2004 onwards. The average size of loans grew from about 100K in 1997 to more than 200K in 2006, with higher average loan amounts for piggyback loans. The number of brokers used by New Century in any given year grew dramatically, from less than 900 in 1997 to over 26,000 in 2006. Over the whole sample period, about 669,000 loans were originated by 56,000 independent brokers with an average loan amount of $190,000.

Our sample represents subprime loans from all parts of the country, with California, Florida and Texas being the three biggest markets by number of loans originated. Throughout the sample period, about 90% of all loans were originated in metropolitan areas. Approximately two-thirds of the loans were taken 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 much more popular, reaching 54% of the loans in 2006. For most of the sample period, the 2/28 hybrid dominates in the hybrid category and the 30-year fixed-rate loan in the fixed-rate category.[21] The majority of loans came with a product-specific prepayment penalty.

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".[22] The fraction of limited or stated documentation

[20]Details on the matching algorithm are provided in Appendix A.

[21]For piggyback loans, the program is identified by the first lien.

[22]Palepu, Srinivasan, and Sesia Jr. (2008) note that in all cases, the applicant's employment status was

loans in our sample varies between a low of 33% in 1997 and a high of 47% in 2004.

The majority of the New Century loans were mortgages obtained for a single-family home that serves as the borrower's primary residence. The average borrower Fico score fell almost 30 points between 1997 and 2001, before rising again by roughly the same amount during the second half of the sample period. Piggyback loans were made to borrowers with relatively high credit scores, but presumably no cash savings. The borrowers who took out limited or stated 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 did not decrease. If anything, they 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. The average loan-to-value (LTV) ratio rose from 73% in 1997 to 80% later in the sample, while second liens gained more and more popularity.

From 1999 onwards, the data obtained from IPRecovery 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 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.

For each year $k$, 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 in the servicing data after $s$ months or experience a first-time delinquency at age $s$. The cumulative delinquency rate of vintage-$k$ loans at age $t$, $\widehat{P}_t^k$, is then given by

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

Figure 2 plots $\widehat{P}_t^k$ as a function of the age of the loan, $t$, and the year of origination, $k$.[23] We find that loans originated in 2000 and 2001 have the highest unconditional delinquency rates. Table 2 suggests that loans originated during these years have the lowest average Fico scores. In Section 3, we analyze to what extent variations in observable risk characteristics can account for the changes in delinquency rates across time. We 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.

verified by phone.

[23]Since the data provided by IPRecovery ends in March 2007, the last vintage year shown is 2005.