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ABSTRACT

Prior to the subprime crisis, mortgage brokers originated about 65% of all subprime mortgages. Yet little is known about their behavior during the runup to the crisis. Using data from New Century Financial Corporation, we find that brokers earned an average revenue of $5,300 per funded loan. We decompose the broker revenues into a cost and a profit component and find evidence consistent with brokers having market power. The profits earned are different for different types of loans and vary with borrower, broker, regulation and neighborhood characteristics. We relate the broker profits to the subsequent performance of the loans and show that brokers earned high profits on loans that turned out to be riskier ex post.

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1. Introduction

Mortgage brokers act as financial intermediaries matching borrowers with lenders, assisting in the selection of loans, and completing the loan application process. Mortgage brokers became the predominant channel for loan origination in the subprime market. For example, in 2005 independent mortgage brokers originated about 65% of all subprime mortgages.[1] Despite the mortgage brokers' central role in the subprime market, little is known about their behavior and incentives, nor about the types of loans, borrowers, or properties that generated profits for the brokers. We study the role of independent brokers in the mortgage origination process using a dataset from one large subprime lender, New Century Financial Corporation, whose rapid rise and fall parallels that of the subprime mortgage market from the mid nineties until the beginning of the subprime crisis in 2007. Figure 1 plots the loan volume originated by New Century between 1997 and 2006 and the split between broker and retail originated loan volume. The rapid growth between 2001 and 2006 mirrors that of the overall subprime market and much of that growth stems from broker originated loans, underscoring the importance of independent mortgage brokers.

Traditionally a mortgage broker operates as an independent service provider, not as a direct agent of the borrower nor a direct agent of the lender. The broker charges a direct fee to the borrower and earns an indirect fee—known as the yield spread premium—from the lender. The broker's services include taking the borrower's application, performing a financial and credit evaluation, giving the borrower information about available loan options, and producing underwriting information for the lender. Figure 2 plots the unconditional frequency distribution of the broker gross revenues and its components in our sample. The top plot shows the distribution of the direct fee portion of the revenues, the middle plot shows the yield spread premium, and the bottom plot shows the distribution of the total broker revenues. All the distributions are quite skewed—

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

there are some extremely large fees and yield spreads paid out to the brokers.

The lender sets a schedule of yield spread premia that rewards the broker for originating loans with a higher interest rate holding other things equal. In addition, the yield spread premium schedule often varies with loan, borrower, and property characteristics. For example, if hybrid mortgages are more appealing to the lender and loans to finance second homes or investment properties are less appealing to the lender, then the lender may set higher yield spread premia for hybrid loans and lower yield spread premia for second home or investment property loans. A more attractive yield spread premium schedule may encourage the broker to focus on originating certain types of loans.

The mortgage broker is likely to trade off the potential benefits of finding the best loan product for the borrower—which may help the broker win future business—against originating a loan product that may generate the highest revenues for the broker from the current loan. We develop a framework that allows us to empirically examine these trade-offs and apply it to a large sample of subprime mortgages. The questions we seek to address are: Is there evidence that mortgage brokers extract rents from the transactions? For what types of loans or borrowers do the brokers extract greater profits? Is there any relationship between broker rents and the subsequent loan performance?

We study these questions using an extensive sample of mortgages originated by New Century Financial Corporation. The sample contains detailed information on the credit worthiness of the borrower, the purpose of the loan, the appraised property value, the location and type of property, the type and terms of loans originated, loan servicing records, and information on whether or not a mortgage broker was involved in the loan. The sample also reports the fees and yield spread premia earned by the brokers, allowing us to compute the total broker revenues for each funded mortgage.

Our empirical framework is based on the idea that in order for a mortgage to be funded, it must be acceptable to the borrower, the broker, and the lender given the information each observes. We model the interaction between the borrower and the broker as a bargaining game over the loan terms and type, subject to the constraint that

the lender will fund the loan. The framework decomposes the total revenues charged by the broker into a cost of facilitating the match and a component that reflects the broker's profits. The lender's surplus is the net present value to the lender from funding the loan less the yield spread premium paid to the mortgage broker. The lender affects the broker's behavior indirectly via the yield spread schedule and directly via the decision to fund a loan, and here we focus on the yield spread premium. The borrower's surplus depends on the benefit that the borrower receives from the loan which in turn depends on the value that the borrower assigns to owning the property and the valuation of various mortgage attributes.

Some profits must be generated in the chain of loan origination in order for both the lender and the broker to be able to extract profits. Why would competition not eliminate such profits? One possibility is that the range of different mortgage products allows sufficient risk-adjusted price dispersion to exist. Such price dispersion may arise for strategic reasons as argued by Carlin (2009) and may not be eliminated by competition as shown by Gabaix and Laibson (2006). Research on household financial decisions provides evidence that individuals and households often make suboptimal decisions, see, for example, Campbell (2006). More choices may also not lead individuals or households to make better decisions, see, for example, Iyengar, Jiang, and Huberman (2004). It therefore is plausible that neither comparison shopping by borrowers nor more competitive pricing by lenders would necessarily eliminate the price dispersion that enables brokers to profit from originating the loans.

We estimate a stochastic frontier model that decomposes the broker's revenues into a cost component and a profit component. The decomposition rests on the idea that when the borrower uses the broker, the broker will only propose loans with non-negative broker profit. The decomposition is identified in our sample because of the empirical skewness, illustrated by Figure 2, in the total broker revenues. In our sample, the mean broker revenue is \$5,300 per loan, and our decomposition attributes approximately \$1,100 to broker profits. We find evidence that hybrid and piggyback loans are particularly prof-

itable in part because the yield spread premia are higher for such loans, whereas balloon loans are more profitable in part because the direct fees are higher. In general, brokers earn greater profits from originating loans in neighborhoods with a greater fraction of minority populations. We find some evidence that stricter state regulations of the lending practices and of mortgage brokers are associated with lower broker profits.

To investigate the relationship between broker profits and the subsequent loan performance, we estimate a Cox proportional hazard model for loan delinquency. The estimates imply that the marginal effect of broker profits is positive for future delinquency once we condition on characteristics of the loan, the borrower and the broker, suggesting that brokers earned high profits on loans that turned out to be riskier ex post. To determine if the effect is primarily driven by the direct fees or by the yield spread premium, we condition on the ratio of fees to loan amount and yield spread premia to loan amount in the hazard model. We find that abnormally high fees increase the delinquency hazard rate whereas abnormally high yield spread premia decrease the hazard rate, indicating that abnormally high broker fees may play an important role in predicting high delinquency rates. The relationship between broker profits and the risk of delinquency is present for the whole sample period although it is somewhat stronger during the last few years.

Demyanyk and Hemert (2009), as well as Mian and Sufi (2009), analyze the quality of securitized subprime mortgage loans. Keys, Mukherjee, Seru, and Vig (2009) and Purnanandam (2009) argue that the lack of screening incentives for originators and excessive risk-taking contributed to the subprime crisis. Despite the prominence of brokers in the subprime mortgage market, little is known about their behavior during the runup to the crisis. El-Anshasy, Elliehausen, and Shimazaki (2006) and LaCour-Little (2009) compare the rates on subprime mortgages originated by lenders through the retail channel and through mortgage brokers. LaCour-Little (2009) shows that loans originated by brokers cost borrowers more than retail loans, while El-Anshasy, Elliehausen, and Shimazaki (2006) do not find support that loans originated through brokers cost borrowers more.

Woodward and Hall (2009) examine the total revenues paid by borrowers to mortgage

brokers for a sample of FHA loans originated in 2001 and show that a substantial portion can be attributed to broker profits and that the broker profits vary with borrower characteristics, consistent with the brokers' profits stemming from lack of information among borrowers. Our approach to estimating broker rents is similar to the one taken by Woodward and Hall (2009) in that we use stochastic frontier analysis to decompose the broker revenues charged into a cost and a profit component. Garmaise (2009) studies the length and intensity of the broker-lender relationship and finds that the quality of loans originated actually declines in the number of interactions between the broker and the lender.

2. Our Sample

Our dataset contains all loans originated by New Century Financial Corporation (New Century) between 1997 and March 2007. New Century made its first loan to a borrower in Los Angeles, California in February 1996 and in 2006, New Century had more than 7,100 employees and 222 sales offices nationwide. In 2006, New Century was one of the largest subprime mortgage originators in the United States

New Century originated, retained, sold and serviced home mortgage loans designed for subprime borrowers. In 1996, the company originated over $350 million in loans. In 1997, New Century went public and was listed on NASDAQ. In 2001, the company's subprime loan origination volume exceeded $6 billion. Volume continued to grow rapidly, and volume increased tenfold to over $60 billion in 2006. The company grew its product offerings so that by 2006, New Century provided fixed rate mortgages, hybrid mortgages which are adjustable rate mortgages that convert to fixed rate mortgages after a number of months, and balloon mortgages. In 2004, New Century restructured into a real estate investment trust (REIT) and began trading on the NYSE. In February of 2007, New Century announced that it would have to restate earnings for the first nine months of 2006 and that it had record a loss for the last quarter of 2006. Increased rates of delinquency

among recent borrowers and inadequate reserves for such losses were the proximate reasons for the company's troubles. New Century filed for Chapter 11 bankruptcy protection on April 2, 2007.

2.1. Origination data

Our dataset contains detailed information on the credit worthiness of the borrower, the purpose of the loan—either a property purchase or a refinance, appraised value, location and type of property, the type and terms of loans originated, origination fees, yield spread premium, and information on whether or not a mortgage broker was involved. These data provide enough detail to allow us to study the matching of borrowers with loan types and the relationship between loan types and revenues paid and received. The dataset was obtained from IPRecovery, Inc., and it contains information on all loan applications and funded loans.[2] We focus on the loans originated by independent brokers as opposed to correspondent brokers, who are affiliated with New Century, and construct a sample that includes all loans originated by independent brokers that meet a set of sample selection and matching criteria. We present details on the sample construction in Appendix A and descriptive statistics below. Table 1 lists variables that we use in our analysis with brief descriptions. We discuss these variables in more detail in Section 4.2.

Table 2 reports descriptive statistics for our sample including the number of broker originated loans, the average loan amount, and the number of brokers who originated loans by origination year. After an initial jump, the number of loans and active brokers stays relatively constant between 1998 and 2000. After 2001, the growth picks up and both the number of loans and the number active brokers grow rapidly until 2006 when the growth slows down again. Over the whole sample period, about 715,000 loans were originated by 58,000 independent brokers with an average loan amount of $189,000.

The next panel shows that our sample represents subprime loans from all parts of

[2]As part of the New Century Financial Corporation bankruptcy proceedings, IP Recovery, Inc. purchased from the New Century Liquidating Trust a collection of datasets on loan origination, loan servicing, loan performance, and broker data for loans originated/serviced by New Century between 1997 and its bankruptcy filing in 2007.

the country by providing the geographical breakdown of the properties. We break out California, Florida, and Texas because they are the three biggest markets by number of loans originated throughout our sample period. We break down the remaining markets by the census regions—West, Midwest, South, and Northeast without California, Florida, and Texas. As the loan volume grows the geographical distribution shifts away from the Midwest to the South including Texas and Florida and to the Northeast. For example, in 1997, only 11% of the loans were originated for properties in the South but by 2006, the corresponding share had grown to 33%. Similarly, 3% of the loans in 1997 were for properties in the Northeast compared to 17% in 2006. California's share fluctuates between a low of 19% and a high of 32%, but without a clear trend. The regions that grow more slowly than the rest appear to be the West outside California and the Midwest. Throughout the sample period, 90% or more of all loans were originated in metropolitan areas.

The next set of statistics shows the breakdown of the purpose of the loans. For the whole sample period, approximately two-thirds of the loans were taken to refinance existing loans. Of all the loans taken to refinance existing mortgages, the majority involved the borrower taking out some cash. These percentages are comparable to the ones reported for the subprime market in general by, for example, Demyanyk and Hemert (2009). From 2003 onwards, loans to refinance become less important and the fraction of loans to purchase properties grows from 20% to 44%. The last two panels of the table report the distribution of loans by type of occupancy and property. The majority of loans are obtained for a single family used as the borrower's primary residence.

Table 3 reports descriptive statistics on the loans in our sample. We can match most second lien loans in our sample with a first lien loan by using a matching algorithm that compares the date and place of origination, the broker, and the characteristics of the borrower and the property. We provide more details on the matching algorithm in Appendix A. We refer to the matched pairs of loans as piggyback loans and to the

unmatched first lien loans as free-standing first lien loans.[3] Piggyback loans become quite popular in the last few years of our sample period with over 40,000 such loans originated in both 2005 and 2006. Many, but not all, piggyback loans in our sample are of the 80/20 type, so a natural benchmark of the total amount borrowed would be a 25% greater loan amount than the first lien amount. The actual difference in our sample of piggyback loans exceeds that benchmark in all years, with the combined loan amount of the piggyback loans exceeding that of the free-standing first lien loans by 33% to 41%.

The next three panels of the table reports the distribution of loan types across major loan programs—hybrid, fixed-rate, and balloon loans.[4] 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 payments become much more popular reaching 40% 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.

Like many 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. Palepu, Srinivasan, and Sesia Jr. (2008) note that in all cases, the applicant's employment status was verified by phone (salaried employees). Stated documentation mortgages were often referred to as "liar loans." While there are some fluctuations year-to-year, the general trend for our sample period is to have fewer full

[3]It is worth noting here that we do not know 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. Of course, that need not be true for other lenders, so our percentage of piggyback loans may be viewed as a lower bound for such loans.

[4]We categorize each loan based on the first lien loan, that is, we ignore the second liens of the piggybacks in this case. A loan with a balloon payment shows up as a balloon loan regardless of whether it is a fixed-rate or hybrid loan.

documentation loans and many more stated documentation loans.

Table 4 reports descriptive statistics for the borrowers in our sample. We report the mean credit score (Fico), the percent of borrowers with a Fico score at or above 620, which is one commonly used cut-off for the subprime category, the monthly income of the borrower, the combined loan to value ratio (CLTV) and the borrower's total monthly debt payment to income ratio. Both the CLTV and the debt-to-income ratios suggest that loan amounts grew relative to both property values and income levels over the sample period. The credit scores provide a bit more mixed meassage but if we compare the first couple of years to the last couple of years there seems to be a shift towards borrowers with higher credit scores. The next three panels break down the statistics by full or limited documentation versus stated documentation loans and piggyback loans, and show that a change in the composition may explain some of the observed trends.

The borrowers who take out free-standing, that is, no piggyback, loans with full or limited documentation have credit scores that are lower and more stable than the borrowers taking out piggyback loans. The stated documentation loans have higher Fico scores and borrowers who take out piggyback loans have even higher Fico score. Part of the rise in overall Fico score may therefore come from a change in the loan type and borrower mix. The rise in CLTV and debt-to-income ratios can also at least in part be traced to the balloon loans.

The last two panels highlight a different side of the changes in the borrower characteristics by contrasting the average characteristics of borrowers with Fico scores above 620 to those with Fico scores below 620. In 1997, the two groups have approximately the same CLTV and debt-to-income ratios. But over the sample period, the higher Fico score borrowers' loan amounts grow more quickly both relative to the other group and relative to their incomes. As a result, by the end of the sample period, the higher Fico score borrowers have CLTV ratios around 90% and debt-to-income ratios of 41% compared to 82% and 40% for the lower Fico score borrowers. To sum up, over the sample period, the typical borrower's creditworthiness increased as measured by the Fico score

but their leverage and the debt-to-income ratios also increased, and this increase was more pronounced among borrowers with high credit scores.

2.2. Broker compensation

As discussed above, a broker typically earns a direct fee paid by the borrower and an indirect fee, the yield spread premium (YSP), paid by the lender. The lender's wholesale rate sheet sets the minimum mortgage rate based on a number of loan and borrower characteristics. Brokers may then earn a higher fee for originating higher rate loans, all else equal. Yield spread premia therefore are an indirect way for the lender to influence the brokers' origination activity. Brokers need not disclose the YSP to borrowers until closing statements are signed.[5] Exhibit 1 at the end of the paper shows an example of a rate sheet distributed by New Century in March of 2007. (Source: "Subprime Debacle Traps Even Very Credit-Worthy," *Wall Street Journal*, Section: A1, December 3rd, 2007, Rick Brooks and Ruth Simon.) The main matrices show at what rates New Century was willing to fund loans as a function of the loan program, that is, full versus stated documentation, and the loan to value ratio (LTV), the borrower's Fico score, and several other loan features, borrower and property characteristics. On the right hand side of the graphic, about half way down the page, is the YSP box that shows that on this date a 0.5 percent higher rate than the minimum translated into a 1% yield spread premium whereas a 0.875% higher rate translated into a 1.5% yield spread premium. The rate sheet shown here can be viewed as a benchmark. Different brokers may have received a slightly more or less favorable set of quotes depending on their loan volume and history.

Table 5 shows that the average broker revenue, as a percent of the loan amount, declines steadily over the sample period from 5.0% to 2.8% whereas the dollar revenues increase every year, with the exception of 1998, from $4,300 to $5,600 per loan. The increase in the dollar revenue corresponds to an annual compound rate of 2.7% which,

[5]The yield spread premium is reported on lines 80–81 of the HUD-1 statement. A good faith estimate of the closing costs that is required prior to the closing must include a range of the various loan-related costs.

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.

The third and fourth panels of Table 5 provide more systematic evidence by reporting the skewness coefficients for both the percentage and the dollar yield spread premia, direct fees, and broker revenues by origination year confirming that the distribution tend to be right skewed. The dollar distribution may exhibit more right skewness because loan amounts are naturally right skewed as well, but the property is present even in the percentage revenues.

Figure 3 provides further evidence on the distribution of broker revenues across different types of loans; fixed-rate versus hybrid loans, free-standing first lien loans versus piggyback loans, full or limited documentation versus stated documentation; loans with no prepayment penalty versus loans with prepayment penalty; and low versus high credit score loans. The right skewness in the distributions appears to be a robust characteristic across the different types of loans. The distribution also appears to shift with the type of loan. For example, the distribution for hybrid loans appears to be shifted to the right compared with that for fixed-rate loans.

The bottom part of Table 5 provides additional information on the broker compensation by the type of loan, loan amount, credit score and for different levels of documentation. The fixed-rate loans generate lower revenues than the hybrid, balloon, and piggyback loans which generate above average broker revenues. For all types of loans, the stated documentation loans generate greater broker revenues. On average, the greater revenues for stated versus full or limited documentation loans comes both from fees and the yield spread premium albeit that for fixed-rate loans the yield spread premium is the same regardless of the level of documentation. The bottom part of the panel confirms the previous results for skewness. Figure 3 provides some insight into how broker compensation varies along different dimensions.

To complement these univariate statistics, we report regression results in Table 6

for Tobit regressions of the direct fees and yield spread premia on our conditioning variables. These regressions illustrate that both fees and yield spread premia may vary systematically, both for different types of loans, e.g., hybrid versus fixed-rate loans, and for different borrowers or properties, e.g., with the borrower's Fico score or depending on whether the property is a primary residence or a second home or an investment property. The results highlight that for many loan, borrower, or property characteristics we observe a trade-off between fees and the yield spread premia. For example, as expected, higher mortgage rates are associated with higher yield spread premia, holding other things equal, and lower direct fees albeit that the trade-off is far from one-for-one. Similarly, between 1998 and 2001 direct fees are rising in dollar terms and the yield spread premia are falling followed by the reverse trend over the next three to four years. There is also evidence of some trade-offs with respect to loan characteristics. For example, we observe lower fees and higher yield spread premia for hybrid and piggyback loans and the reverse for stated documentation and balloon loans. Borrower with higher Fico scores pay lower direct fees but generate higher yield spread premia. Below we will develop a framework that allows us to address the question of whether these variations reflect differences in costs or profits.

2.3. Loan performance data

The data obtained from IPRecovery contains detailed loan servicing records on most of the originated mortgages. For every year from 1999 to 2006, 93% or more of the funded loans are part of the servicing data, except for 2001 (47%) and 2002 (30%). Figure 4 plots the percentage of loans delinquent as a function of the age of the loan by the year of origination. A loan is considered delinquent if payments on the loan are 60 or more days late, or if the loan is reported as in foreclosure, real estate owned, or in default. The left panel of the figure shows actual delinquency rates, which are computed as follows: Let $\hat{p}_s^k$ denote the observed ratio of the number of vintage k loans experiencing a first-time delinquency at s months of age over the number of vintage k loans that either are still

active in the servicing data after s months or experience a first-time delinquency at age s. We compute the actual (cumulative) delinquency rate for vintage k at age t, $\hat{P}_t^k$, as

$$\hat{P}_t^k \;=\; 1 - \prod_{s=1}^{t} \left(1 - \hat{p}_s^k\right), \quad \text{for } k = 1999, \ldots, 2005.$$

We find that loans originated in 1999, 2000 and 2001 have the highest unconditional delinquency rates. Tables 3 and 4 suggest that loans originated during these years have, on average, higher initial rates and lower Fico scores than loans funded later in the sample. We control for such differences in loan-level characteristics by computing adjusted delinquency rates, which are obtained by using estimated coefficients for vintage dummies after controlling for loan, borrower and broker characteristics, and macroeconomic variables.[6] Following Demyanyk and Hemert (2009), we impose the restriction that the average actual and average adjusted delinquency rates are equal for any given age of the loan. The average actual delinquency rate, $\bar{P}_t$, is defined as

$$\bar{P}_t \;=\; 1 - \prod_{s=1}^{t} \left(1 - \bar{p}_s\right),$$

where $\bar{p}_s = \frac{1}{7}\sum_{k=1999}^{2005} \hat{p}_s^k$. The right panel of Figure 4 shows the adjusted delinquency rates. The plot is consistent with the evidence reported in Demyanyk and Hemert (2009) in that, after controlling for year-by-year variation in loan-level characteristics and macroeconomic variables, loans originated in 2004 and 2005 appear riskier ex post than loans originated earlier.

3. Framework

We model the underwriting process as follows. The borrower arrives to the broker requesting a mortgage loan. The broker evaluates the borrower's characteristics including the borrower's credit quality and willingness to pay, and based on that information the

[6] Details are provided in Section 5.

broker provides the borrower with financing options. The broker submits funding requests to one or more lenders, and the lenders respond with a decision to fund the loan or not. Funding requests are submitted until the borrower, broker and lender find an acceptable loan. At that point, the mortgage is written. If no acceptable loan is found, then no mortgage is written.

We consider some borrower i and broker j. To describe the terms of the loan broker j originates with borrower i, let P denote the loan principal. In what follows, we assume that the amount P the prospective homebuyer wants to borrow is given. The borrower and broker then have to agree on the type of loan, l—fixed, hybrid, maturity, documentation type, does the loan have a prepayment penalty, maturity, and so on—and the loan's interest rate r, so that $L = (P, l, r)$ denotes the loan.

Let $f_{i,j}$ denote the total fees that broker j charges borrower i for originating the loan, including the origination fee and the credit fee. Define $\nu_{i,j}$ as the borrower's dollar valuation for the loan as a function of the loan characteristics L. The function $\nu_{i,j} = \nu_{i,j}(L)$ measures the wealth equivalent benefits that the borrower receives from the loan. Assuming that the borrower is risk-neutral, the borrower's total surplus from receiving a funded loan L, and paying fees of $f_{i,j}$, is

$$\nu_{i,j} - f_{i,j}.$$

The lender pays the broker a yield spread of $y_{i,j}$ for originating the loan. We use $C_{i,j}$ to denote the broker's costs of originating the loan. It includes the broker's time costs of dealing with the borrower, as well as any administrative costs paid by the broker for intermediating the mortgage. Both $y_{i,j} = y_{i,j}(L)$ and $C_{i,j} = C_{i,j}(L)$ are functions of the loan characteristics L. Assuming that the broker is risk-neutral, the broker's surplus from originating a funded loan L, receiving fees of $f_{i,j}$ and a yield spread of $y_{i,j}$, and paying costs of $C_{i,j}$ is

$$f_{i,j} + y_{i,j} - C_{i,j}.$$

We assume that the terms of the mortgage loan can be described by a generalized Nash bargain between the broker and the borrower, subject to the constraint that the lender will fund the loan. Let F denote the set of loans that will be funded by the lender:

$$F_{i,j} = \{L|\text{lender will fund loan type } L = (P, l, r) \text{ for borrower } i \text{ and broker } j\}.$$

We use $\rho_{i,j} \in [0, 1]$ to denote the bargaining power of broker j relative to the bargaining power of borrower i. If $\rho_{i,j} = 0$, the borrower has all the bargaining power, and if $\rho_{i,j} = 1$, the mortgage broker has all the bargaining power. The funded loan contract maximizes the generalized Nash product:

$$\max_{f_{i,j},\, L \in F_{i,j}} \left(f_{i,j} + y_{i,j} - C_{i,j}\right)^{\rho_{i,j}} \left(\nu_{i,j} - f_{i,j}\right)^{1-\rho_{i,j}},$$

subject to the participation constraints:

$$\nu_{i,j} - f_{i,j} \geq 0, \tag{1}$$

$$f_{i,j} + y_{i,j} - C_{i,j} \geq 0. \tag{2}$$

Condition (1) requires that the fees do not exceed the borrower's valuation of the loan and condition (2) requires that the fees plus the yield spread premium are greater than or equal to the broker's cost. The participation constraints can only be satisfied if the gains to trade are non-negative:

$$\nu_{i,j} + y_{i,j} - C_{i,j} \geq 0.$$

If the gains from trade are negative, the bargaining ends and no mortgage is funded.

When the gains from trade are positive and the terms of the loan are in the interior

of F, the first-order conditions imply:

$$(1-\rho_{i,j})\left(\nu_{i,j}+y_{i,j}-C_{i,j}\right) \;=\; \rho_{i,j}\left(\nu_{i,j}-f_{i,j}\right), \tag{3}$$

and

$$\frac{\partial \nu_{i,j}}{\partial L}+\frac{\partial y_{i,j}}{\partial L} \;=\; \frac{\partial C_{i,j}}{\partial L}. \tag{4}$$

Condition (3) is the direct condition for setting the fees: the fees are set so that the total surplus is split according to the relative bargaining power of the broker and the borrower. Using condition (3) to solve for the fees yields

$$f_{i,j} \;=\; \rho_{i,j}\nu_{i,j}+(1-\rho_{i,j})\left(C_{i,j}-y_{i,j}\right). \tag{5}$$

If borrower i has all the bargaining power, then $\rho_{i,j}=0$ and

$$f_{i,j}=C_{i,j}-y_{i,j},$$

so that all the surplus flows to the borrower. If the broker has all the bargaining power, then $\rho_{i,j}=1$ and

$$f_{i,j}=\nu_{i,j},$$

so that all the surplus flows to the broker.

Condition (4) is an efficiency condition: the sum of the marginal gains to trade for the terms of the loan are equal to zero, that is, the loan type maximizes the total surplus. Recall that we have assumed that the borrower and mortgage broker bargain over the loan type l and interest rate r, but not over the loan size P. If we relaxed that assumption and allowed the loan size to be part of the bargaining, then similar efficiency conditions would also hold with regard to loan size.

The lender effects the loan underwriting process in two ways. First, the lender deter-

mines the yield spread function, which determines which loans will be submitted because the yield spread function directly determines the broker's participation constraint in equation (2) and efficiency condition (4). Since the broker's surplus directly depends on the yield spread, condition (3) implies that the fees themselves depend on the yield spread. Second, the lender's decision on which loans to fund determines which loans will be offered directly though the effects of the constraints in the set of loans that will be funded, F, on the generalized Nash solution. In our empirical analysis, we focus on the first channel while conditioning on the loan being funded.

For the funded loans in our sample, we observe the broker's revenue equal to $f_{i,j}+y_{i,j}$. Substituting in the equilibrium fees from equation (5), we obtain

$$f_{i,j} + y_{i,j} \quad = \quad C_{i,j} + \rho_{i,j} \left(\nu_{i,j} + y_{i,j} - C_{i,j} \right), \tag{6}$$

which states that the broker's revenue equals the cost of intermediating the loan plus the fraction of the total gains from trade that the broker is able to capture. If the broker has all the bargaining power ($\rho_{i,j} = 1$), the broker receives all the gains from trade, and if the borrower has all the bargaining power ($\rho_{i,j} = 0$), the broker revenues are equal to the costs of intermediating the trade.

From equation (6), the broker's profits can be high for a few reasons. First,the broker might have high bargaining power, measured by a high ρ_{ij}. Such high bargaining power may arise because there is little competition among the brokers perhaps because the borrowers have high search costs, or because the broker puts little weight on reputation concerns. Second, the total surplus may be high for the loan. The loan surplus could be high because the yield spread premium is high relative to the broker's cost, or the surplus could be high because the borrower have a high valuation for the loan. Such a high valuation could arise because the borrower values the underlying property highly, or perhaps because the borrower has optimistic expectations for future property values and the financing flexibility in the loan, or perhaps because the borrower has a short horizon

relative to the length of the loan. The framework thus allows for both opportunistic brokers and opportunistic borrowers.

4. Estimating Broker Profits

We now describe our empirical approach for decomposing broker revenues into costs and profits, and discuss the estimation results.

4.1. Decomposing broker revenues into costs and profits

We are interested in empirically decomposing the observed revenues into a cost component and the gains from trade captured by the broker. We define X_{ij} as the vector of conditioning variables the econometrician can observe. It includes a vector of characteristics for borrower i such as Fico score and borrower income, a vector of the broker's characteristics such as the broker's underwriting history and market share, and a vector of overall market conditions such as the benchmark 30-year mortgage rate or recent house price appreciation. $X_{i,j}$ also captures the loan type L that is the outcome of the bargain between borrower i and broker j.

We then parameterize the broker's cost function as

$$C_{i,j} \quad = \quad C(X_{i,j}) + \epsilon_{i,j}, \tag{7}$$

where $C(X_{i,j})$ is the cost function conditional on loan, borrower and mortgage broker characteristics, and ϵ_{ij} is a symmetric mean zero error term that represents unobserved heterogeneity in the brokers' costs. Let $\xi_{i,j} = \rho_{i,j}\left(\nu_{i,j} + y_{i,j} - C_{i,j}\right)$ denote the broker's profit. Then equations (6) and (7) yield

$$f_{i,j} + y_{i,j} \quad \equiv \quad C(X_{i,j}) + \epsilon_{i,j} + \xi_{i,j}, \tag{8}$$

where $\xi_{i,j}$ is non-negative. Conversations with a market participant indicated that a

brokers cost function is likely to be unaffected by the loan amount, the loan type, or loan rates. But since our sample includes many brokers operating in many different markets we include the loan amount to capture differences in costs that may be correlated with differences in the price of housing. To check the robustness of our results we also consider specifications that allow the cost function to depend, among others, on the loan type, the prepayment penalty, and whether or not the loan is a refinance. Our main results carry through to a range of model specifications.

The model in equation (8) fits naturally into a specification that can be estimated using stochastic frontier analysis. Kumbhakar and Lovell (2000) and Greene (2002) are textbook references for stochastic frontier models. Frontier models are used to estimate cost or profit functions that are viewed as the most efficient outcomes possible. Individual observations deviate from the efficient outcomes by a symmetric mean zero error and a one-sided error that measures that observation's inefficiency. Such models have been applied in financial economics by Hunt-McCool, Koh, and Francis (1996) and Koop and Li (2001) to study IPO underpricing, by Altunbas, Gardener, Molyneux, and Moore (2001) and Berger and Mester (1997) to study efficiency in the banking industry, by Green, Hollifield, and Schürhoff (2007) to study dealers' profits in intermediating municipal bonds, and by Woodward and Hall (2009) in studying broker profits in the mortgage industry.

In our application, the broker's costs for underwriting the loan take the place of the most efficient broker revenue, and the efficiency term is a measure of the broker's profits. If the borrowers have enough bargaining power, then the broker's revenues would be driven down to their costs, and the one-sided error would be zero. Measures of the relative importance and determinants of the distribution of the one-sided error therefore provide useful information about the brokers' ability to earn profits by underwriting loans. In particular, the distribution of the one-sided error across different loan characteristics provides estimates of the relative profitability of different types of loans.[7]

[7]We note here that both the borrower's and the lender's participation constraints can also be esti-

To arrive at an econometric specification of the model, we impose parametric structure on $C(X_{i,j})$, and on the distribution of the symmetric error $\epsilon_{i,j}$ and on the broker's profits $\xi_{i,j}$. In particular, we assume

$$C(X_{i,j}) \quad = \quad \gamma_0 + \sum_k \gamma_k X_{ij,k}.$$

We parameterize $\epsilon_{i,j}$ as being normally distributed with mean zero and standard deviation $\sigma_{i,j}$. We allow for heteroscedasticity in the cost function by assuming that

$$\sigma_{i,j} \quad = \quad c_0 \, \exp\left(\sum_k c_k X_{ij,k}\right). \tag{9}$$

In our base model specification, we parameterize the mean and the variance of the broker's cost as a function of dummies for the year and the geographic location, as well as loan amount.

The profit function $\xi_{i,j}$ is parameterized as an exponential distribution with mean parameter $\lambda_{i,j}$. The first two moments of $\xi_{i,j}$ are

$$\begin{aligned} E\left(\xi_{i,j} | \, X_{i,j}\right) &= \lambda_{i,j}, \\ \text{Std. dev.}\left(\xi_{i,j} | \, X_{i,j}\right) &= \lambda_{i,j}. \end{aligned}$$

We estimate specifications in which the exponential term has as parameter $\lambda_{i,j}$ a log-linear function in our explanatory variables $X_{i,j}$:

$$\lambda_{i,j} \quad = \quad \beta_0 \, \exp\left(\sum_k \beta_k X_{ij,k}\right).$$

If the parameter β_0 equals zero, then the broker's profits are zero: the borrowers have all the bargaining power and there is no asymmetric term. The asymmetric term can be also be zero if there is little dispersion in the borrowers' valuations and the yield spread

mated using stochastic frontier analysis.

premium schedule is zero so that even in a situation with symmetric bargaining power there would be zero profits. If the constant is non-zero, then there is evidence that the brokers have bargaining power and that there are strictly positive gains to trade. The gains from trade might be dispersed because the borrowers have dispersed valuations, because the yield spreads are dispersed, or some combination of the two. Variables that increase $\lambda_{i,j}$ suggest higher broker bargaining power, higher borrower valuations or higher yield spread premia, and therefore higher profits for the brokers. Because of the log-linear functional form, the coefficients on the conditioning variables measure the percentage change in profits per unit change in the explanatory variable.

The stochastic frontier model is estimated from the right tail of the revenue distribution. Appendix B reports the moment conditions used in the model.

4.2. Conditioning variables

Our explanatory variables include characteristics of the loans, borrowers, properties, and brokers, variables that capture differences in the regulation, neighborhood characteristics, macroeconomic variables, as well as dummies for the year and the geographic region. Table 1 lists the variables used in our empirical analysis with brief explanations.

The loan characteristics variables include indicators for hybrid, balloon, and piggyback loans; an indicator for loans with stated documentation; an indicator for loans with a prepayment penalty; an indicator for loans obtained to refinance an existing mortgage and an indicator for cash-out refinancing; and the combined loan-to-value ratio (CLTV). The benchmark loan is a fixed-rate loan obtained to purchase a property. The borrower characteristics include the borrower's Fico score and the back-end debt-to-income ratio (DTI). The property characteristics include indicator variables for second home or investment properties and an indicator for multi-unit properties. The benchmark loan is obtained to purchase a single-family home that serves as the borrower's primary residence. The descriptive statistics reported in Table 2 indicate that loan applications for second homes are rare. We include the type of property as alternative proxy for the

purpose of the loan.

The explanatory variables determine the asymmetric profit component, ξ_{ij}, in equation (8) which is the product of the broker's bargaining power and the total gains from trade. Because we can only model the product it is not possible to determine if differences in profits are driven by differences in the brokers' bargaining power or differences in the total gains from trade—with differences in the gains from trade arising from differences in the borrowers' valuations or the yield spread premium. This is further complicated by the fact that we do not observe the complete schedules of yield spread premia, only the points for the loans that were originated. Nonetheless this decomposition allows us to learn more about what drives broker profits.

Our regulation variables capture state or local laws that deviate from the applicable federal laws. The 1994 Home Owners' Equity Protection Act (HOEPA) sets a baseline for federal regulation of the mortgage market. Reports of questionable practices in the subprime mortgage market in the late nineties led to new legislation that targeted predatory lending practices starting with North Carolina in 1999.[8] We apply the approach taken by Ho and Pennington-Cross (2005) and Ho and Pennington-Cross (2006) to our sample period, and use an index that measures the coverage of anti-predatory lending laws that assigns higher positive values if the laws cover more types of mortgages than HOEPA. In a similar fashion we construct an index that measures the restrictiveness of the anti-predatory lending laws giving, for example, higher values to laws that put stricter limits on prepayment penalties or balloon payments. Both indices capture differences between states as well as differences over time as more states implemented anti-predatory lending laws.

In some states, mortgage brokers are subject to different types of occupational licensing laws and regulations.[9] We use the index of mortgage broker regulations constructed

[8]The impact and effectiveness of anti-predatory lending laws has been studied by, among others, Ho and Pennington-Cross (2005), Ho and Pennington-Cross (2006) and Li and Ernst (2007).

[9]Pahl (2007) presents a compilation of all state laws and regulations between 1996 and 2006. Kleiner and Todd (2007) study the impact of occupational licensing on employment and earnings of mortgage brokers and the outcomes for borrowers.

by Pahl (2007). In addition, we use the minimum financial requirement for mortgage brokers. For example, states that require a surety bond of $45,000 are assigned a value of 4.5 for that year. Both indices capture differences between states and some changes over time albeit these laws are more stable over time than the anti-predatory lending laws.

To capture more differences between markets we also include some regional and zip-code level variables. We include the percent of the population in a given zip code who is white. Much of the evidence of predatory lending practices that spurred the new legislation came from areas with larger minority populations where subprime lending often was more prevalent. We also use the census variable for the percent of the population who is hispanic, and the percent of the population who holds a bachelors degree.

Goetzmann, Peng, and Yen (2009) report evidence of house price appreciation having an effect on both the demand and supply of mortgages in the subprime market. In our setting, a positive demand effect may increase the borrowers' willingness to pay for a mortgage which has the same effect as increasing the broker's bargaining power. We use the FHA house price index to construct a variable that measures the lagged three-year house price appreciation for each of the census divisions. We normalize the appreciation relative to the national index and demean it.

4.3. Estimates for baseline specification

Table 7 reports estimates for our baseline specifications. We show results for two formulations of the cost function: a base cost function and a cost function that includes additional loan characteristics. We discuss the differences between the two cost functions for all specifications below in Section 4.6 which covers robustness issues. Here we focus on the base case cost function that allows the cost of intermediation to depend on the loan amount and whether or not the loan is a piggyback loan. The cost is increasing and concave in the loan amount. The negative marginal effect for piggyback loans implies lower cost of origination, holding the loan amount constant. The variance of the symmetric error term is increasing both in the loan amount and the indicator for piggyback

loans, implying more cost heterogeneity for larger loans and for piggyback loans.

The estimated marginal effect on the loan amount is less than one and therefore the broker profit function is a concave function of the loan amount. The interaction terms indicate that the slope changes for smaller and larger loan amounts but that the shape remains the same. The mortgage rate relative to the 30-year benchmark rate is a strong determinant of broker profits, which is expected because the rate is a primary variable that determines the yield spread premium. For example, a 25 basis point higher mortgage rate, holding other things equal, implies an 8% increase in the broker profits.

Based on the marginal effects for the loan characteristics variables broker profits are substantially higher for hybrid and piggyback loans, for loans with prepayment penalties, and for cash-out refinance loans. The marginal effect is close to zero for balloon loans and for the CLTV, and the marginal effect is negative for stated documentation loans. The marginal effects of property characteristics are negative for properties that are either second homes or investment properties, and positive for multi-unit properties. The borrower's credit score has a positive marginal effect on profits that is slightly lower for borrowers with Fico scores above 620. Below 620, an increase in the Fico score of thirty points translates into approximately a 5% increase in broker profits.

By comparing the results in Table 7 with the results in Table 6 we can gains some additional insights. For example, the higher profits for hybrid and piggyback loans appear to be driven primarily by higher yield spread premia whereas the profits for loans with prepayment penalties or cash-out refinance loans are in no small part due to higher fees for such loans. For balloon, stated documentation loans, and for CLTV, the fees tend to be higher and yield spread premia lower, producing a net effect on profits which is approximately zero except for stated documentation loans.

The estimated profits are increasing in the borrower Fico score. The estimates in Table 6 suggest that this results reflects the net effect of higher yield spread premia and lower fees for higher Fico score borrowers. This illustrates how the lender's yield spread schedule, which appears to favor higher credit scores, is partly offset by differences in

direct fees. The broker's bargaining power may be greater when dealing with borrowers with lower credit scores or borrower's with lower Fico scores may have worse outside option and hence put a higher value on obtaining the loan. The results for the borrower's debt to income ratio are consistent with this interpretation because higher fees appear to be offset by lower yield spread premia with the net effect being zero.

4.4. Estimates for specification that adds regulation and neighborhood characteristics

Table 8 reports estimates for specifications of the frontier model that adds regulation and neighborhood characteristics. The estimated marginal effects for the race and ethnicity variables are consistent with greater broker profits in neighborhoods or zip codes with greater minority populations with potentially greater marginal effects in areas with a larger hispanic population. The estimated marginal effects for the education variable is negative suggesting that, holding other things equal, broker profits are smaller in neighborhoods with a more educated population. The results imply that either brokers have more bargaining power in zip codes with higher minority or less educated populations, or that the total surplus from the loans in such zip codes are higher.

The marginal effects for both the anti-predatory lending laws and the broker regulation variables are negative, consistent with lower profits in years and states with regulations that were stricter than the federal HOEPA laws or stricter broker regulations. Based on the summary statistics reported in Table A.1 in Appendix A, the average level of both regulation indices increases from zero to approximately two between the 1997-99 and 2000-03 periods, which based on our estimates would have been associated with a drop in the broker profits by six to ten percent.

4.5. Estimates for specification that adds broker variables

Table 9 reports estimates for specifications of the frontier model that includes broker variables. Brokers that have submitted loan applications in the previous month to New Century earn higher profits. The higher profit could stem from such brokers being awarded greater yield spread premia for loans with otherwise similar characteristics but

is is also consistent with greater broker bargaining power. The negative coefficient for the broker's fund rate indicates that for a broker who has submitted multiple loan applications there is a trade-off between profits and the lender's funding decision, albeit a fairly small one.

4.6. Robustness

For each of the specifications discussed above we report results for two specifications of the cost function. One specification has a base cost function that includes relatively few variables. A second specification adds more loan, property, borrower and broker characteristics as controls to the cost function to make it easier to assess the robustness of our findings.

While the coefficients on the additional loan characteristics are economically large and estimated precisely, the results in Tables 7 though 9 show that the general pattern of the coefficients in the one-sided error is similar to results reported for the base case cost function. Exceptions are the marginal effects for loans to refinance and loans with a balloon payment, which drop significantly. For loans to refinance, the shift essentially attributes the added revenue to costs rather than to the asymmetric error term, whereas for balloons, high marginal effects on costs are partially offset by negative effects on profits.

Adding property characteristics to the cost function leaves the marginal effect of the property type on the profits large the same, but attributes the added revenue for multi units to costs rather than to the asymmetric error term. Including the borrower credit score to the cost function makes economic sense, for example, if the broker incurs greater costs when dealing with borrowers with lower credit scores because such loan applications require more work or are riskier for the broker's reputation with New Century. Consistent with this, the cost estimates in the second specification decrease in the Fico score, and decrease more for higher Fico scores.

Including broker characteristics in the cost function allows us to account for potential

differences in the cost structure across different groups of brokers. While allowing for broker fixed effects per se is not feasible, we create distinct broker profiles based on a broker competition variable and the broker's past origination activity and fund rate with New Century, and let the cost function depend on these. Table 9 shows that loan origination is more costly at the margin if there are less housing units per broker in the zip code where the loan is orginated, and for brokers that submitted three or more loan applications to New Century in the last month. For the extended cost function, the positive coefficient for the number of housing units per broker is consistent with the interpretation that areas with relative many housing units per broker may have less competition between brokers, supporting higher profits.

The above discussion of the decomposition or broker revenues focused on the marginal effects. It is important to note, however, that often the total effect of a change in a certain loan characteristic is more interesting than the marginal effect. This may be particularly true here since many loan, borrower and property characteristics are correlated. We provide some evidence on the total effects of changing some key loan characteristics in Tables 10 and 11.

One approach to make the structure of the cost and profit functions even more flexible is to allow for interaction terms with certain loan characteristics. We test the merit of such an extension by re-estimating the model in columns four through six of Table 9 for different strata of loans. The results are reported in Table 12. They show a similar distribution of estimated costs and profits whether of not the model is estimated on the full sample or on the stratified sample. This indicates that the full model specification in Table 9 is robust to including interaction terms with a number of loan and location dummies as these are unlikely to have a major impact on our decomposition of revenues into cost and profit components.

4.7. Broker profit estimates based on frontier models

In order to further understand the results, Tables 10 and 11 report statistics for the fitted values based on the estimates reported in columns four through six of Table 9. We select this specification of the cost function because it produces conservative estimates of the broker profits. Tables 10 reports the mean and the median of the estimated profits based on the frontier model and the mean and median of the broker revenues by region and year. Table 11 reports the mean and median of the estimated profits, the revenue, the fees, and the yield spread premium by different loan types, borrower and property characteristics, and regulation, neighborhood, and broker variables.

The figures in Tables 10 indicate that across all years and regions, the average broker profit is approximately $1,100 or 20% of the revenue. With the exception of 1997 the average and median revenues tend to trend upwards and yet the profits fluctuate above and below $1,100 consistent with the profit margins declining somewhat over time. Across the regions we observe a similar pattern in that revenues fluctuate much more than the profits, consistent with a portion of the revenue differences stemming from cost differences across regions.

The mean broker profits for fixed-rate mortgages in Table 11 is $800 compared to $1,100 for hybrid loans $1,350 for balloon loans. The greater profits for balloon loans despite the negative marginal effects in all frontier model specifications is explained at least in part by greater loan amounts, higher credit scores, and by regional differences. Piggyback loans generate on average a $1,200 profit compared to $1,000 for free-standing first lien loans. Loans with prepayment penalties generate a profit that is $150 higher than loans without a prepayment penalty.

The neighborhood characteristics confirm that brokers make more profits on loans originated in neighborhoods with greater minority populations. The education and regulation variables produce smaller differences in the profits but the directions are all in line with the marginal effects discussed above. Active brokers make a $200 higher profits than inactive brokers. For the number of housing units per broker the total effect re-

verses the marginal effect. A greater density of brokers or fewer housing units per broker is associated with higher broker profits.

Overall, our decomposition of the broker revenues provides economically and statistically significant evidence of broker profits consistent with brokers having market power. In principle, higher broker profits can be driven by higher yield spread premia, higher borrower valuations, greater broker bargaining power, or some combination of the three. It is difficult based on our information to distinguish between these explanations. But in some cases, for example for hybrid and piggyback loans or loans with prepayment penalties, the main driver appears to be the yield spread premium. In other cases, for example for loans to refinance with or without cash being taken out, the driver is either greater dispersion in the borrowers' valuations for these loans or greater broker bargaining power. We now turn to the relationship between the broker profits and the loan performance.

5. The Effects of Broker Compensation on Loan Performance

The effects of broker compensation on loan performance are illustrated by Figure 5 which plots, for hybrid free-standing first-lien loans with stated documentation originated in California, the delinquency rate as a function of months from origination by year of origination. As in Section 2.3, a loan is considered delinquent if payments on the loan are 60 or more days late, or if the loan is reported as in foreclosure, real estate owned, or in default. The left plot shows the delinquency rates for loans with low broker profits, and the right plot shows the corresponding rates for high-broker-profit loans. Broker profits are estimated using the model described in columns four through six in Table 9. High-broker-profit loans are in the upper tercile of the conditional broker profit distribution, and low-broker-profit loans are in the lower tercile of the profit distribution. For each origination year, the delinquency rate tends to be higher for higher-broker-profit loans, conditional on the loan type.

To more formally establish a link between broker compensation and the ex-post riskiness of loans, we perform a duration analysis with 60-day delinquency as non-survival. Loans that leave the servicing data for reasons other than delinquency are treated as censored observations.[10] Let T denote the time at which a loan becomes at least 60 days delinquent or defaults for the first time, and let $S_{i,j}(t)$ denote the probability that a loan with covariate values $X_{i,j}$ survives until time t. That is,

$$S_{i,j}(t) = \Pr\left(T > t | X_{i,j}\right).$$

The hazard function for 60-day delinquency, $h_{i,j}(t)$, is the instantaneous rate of delinquency:

$$\begin{aligned} h_{i,j}(t) &= \lim_{t \to 0} \frac{\Pr\left(t + \Delta t > T > t | T > t, X_{i,j}\right)}{\Delta t} \\ &= -\frac{S'_{i,j}(t)}{S_{i,j}(t)}. \end{aligned}$$

We use the Cox (1972) proportional hazard approach to model $h_{i,j}(t)$ as:

$$h_{i,j}(t) = h_{ij,0}(t) \exp\left(\sum_k b_k X_{ij,k}\right).$$

Cox proportional hazard models provide estimates of the b_k's, but provide no direct estimates of the baseline hazard function $h_{ij,0}(t)$.

Table 13 reports parameter estimates for several Cox proportional hazard models that relate 60-day loan delinquency to loan, borrower, and broker characteristics, and macroeconomic variables. We find that the size of the mortgage has a positive marginal effect on delinquency rates, and that the marginal effect is larger for very small and for large loans. If the initial rate on the mortgage increases relative to the benchmark

[10] There is a vast empirical literature on mortgage termination, including Deng (1997), Ambrose and Capone (2000), Deng, Quigley, and Order (2000), Calhoun and Deng (2002), Pennington-Cross (2003), Deng, Pavlov, and Yang (2005), Clapp, Deng, and An (2006), Pennington-Cross and Chomsisengphet (2007), Demyanyk and Hemert (2009) and Jiang, Nelson, and Vytlacil (2009).

30-year mortgage rate, the loan's delinquency rate increases, everything else being equal. This is rather intuitive since a higher rate may indicate compensation for higher expected delinquency risk. In addition, the higher the mortgage rate, the harder it may be for the borrower to make the monthly payments. We observe a dramatic marginal effect of 33-35% higher delinquency rates for hybrid versus fix-rate loans, depending on the model specification. The effect is still positive but somewhat less pronounced for mortgages with a balloon payment at roughly 11-12%. We find that the hazard rate increases by about 30% for piggyback loans relative to free-standing first liens, everything else being equal. We also find that loans with stated documentation have positive marginal effects consistent with the findings of Jiang, Nelson, and Vytlacil (2009). The results in Table 13 show that hazard rates increase by about 20% if the mortgage is a stated-doc loan, and by approximately 10% if it has a prepay penalty. Not surprisingly, a higher CLTV leads to higher marginal delinquency rates. Refinance, and especially refinance cash-out mortgages, have a negative marginal effect consistent with the findings and interpretation in Chomsisengphet and Pennington-Cross (2006).

Table 13 shows that, everything else being equal, borrowers with higher credit scores and lower debt-to-income ratios default less frequently on their obligations, consistent with the evidence in Demyanyk and Hemert (2009). We find that loans that were originated in neighborhoods with a higher fraction of white population, higher fraction of hispanic population, or higher educational attainment exhibit marginally lower delinquency rates. The marginal effect for the regulation variables are mixed with 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. Our results show that increased broker competition is consistent with higher hazard rates. 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 2005.

The estimates in Table 13 also controls for the percentage direct fees and the per-

centage yield spread premia the broker receives. Specification I shows that, holding all else equal, abnormally high percentage fees and abnormally low yield spread premia are associated with higher delinquency rates. In particular, after controlling for all observable conditioning variables, it appears that the lender paid higher yield spreads for loans that turned out to be safer ex-post. Holding yield spreads the same, fees can differ across borrower-broker pairs with the same observable characteristics either due to a difference in bargaining power, or due to unobserved information that accounts for differences in borrower valuations and/or the broker's cost, see equation (6).

Specification II in Table 13 repeats the hazard rate estimation with additional temporal interaction terms for the percentage fees and yield spreads. For both the direct and indirect compensation channel, we observe that during the second half of our sample, from 2004 to 2006, mortgage brokers were compensated marginally better for loans that turned out to be more risky ex-post. As a result, abnormal fees paid by the borrower are even more indicative of higher future delinquencies during the second half of our sample than they were prior to 2004. And while the lender, conditional on all observable characteristics, paid higher abnormal yield spread premia for loans that turned out to be safer ex-post prior to 2004, the overall effect of abnormal yield spreads on delinquency rates is no longer significant during the 2004-6 period.

Specifications III and IV in Table 13 repeat the analysis after replacing percentage fees with log broker profits as estimated in columns four through six in the previous specifications. The marginal effects of loan, borrower and broker characteristics on loan performance are similar to those in the previous table. Note, however, that an increase in broker competition, measured as a decrease in the number of housing units per broker in a zip code, now yields significantly higher hazard rates. A one-standard-deviation increase in the number of housing units per broker leads to a 1.3% decrease in hazard rates, everything else being the same.

The marginal effects for broker profits are positive, suggesting that brokers earned high profits on loans that turned out to be riskier ex post. During the 1999-2006 period,

an increase in broker profits by 10% was associated with roughly a 2% increase in delinquency rates, all else equal. This effect was even more pronounced during the 2004-6 period. In the context of equations (6) through (8), this implies that as the fraction of the total gains from trade that the broker is able to capture, $\rho_{i,j}(\nu_{i,j} + y_{i,j} - C_{i,j})$, increases, ex-post delinquency rates rise. Holding yield spreads the same, broker profits can differ across borrower-broker pairs with the same observable characteristics either due to a difference in bargaining power, or due to unobserved information that accounts for differences in borrower valuations and/or the broker's cost. This allows us draw conclusions about the marginal effect of bargaining power and borrower valuation on delinquency rates similar to those based on the results in specifications I and II.

6. Conclusion

The financial crisis has led to new regulations for mortgage broker compensation and consumer protection in the mortgage market. We contribute to the ongoing discussion of the role of mortgage brokers by examining the incentives of mortgage brokers during the runup to the subprime crisis. We find statistically and economically strong evidence of positive broker profits, consistent with broker market power, that vary systematically with loan, borrower, and broker characteristics. Broker revenues in our sample range from an average of $3,700 in 1998 to $5,600 in 2005 and 2006. Approximately 70% of that comes from the direct fees and the rest from the yield spread premia. We attribute approximately $1,100 of the revenues to broker profits.

The relative importance for profits of direct fees and yield spread premia varies across loans of different types, borrower and broker characteristics. For example, greater profits for hybrid and piggyback loans appear to be driven by higher yield spread premia whereas higher profits on stated documentation and balloon loans appear to be driven more by greater fees. Overall, our results point to a poor alignment of the mortgage brokers' incentives and loan quality and performance during the runup to the subprime crisis.

We relate the estimated broker profits to future loan performance and find that after controlling for other factors, loans associated with higher broker profits have a greater risk of future delinquency. Profits that disproportionately stem from fees increase the risk of delinquency further. While both fees and the yield spread premia contribute to high profits, these findings suggest that the incentives provided by the yield spread premia may have left too much room for brokers to try to extract profits from the fees.

References

Altunbas, Y., E. Gardener, P. Molyneux, B. Moore, 2001. Efficiency in European Banking. European Economic Review 45, 1931–1955.

Ambrose, B., C. Capone, 2000. The hazard rates of first and second defaults. Journal of Real Estate Finance and Economics 20, 275–293.

Berger, A., L. Mester, 1997. Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions. Journal of Banking and Finance 21, 895–947.

Calhoun, C., Y. Deng, 2002. A dynamic analysis of fixed- and adjustable-rate mortgage terminations. Journal of Real Estate Finance and Economics 24, 9–33.

Campbell, J., 2006. Household Finance. Journal of Finance 61, 1553–1604.

Carlin, B., 2009. Strategic Price Complexity in Retail Financial Markets. Journal of Financial Economics 91, 278–287.

Chomsisengphet, S., A. Pennington-Cross, 2006. Subprime Refinancing: Equity Extraction and Mortgage Termination. Unpublished working paper, Federal Reserve Bank of St. Louis.

Clapp, J., Y. Deng, X. An, 2006. Unobserved heterogeneity in models of competing mortgage termination risks. Real Estate Economics 34, 243–273.

Cox, D., 1972. Regression Models and Life Tables. Journal of the Royal Statistical Society Series B 34, 187–220.

Demyanyk, Y., O. V. Hemert, 2009. Understanding the subprime mortgage crisis. Forthcoming, Review of Financial Studies.

Deng, Y., 1997. Mortgage Termination: An Empirical Hazard Model with Stochastic Term Structure. Journal of Real Estate Finance and Economics 14, 309–331.

Deng, Y., A. Pavlov, L. Yang, 2005. Spatial heterogeneity in mortgage terminations by refinance. Real Estate Economics 33, 739–764.

Deng, Y., J. M. Quigley, R. V. Order, 2000. Mortgage Terminations, Heterogeneity and the Exercise of Mortgage Options. Econometrica 68, 275–307.

El-Anshasy, A., G. Elliehausen, Y. Shimazaki, 2006. The pricing of subprime mortgages by mortgage brokers and lenders. Unpublished working paper, George Washington University.

Gabaix, X., D. Laibson, 2006. Shrouded Attributes, Consumer Myopia, and Information Suppression in Competitive Markets. Quarterly Journal of Economics 121, 505–540.

Garmaise, M., 2009. After the Honeymoon: Relationship Dynamics Between Morgage Brokers and Banks. Unpublished working paper, UCLA.

Goetzmann, W., L. Peng, J. Yen, 2009. The Subprime Crisis and House Price Appreciation. NBER working paper #15334.

Green, R., B. Hollifield, N. Schürhoff, 2007. Financial Intermediation and the Costs of Trading in an Opaque Market. Review of Financial Studies 20, 275–314.

Greene, W. E., 2002. Econometric Analysis. Prentice Hall, Upper Saddle River, NJ.

Ho, G., A. Pennington-Cross, 2005. The impact of local predatory lending laws. Unpublished working paper, Federal Reserve Bank of St. Louis.

——— , 2006. The Impact of Local Predatory Lending Laws on the Flow of Subprime Credit. Journal of Urban Economics 60, 210–228.

Hunt-McCool, J., S. Koh, B. Francis, 1996. Testing for Deliberate Underpricing in the IPO Premarket: A Stochastic Frontier Approach. Review of Financial Studies 9, 1251–1269.

Iyengar, S., W. Jiang, G. Huberman, 2004. How Much Choice is Too Much?: Contributions to 401(k) Retirement Plans. in *Pension design and structure: new lessons from behavioral finance*, ed. by O. Mitchell, and S. Utkus. Oxford University Press New York chap. 5.

Jiang, W., A. Nelson, E. Vytlacil, 2009. Liar Loans? Effects of Loan Origination and Loan Sale on Delinquency. Unpublished working paper, Columbia Business School.

Keys, B., T. Mukherjee, A. Seru, V. Vig, 2009. Financial regulation and securitization: Evidence from subprime loans. Journal of Monetary Economics 56, 700–720.

Kleiner, M., R. Todd, 2007. Mortgage Broker Regulations That Matter: Analyzing Earnings, Employment, And Outcomes For Consumers. NBER working paper #13684.

Koop, G., K. Li, 2001. The Valuation of IPO and SEO Firms. Journal of Empirical Finance 8, 375–401.

Kumbhakar, S., K. Lovell, 2000. Stochastic Frontier Analysis. Cambridge University Press, New York, NY.

LaCour-Little, M., 2009. The Pricing of Mortgages by Brokers: An Agency Problem?. Journal of Real Estate Research 31, 235–263.

Li, W., K. Ernst, 2007. Do State Predatory Lending Laws Work? A Panel Analysis of Market Reforms. Housing Policy Debate 18, 347–391.

Mian, A., A. Sufi, 2009. The consequences of mortgage credit expansion: Evidence from the U.S. mortgage default crisis. Quarterly Journal of Economics 124, 1449–1496.

Pahl, C., 2007. A Compilation of State Mortgage Broker Laws and Regulations 1996-2006. Federal Reserve Bank of Minneapolis, Community Affairs Report #2007-2.

Palepu, K., S. Srinivasan, A. Sesia Jr., 2008. New Century Financial Corporation. HBS case #9-109-034.

Pennington-Cross, A., 2003. Credit history and the performance of prime and nonprime mortgages. Journal of Real Estate Finance and Economics 27, 279–301.

Pennington-Cross, A., S. Chomsisengphet, 2007. Subprime Refinancing: Equity Extraction and Mortgage Termination. Real Estate Economics 35, 233–263.

Purnanandam, A., 2009. Originate-to-distribute model and the subprime mortgage crisis. Unpublished working paper, University of Michigan.

Woodward, S., R. Hall, 2009. The Equilibrium Distribution of prices Paid by Imperfectly Informed Customers: Theory and Evidence from the Mortgage Market. Unpublished working paper, Stanford University.

Table 1: **List of Variables** The table describes the conditioning variables used in the empirical analysis.

Variable	Description
	Loan Characteristics
Rate-benchmark 30yr rate	Initial mortgage rate minus 30-year conventional mortgage rate in %
Loan amount	Loan amount in thousands of dollars
Log loan amount	Natural logarithm of loan amount in thousands of dollars
Hybrid	Indicator for hybrid mortgages
Balloon	Indicator for mortgages with a balloon payment
Piggyback	Indicator for a matched pair of a 1st and a 2nd lien loan*
Stated doc	Indicator for a stated documentation loan
Prepay penalty	Indicator for a loan with a prepayment penalty
Refi	Indicator for a refinancing
Refi cash-out	Indicator for a cash-out refinancing
CLTV	Combined loan to value ratio in %
	Borrower Characteristics
Fico	Fair, Isaac and Company (Fico) credit score at origination
Debt-to-income	Debt to income ratio (back-end ratio) in %
Monthly income	Combined monthly borrower income in thousands on dollar
	Property Characteristics
2nd home/investment property	Indicator for second home or investment property
Multi unit	Indicator for 2-4 unit properties
Planned unit development (PUD)	Individual ownership of unit, shared ownership of common areas
	Market Conditions
Benchmark 30yr rate	30-year conventional mortgage in %
Slope of yield curve	10-year minus 1-year Treasury rate in %
House prices	Lagged abnormal 3-year cumulative house price appreciation (OFHEO)
	*Regulation Variables***
Regulation (coverage)	Index of coverage of anti-predatory lending laws
Regulation (restrictions)	Index of restrictions of anti-predatory lending laws
Broker regulation-Pahl	Index of mortgage broker regulation
Broker regulation-KT	Financial requirements for mortgage brokers
	*Neighborhood Characteristics***
Race	% white population in zip code
Ethnicity	% hispanic population in zip code
Education	% of population with a BA degree
	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
Broker fund rate	Ratio of funded loans to loan applications for active brokers in %

* Details on the matching algorithm are provided in Appendix A.
** We provide more details and summary statistics in Appendix A.

Table 2: **Descriptive Statistics** The table reports descriptive statistics for our sample of broker originated loans. The sample period is 1997 to 2006. We provide details on how we constructed the sample in Appendix A. Due to rounding, the percentages may not add up to one hundred.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	All
					Number of funded broker loans (×1000)						
Number of loans	4	15	19	19	30	67	113	142	157	150	715
					Loan Amount (×$1,000) for funded broker loans						
Avg loan amount	105	100	109	123	146	156	175	196	215	219	189
					Number of brokers with funded loans (×1000)						
Number of brokers	1	3	5	5	6	10	15	21	25	27	58
					Geographical location (percent of funded broker loans))						
CA	26	19	19	26	32	30	31	31	27	21	27
FL	5	8	9	9	8	9	9	9	12	11	10
TX	3	5	7	7	4	5	6	6	5	8	6
West w/o CA	20	14	13	13	12	11	10	14	14	12	13
South w/o FL, TX	3	14	15	13	12	12	11	10	11	14	12
Midwest	40	32	27	25	25	23	19	15	15	17	18
Northeast	3	8	12	8	7	10	14	15	16	17	14
Metro areas	91	90	89	90	91	92	92	91	91	90	91
Non-metro areas	9	10	11	10	9	8	8	9	9	10	9
					Loan purpose (percent of funded broker loans)						
Refi, cash out	55	49	56	56	60	63	62	56	47	46	54
Refi, no cash out	23	17	18	18	18	17	12	6	9	9	11
Purchase	22	34	26	25	21	20	26	38	44	44	36
					Occupancy type (percent of funded broker loans)						
Primary residence	83	79	86	91	90	91	93	92	89	87	90
Second home	1	1	1	0	0	0	1	1	2	3	1
Investment property	16	21	13	9	9	8	7	7	8	10	9
					Property type (percent of funded broker loans)						
Single family	84	82	83	81	80	79	78	75	74	75	76
2-4 unit	8	9	8	6	7	8	7	8	7	7	7
Condo	3	4	4	5	5	5	6	7	8	7	6
PUD	5	4	5	8	8	8	9	11	11	12	10

Table 3: **Loan Characteristics at Origination by Vintage Year** The table reports descriptive statistics for the loans in our sample. We provide details on our sample construction in Appendix A. The majority of second lien loans in our sample can be matched precisely on loan, property, borrower, and broker characteristics with a first lien loan using a matching scheme that we describe in Appendix A. A piggyback mortgages is defined as a matched pair of a first and second lien for the same borrower and property. Any unmatched second lines are dropped so our sample contains free-standing first liens and matched piggyback loans (1st+2nd liens).

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	All
						Number of funded broker loans (×1000)					
Free-standing 1st lien	4	15	19	19	30	66	107	117	112	109	598
Piggyback	0	0	0	0	0	1	6	25	45	41	117
						Loan Amount (×$1,000) for funded broker loans					
Free-standing 1st lien	104	100	109	123	146	156	174	194	209	211	182
Piggyback	-	-	-	-	-	-	231	258	288	298	282
						Loan program (percent of funded broker loans)					
Fixed-rate	24	36	31	18	19	28	32	23	19	15	22
Hybrid	76	64	69	82	81	72	68	77	75	45	68
Balloon	0	0	0	0	0	0	0	0	7	40	10
						Fixed-rate loans (percent of funded fixed broker loans)					
30-year FRM	87	88	86	85	87	86	85	85	84	64	82
Other fixed-rate	13	12	14	15	13	14	15	15	16	36	18
						Hybrid loans (percent of funded hybrid broker loans)					
2/28	65	85	88	80	96	95	94	73	50	34	66
Other hybrid	35	15	12	20	4	5	6	27	50	66	34
						Full or limited documentation (percent of funded broker loans)					
All	70	63	65	65	60	60	59	52	56	59	58
Fixed-rate	68	64	68	72	64	64	67	64	73	74	68
Hybrid	70	63	64	64	59	59	56	49	52	56	55
Balloon	-	-	-	-	-	-	-	-	50	52	52
						Mortgage rate (percent)					
All	9.9	10.0	10.3	10.9	9.6	8.5	7.5	7.1	7.4	8.5	8.0
Fixed-rate	9.9	10.2	10.5	11.4	9.7	8.4	7.5	7.1	7.3	8.3	8.0
Hybrid	9.9	9.9	10.2	10.8	9.6	8.5	7.6	7.3	7.7	8.8	8.3
Piggyback, 1st lien	-	-	-	-	-	-	6.6	6.4	6.9	7.9	7.2
Piggyback, 2nd lien	-	-	-	-	-	-	10.5	10.3	10.4	11.2	10.7
						Prepayment penalty (percent of funded broker loans)					
Prepay penalty	63	71	75	84	83	80	80	78	73	71	76

Table 4: **Borrower Characteristics by Vintage Year** The tables reports descriptive statistics for the borrowers at the time of origination. The mean credit score (Fico), combined monthly income, combined loan-to-value ratio (CLTV), and the debt-to-income ratio (back-end ratio) are reported along with the percent of borrowers with Fico scores at or above 620 for different groups of loans. The bottom part of the table reports the average monthly income, CLTV, loan amount, and debt-to-income ratio for borrowers by borrower credit score—at or above 620 versus below 620.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	All
						All loans					
Fico score	602	600	594	581	582	591	606	621	623	615	611
Fico $\geq$ 620 (%)	38	40	35	26	24	31	41	51	53	47	45
Monthly income	6	6	5	5	6	6	6	6	7	8	7
CLTV	74	78	77	77	78	79	82	85	86	86	83
Debt-to-income	37	36	37	39	39	39	39	40	40	40	40
						Full or limited documentation, free-standing 1st liens					
Fico score	597	596	588	572	571	579	597	603	599	591	593
Fico $\geq$ 620 (%)	34	35	30	20	17	23	33	37	35	28	31
Monthly Income	5	5	5	5	5	5	5	5	6	7	6
CLTV	75	79	78	78	79	79	81	81	80	81	80
Debt-to-income	38	38	39	40	40	40	39	40	40	40	40
						Stated documentation, free-standing 1st liens					
Fico score	615	609	605	597	597	607	613	624	626	617	617
Fico $\geq$ 620 (%)	47	46	43	35	34	42	47	54	54	46	48
Monthly income	6	6	6	7	7	7	7	7	8	9	8
CLTV	70	77	76	77	78	78	80	82	81	82	80
Debt-to-income	35	34	35	37	37	37	39	39	39	39	38
						All documentation types, piggyback loans					
Fico score	-	-	-	-	-	-	647	658	655	653	655
Fico $\geq$ 620 (%)	-	-	-	-	-	-	73	80	78	77	78
Monthly income	-	-	-	-	-	-	7	7	8	9	8
CLTV	-	-	-	-	-	-	100	100	100	100	100
Debt-to-income	-	-	-	-	-	-	42	42	42	42	42
						Fico $\geq$ 620, all loans, all documentation types					
Monthly income	6	6	6	6	7	7	7	7	8	9	8
CLTV	74	80	80	82	81	82	85	89	90	91	88
Loan amount	114	108	118	136	166	182	204	233	266	276	236
Debt-to-Income	37	35	36	38	38	38	39	40	40	41	40
						Fico $<$ 620, all loans, all documentation types					
Monthly income	5	5	5	5	6	5	6	6	6	6	6
CLTV	74	77	76	76	77	78	79	81	81	82	80
Loan amount	99	95	105	118	140	145	159	175	193	198	168
Debt-to-income	38	37	38	39	39	39	39	40	40	40	40

Table 5: **Broker Compensation** The table reports the mean and the skewness coefficient for the yield spread premium, the direct fees, and the broker's total revenue with the mean on the first and skewness on the second row. The top of the table reports the statistics by origination year, the middle part reports them by loan type, and the bottom part reports them by loan amount and borrower credit score.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
					Percent of loan amount					
YSP	1.8	1.3	1.1	1.0	0.9	1.0	0.9	1.0	0.8	0.7
	-0.3	0.2	0.6	0.3	0.3	0.1	0.1	0.3	0.3	0.5
Direct fees	3.3	3.3	3.5	3.3	3.0	2.8	2.4	2.1	2.0	2.1
	0.9	1.0	1.0	0.7	0.6	0.6	0.8	0.9	0.8	0.4
Revenue	5.0	4.6	4.5	4.3	3.8	3.7	3.3	3.0	2.8	2.8
	0.8	0.9	0.9	0.7	0.6	0.6	0.6	0.8	0.8	0.4
					Dollars per loan (×$1,000)					
YSP	1.8	1.2	1.0	1.1	1.1	1.4	1.5	1.9	1.7	1.4
	2.3	2.3	2.3	1.9	1.7	1.5	1.4	1.3	1.3	1.6
Direct fees	2.7	2.6	3.0	3.4	3.7	3.6	3.5	3.6	3.9	4.3
	1.2	1.6	1.6	1.5	1.4	1.3	1.2	1.2	1.2	1.2
Revenue	4.3	3.7	4.0	4.4	4.8	4.9	5.0	5.4	5.6	5.6
	1.6	1.8	1.6	1.4	1.3	1.2	1.2	1.1	1.0	1.0

Loan program	All loans		FRM		Hybrid		Balloon		Piggyback	
Full or limited doc?	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
					Dollars per loan (×$1,000)					
YSP	1.4	1.7	0.9	0.9	1.6	1.8	1.2	1.5	1.8	2.0
	1.6	1.3	2.0	2.1	1.5	1.3	1.6	1.4	1.2	1.0
Direct fees	3.6	4.0	3.5	3.8	3.7	4.0	4.9	5.2	3.5	4.3
	1.5	1.2	1.6	1.3	1.4	1.2	1.0	0.8	1.4	1.0
Revenue	5.0	5.7	4.3	4.6	5.2	5.7	6.1	6.7	5.3	6.3
	1.3	1.0	1.4	1.3	1.2	0.9	0.9	0.6	1.3	0.8

	Loan amount						Fico score			
Loan amount/Fico score	$(0, \$100]$		($100, $300)		$[\$300, \infty)$		≥620		<620	
Full or limited doc?	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
					Dollars per loan (×$1,000)					
YSP	0.8	0.8	1.5	1.6	2.7	2.8	1.5	1.8	1.4	1.6
	0.4	0.4	0.7	0.7	0.6	0.5	1.5	1.2	1.6	1.4
Direct fees	2.3	2.2	3.8	3.9	5.9	5.8	3.7	4.0	3.5	4.0
	0.7	0.7	1.0	0.9	0.5	0.4	1.4	1.2	1.5	1.2
Revenue	3.0	2.9	5.3	5.4	8.6	8.6	5.2	5.7	4.9	5.5
	0.7	0.7	0.9	0.8	0.2	0.1	1.2	0.9	1.3	1.0

Table 6: **Direct Fees and YSP Regressions** The table reports the parameter estimates for Tobit regressions with the broker direct fees and the yield spread premia in percent and in thousands of dollars as dependent variables. All estimates are statistically significant at the 5% level except for Fico×1(Fico $\geq$ 620), debt-to-income, 1998, 2001 (fees, %), for piggyback, 1998, 2001 (fees, \$), for non-metro areas (YSP, %), and for Fico×1(Fico $\geq$ 620) (YSP, \$).

	Direct fees		YSP	
	%	\$	%	\$
Constant	5.097	4.373	-2.728	-6.840
		Loan Characteristics		
Rate-benchmark 30yr rate	-0.030	-0.216	0.491	0.886
Loan amt (\$1,000)	-0.006	0.009	0.001	0.010
Loan amt × 1(loan amt $\leq$ \$100K)	0.003	-0.002	-0.0004	-0.003
Loan amt × 1(loan amt $\geq$ \$300K)	0.002	-0.001	-0.0002	-0.001
Hybrid	-0.170	-0.180	0.588	1.117
Balloon	0.165	0.436	-0.207	-0.461
Piggyback	-0.196	0.010	0.214	0.815
Stated doc	0.072	0.296	-0.416	-0.752
Prepay penalty	0.306	0.513	0.129	0.216
Refi	0.258	0.486	-0.181	-0.300
Refi w/ cash out	0.231	0.382	0.050	0.068
CLTV	-0.004	0.007	-0.010	-0.019
		Property Characteristics		
2nd home/investment property	0.0640	-0.185	-0.346	-0.591
Multi unit	0.162	0.633	-0.020	-0.069
		Borrower Characteristics		
Fico	-0.002	-0.004	0.004	0.007
Fico × 1(Fico $\geq$ 620)	0.00001	-0.0001	-0.000001	-0.0002
Debt-to-income	0.00006	0.008	-0.003	-0.004
		Market Conditions		
Benchmark 30yr rate	-0.021	-0.089	0.188	0.230
Slope of yield curve	-0.056	-0.179	0.198	0.373
House prices	0.014	0.022	-0.003	-0.015
		Location Dummies		
Non-metro areas	0.010	-0.100	0.006	-0.031
FL	-0.104	-0.538	0.111	0.238
TX	-0.396	-0.748	0.570	0.858
West	-0.256	-0.628	0.120	0.251
South	-0.014	-0.356	0.107	0.211
Midwest	-0.133	-0.790	0.182	0.311
Northeast	-0.101	-0.316	0.125	0.314
		Year Dummies		
1998	-0.007	0.009	-0.495	-0.661
1999	0.217	0.302	-0.896	-1.125
2000	0.116	0.386	-1.048	-1.311
2001	-0.011	0.600	-1.236	-1.705
2002	-0.166	0.379	-0.801	-0.930
2003	-0.412	0.059	-0.630	-0.629
2004	-0.558	-0.161	-0.345	-0.098
2005	-0.500	-0.059	-0.355	-0.166
2006	-0.482	0.171	-0.719	-0.825
σ	1.174	2.106	0.827	1.762
Number of observations		715,011		

Table 7: **Broker Revenue Decomposition – Baseline Specifications** The table reports parameter estimates for the stochastic frontier model developed in Section 3. The dependent variable is broker revenue in $1,000. The estimates for the cost function and the symmetric error variance function are reported in the first two columns. The third column shows the estimated specification of broker profits. Estimates for yearly dummies, which are included in all equations, are omitted from the table. Columns 4-6 report the results for an extended cost function. The benchmark set contains all CA fixed-rate mortgages originated in 1997.

	Base Cost Function			Extended Cost Function		
	Cost	Std. Dev.	Profit	Cost	Std. Dev.	Profit
Constant	1.3740	0.0280	0.0072	1.5370	0.0231	0.0100
	(0.0345)	(0.0009)	(0.0008)	(0.0588)	(0.0010)	(0.0012)
			Loan Characteristics			
Rate - benchmark 30yr rate			0.3025			0.3125
			(0.0027)			(0.0031)
Loan amt	0.0184			0.0182		
	(0.0001)			(0.0001)		
Loan amt × 1(loan amt ≤ $100K)	0.0030			0.0046		
	(0.0001)			(0.0001)		
Loan amt × 1(loan amt ≥ $300K)	-0.0038			-0.0042		
	(0.0001)			(0.0001)		
Log loan amt		0.8365	0.6180		0.8470	0.5845
		(0.0051)	(0.0135)		(0.0054)	(0.0148)
Log loan amt × 1(loan amt ≤ $100K)		0.0273	-0.0860		0.0413	-0.1490
		(0.0013)	(0.0037)		(0.0014)	(0.0058)
Log loan amt × 1(loan amt ≥ $300K)		-0.0032	0.0352		-0.0094	0.0530
		(0.0011)	(0.0034)		(0.0012)	(0.0032)
Hybrid			0.3895	0.1840	0.0297	0.2140
			(0.0060)	(0.0063)	(0.0034)	(0.0092)
Balloon			0.0391	0.0581	0.0431	-0.0201
			(0.0083)	(0.0119)	(0.0053)	(0.0122)
Piggyback	-0.0849	-0.0115	0.5600	0.0632	-0.0096	0.4085
	(0.0093)	(0.0039)	(0.0117)	(0.0101)	(0.0046)	(0.0119)
Stated doc			-0.2080	-0.0070	0.0017	-0.2120
			(0.0049)	(0.0059)	(0.0029)	(0.0075)
Prepay penalty			0.5985	0.2790	0.0410	0.3080
			(0.0070)	(0.0063)	(0.0033)	(0.0086)
Refi			0.2210	0.2140	0.0630	-0.0033
			(0.0082)	(0.0099)	(0.0049)	(0.0138)
Refi w/ cash out			0.2960	0.1420	-0.0263	0.2000
			(0.0074)	(0.0090)	(0.0045)	(0.0126)
CLTV			-0.0076	0.0017	0.0004	-0.0092
			(0.0002)	(0.0002)	(0.0001)	(0.0003)

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Table 7 – continued from previous page

	Base Cost Function			Extended Cost Function		
	Cost	Std. Dev.	Profit	Cost	Std. Dev.	Profit
			Property Characteristics			
2nd home/investment prop			-0.2815	-0.0504	0.0895	-0.3045
			(0.0081)	(0.0091)	(0.0047)	(0.0154)
Multi unit			0.2340	0.0948	-0.0412	0.1955
			(0.0085)	(0.0117)	(0.0057)	(0.0123)
			Borrower Characteristics			
Fico			0.00069	-0.00132	0.00008	0.00163
			(0.00007)	(0.00008)	(0.00004)	(0.00010)
Fico × 1(Fico ≥ 620)			-0.00008	-0.00005	0.00002	-0.00004
			(0.00001)	(0.00001)	(0.00001)	(0.00002)
Debt-to-income			-0.0003	0.0008	-0.0013	0.0001
			(0.0002)	(0.0003)	(0.0001)	(0.0004)
			Market Conditions			
Benchmark 30yr rate			0.1035			0.0980
			(0.0082)			(0.0083)
Slope of yield curve			0.0770			0.0765
			(0.0060)			(0.0060)
House prices			0.0013			0.0023
			(0.0005)			(0.0005)
			Location Dummies			
Non-metro areas	-0.0371	-0.0182	-0.0042	-0.05400	-0.02455	0.0173
	(0.0079)	(0.0048)	(0.0118)	(0.00777)	(0.00473)	(0.0120)
FL	-0.1840	0.1110	0.0580	-0.27300	0.08600	0.1310
	(0.0134)	(0.0053)	(0.0148)	(0.01330)	(0.00540)	(0.0148)
TX	-0.2350	-0.0850	0.2845	-0.17800	-0.08700	0.2050
	(0.0128)	(0.0068)	(0.0164)	(0.01330)	(0.00695)	(0.0171)
West w/o CA	-0.4010	-0.0845	0.1185	-0.41100	-0.09250	0.1195
	(0.0122)	(0.0050)	(0.0119)	(0.01240)	(0.00510)	(0.0125)
South w/o FL and TX	-0.2810	-0.0334	0.2065	-0.29800	-0.05200	0.2350
	(0.0119)	(0.0054)	(0.0134)	(0.01200)	(0.00550)	(0.0134)
Midwest	-0.1850	0.0301	-0.0474	-0.21000	0.03390	-0.0825
	(0.0114)	(0.0047)	(0.0134)	(0.01210)	(0.00497)	(0.0161)
Northeast	-0.2790	-0.0266	0.1785	-0.31800	-0.05050	0.2195
	(0.0132)	(0.0051)	(0.0139)	(0.01260)	(0.00520)	(0.0125)
Included but not reported: Year dummies for 1998-2006						
Number of observations		715,011			715011	

Table 8: **Broker Revenue Decomposition – Adding Neighborhood and Regulation Variables**
The table reports parameter estimates for the stochastic frontier model developed in Section 3. The dependent variable is broker revenue in $1,000. The estimates for the cost function and the symmetric error variance function are reported in the first two columns. The third column shows the estimated specification of broker profits. Estimates for yearly and regional dummies, which are included in all equations, are omitted from the table. Columns 4-6 report the results for an extended cost function. The benchmark set contains all CA fixed-rate mortgages originated in 1997.

	Base Cost Function			Extended Cost Function		
	Cost	Std. Dev.	Profit	Cost	Std. Dev.	Profit
Constant	1.3520	0.0274	0.0101	1.4960	0.0229	0.0119
	(0.0340)	(0.0009)	(0.0011)	(0.0586)	(0.0010)	(0.0014)
			Loan Characteristics			
Rate - benchmark 30yr rate			0.2965			0.3060
			(0.0027)			(0.0029)
Loan amt	0.0185			0.0182		
	(0.0001)			(0.0001)		
Loan amt × 1(loan amt ≤ $100K)	0.0028			0.0036		
	(0.0001)			(0.0001)		
Loan amt × 1(loan amt ≥ $300K)	-0.0040			-0.0041		
	(0.0001)			(0.0001)		
Log loan amt		0.8370	0.7575		0.8460	0.7410
		(0.0050)	(0.0133)		(0.0053)	(0.0145)
Log loan amt × 1(loan amt ≤ $100K)		0.0245	-0.0805		0.0330	-0.1180
		(0.0013)	(0.0035)		(0.0013)	(0.0044)
Log loan amt × 1(loan amt ≥ $300K)		-0.0061	0.0402		-0.0087	0.0459
		(0.0010)	(0.0030)		(0.0011)	(0.0031)
Hybrid			0.4090	0.1720	0.0229	0.2470
			(0.0060)	(0.0063)	(0.0034)	(0.0094)
Balloon			0.0270	0.0632	0.0420	-0.0393
			(0.0084)	(0.0117)	(0.0052)	(0.0127)
Piggyback	-0.0724	-0.0117	0.5805	0.0855	-0.0051	0.4200
	(0.0088)	(0.0037)	(0.0114)	(0.0100)	(0.0046)	(0.0122)
Stated doc			-0.2200	-0.0071	0.0026	-0.2235
			(0.0049)	(0.0059)	(0.0029)	(0.0076)
Prepay penalty			0.5225	0.2790	0.0463	0.2425
			(0.0066)	(0.0061)	(0.0032)	(0.0087)
Refi			0.2070	0.2020	0.0585	-0.0024
			(0.0081)	(0.0099)	(0.0049)	(0.0139)
Refi w/ cash out			0.2605	0.1510	-0.0229	0.1555
			(0.0073)	(0.0090)	(0.0045)	(0.0127)
CLTV			-0.0095	0.0018	0.0005	-0.0111
			(0.0002)	(0.0002)	(0.0001)	(0.0003)

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Table 8 – continued from previous page

	Base Cost Function			Extended Cost Function		
	Cost	Std. Dev.	Profit	Cost	Std. Dev.	Profit
			Property Characteristics			
2nd home/investment prop			-0.2830	-0.0670	0.0840	-0.2750
			(0.0081)	(0.0088)	(0.0046)	(0.0139)
Multi unit			0.0775	0.1420	-0.0310	-0.0068
			(0.0086)	(0.0115)	(0.0055)	(0.0127)
			Borrower Characteristics			
Fico			0.00070	-0.00131	0.00005	0.00165
			(0.00007)	(0.00008)	(0.00004)	(0.00010)
Fico $\times$ 1(Fico $\geq$ 620)			-0.00008	-0.00005	0.00002	-0.00004
			(0.00001)	(0.00001)	(0.00001)	(0.00002)
Debt-to-income			-0.0010	0.0010	-0.0013	-0.0009
			(0.0002)	(0.0003)	(0.0001)	(0.0004)
			Market Conditions			
Benchmark 30yr rate			0.0705			0.1420
			(0.0082)			(0.0083)
Slope of yield curve			0.0860			0.1720
			(0.0060)			(0.0060)
House prices			0.0030			0.0023
			(0.0005)			(0.0005)
			Neighborhood and Regulation Variables			
Race			-0.0050			-0.0052
			(0.0001)			(0.0001)
Ethnicity			0.0020			0.0022
			(0.0001)			(0.0001)
Education			-0.0122			-0.0118
			(0.0004)			(0.0004)
Regulation (coverage)			-0.0464			-0.0444
			(0.0015)			(0.0015)
Regulation (restrictions)			-0.0257			-0.0261
			(0.0014)			(0.0014)
Regulation (brokers, Pahl)			-0.0081			-0.0061
			(0.0020)			(0.0020)
Regulation (brokers, KT)			-0.0113			-0.0131
			(0.0015)			(0.0014)
Included but not reported: Location and Year dummies						
Number of observations		715,011			715,011	

Table 9: **Broker Revenue Decomposition – Adding Broker Variables** The table reports parameter estimates for the stochastic frontier model developed in Section 3. The dependent variable is broker revenue in $1,000. The estimates for the cost function and the symmetric error variance function are reported in the first two columns. The third column shows the estimated specification of broker profits. Estimates for yearly and regional dummies, which are included in all equations, are omitted from the table. Columns 4-6 report the results for an extended cost function. The benchmark set contains all CA fixed-rate mortgages originated in 1997.

	Base Cost Function			Extended Cost Function		
	Cost	Std. Dev.	Profit	Cost	Std. Dev.	Profit
Constant	1.3390	0.0286	0.0075	1.5200	0.0252	0.0081
	(0.0338)	(0.0009)	(0.0008)	(0.0577)	(0.0010)	(0.0010)
			Loan Characteristics			
Rate - benchmark 30yr rate			0.3075			0.3190
			(0.0027)			(0.0029)
Loan amt	0.0182			0.0178		
	(0.0001)			(0.0001)		
Loan amt × 1(loan amt ≤ $100K)	0.0027			0.0037		
	(0.0001)			(0.0001)		
Loan amt × 1(loan amt ≥ $300K)	-0.0038			-0.0038		
	(0.0001)			(0.0001)		
Log loan amt		0.8245	0.7885		0.8265	0.7845
		(0.0049)	(0.0130)		(0.0053)	(0.0144)
Log loan amt × 1(loan amt ≤ $100K)		0.0237	-0.0785		0.0336	-0.1245
		(0.0012)	(0.0035)		(0.0013)	(0.0045)
Log loan amt × 1(loan amt ≥ $300K)		-0.0022	0.0314		-0.0038	0.0354
		(0.0010)	(0.0029)		(0.0011)	(0.0030)
Hybrid			0.4140	0.1820	0.0222	0.2470
			(0.0060)	(0.0062)	(0.0034)	(0.0092)
Balloon			0.0191	0.0497	0.0376	-0.0366
			(0.0084)	(0.0116)	(0.0052)	(0.0124)
Piggyback	-0.0419	0.0039	0.5515	0.0908	-0.0020	0.4225
	(0.0087)	(0.0037)	(0.0114)	(0.0099)	(0.0045)	(0.0123)
Stated doc			-0.2220	-0.0076	0.0045	-0.2285
			(0.0049)	(0.0058)	(0.0028)	(0.0075)
Prepay penalty			0.5305	0.2730	0.0412	0.2540
			(0.0067)	(0.0060)	(0.0032)	(0.0087)
Refi			0.1960	0.1730	0.0427	0.0138
			(0.0082)	(0.0096)	(0.0048)	(0.0136)
Refi w/ cash out			0.2480	0.1440	-0.0253	0.1520
			(0.0073)	(0.0087)	(0.0044)	(0.0122)
CLTV			-0.0097	0.0020	0.0007	-0.0117
			(0.0002)	(0.0002)	(0.0001)	(0.0003)

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Table 9 – continued from previous page

	Base Cost Function			Extended Cost Function		
	Cost	Std. Dev.	Profit	Cost	Std. Dev.	Profit
			Property Characteristics			
2nd home/investment prop			-0.2765	-0.0516	0.0900	-0.2960
			(0.0081)	(0.0086)	(0.0045)	(0.0140)
Multi unit			0.0905	0.1470	-0.0261	0.0010
			(0.0087)	(0.0114)	(0.0055)	(0.0128)
			Borrower Characteristics			
Fico			0.00077	-0.00136	0.00001	0.00179
			(0.00007)	(0.00008)	(0.00004)	(0.00010)
Fico × 1(Fico ≥ 620)			-0.00008	-0.00005	0.00002	-0.00004
			(0.00001)	(0.00001)	(0.00001)	(0.00002)
Debt-to-income			-0.0012	0.0009	-0.0013	-0.0009
			(0.0002)	(0.0003)	(0.0001)	(0.0004)
			Market Conditions			
Benchmark 30yr rate			0.0735			0.0755
			(0.0083)			(0.0084)
Slope of yield curve			0.0850			0.0860
			(0.0060)			(0.0061)
House prices			0.0029			0.0022
			(0.0005)			(0.0005)
			Broker Variables			
Housing per broker			-0.0034	-0.0068	-0.0003	0.0049
			(0.0006)	(0.0006)	(0.0004)	(0.0009)
Active broker			0.4500	0.2090	0.0560	0.2755
			(0.0087)	(0.0119)	(0.0060)	(0.0135)
Broker fund rate			-0.0014	-0.0003	-0.0005	-0.0012
			(0.0001)	(0.0002)	(0.0001)	(0.0002)
Included but not reported: Neighborhood and Regulation Variables, Location and Year dummies						
Number of observations		715,011			715,011	

Table 10: **Estimated Profits by Year and Region** The table reports the mean (first row) and median (second row) broker profits as estimated in columns four through six of Table 9, by origination year and region. For each year and region, we provide the same summary statistics for total broker revenues. The profits and revenues are measured in $1,000 dollars.

	CA		FL		TX		West*		South*		Midwest		Northeast		All regions	
	Profit	Rev	Profit	Rev	Profit	Rev	Profit	Rev	Profit	Rev	Profit	Rev	Profit	Rev	Profit	Rev
1997	1.37	5.18	0.97	3.59	1.11	3.60	1.16	4.46	1.28	4.02	1.01	3.99	0.92	3.50	1.14	4.35
	0.95	4.61	0.57	2.93	0.63	3.13	0.79	3.99	0.70	3.20	0.69	3.43	0.68	3.16	0.77	3.78
1998	1.21	4.87	0.69	3.16	0.69	2.83	0.88	3.99	0.86	3.34	0.71	3.49	0.89	3.36	0.86	3.73
	0.88	4.29	0.47	2.69	0.44	2.36	0.62	3.60	0.53	2.74	0.51	3.09	0.61	2.85	0.59	3.21
1999	1.33	5.63	0.78	3.58	0.86	3.23	0.95	4.24	0.90	3.57	0.74	3.57	0.98	3.82	0.94	4.04
	0.99	5.02	0.54	3.08	0.52	2.59	0.66	3.72	0.57	3.04	0.54	3.18	0.67	3.29	0.64	3.42
2000	1.45	6.10	0.77	3.64	0.77	3.13	1.05	4.47	0.91	3.69	0.79	3.76	1.20	4.45	1.04	4.44
	1.09	5.60	0.53	3.25	0.51	2.65	0.73	3.95	0.58	3.19	0.56	3.40	0.84	3.91	0.71	3.80
2001	1.41	6.25	0.69	3.69	0.76	3.65	1.07	4.73	0.88	3.94	0.69	3.88	1.04	4.78	1.01	4.79
	1.05	5.69	0.50	3.30	0.48	3.00	0.70	4.19	0.58	3.41	0.50	3.53	0.78	4.36	0.70	4.14
2002	1.22	6.20	0.80	4.19	0.66	3.70	1.03	4.72	0.93	4.23	0.70	4.11	1.30	5.55	0.99	4.95
	0.94	5.74	0.57	3.78	0.42	3.20	0.69	4.19	0.58	3.60	0.51	3.73	0.90	4.99	0.69	4.35
2003	1.11	6.24	0.83	4.29	0.71	3.82	0.95	4.68	0.91	4.28	0.68	3.98	1.27	5.63	0.97	5.03
	0.87	5.76	0.61	3.89	0.47	3.34	0.69	4.22	0.58	3.61	0.51	3.59	0.90	5.07	0.70	4.44
2004	1.23	6.72	0.95	4.40	0.74	3.90	1.00	4.96	0.98	4.61	0.71	4.22	1.27	5.92	1.05	5.38
	0.98	6.25	0.67	4.02	0.49	3.44	0.73	4.43	0.63	3.91	0.52	3.82	0.94	5.38	0.77	4.76
2005	1.49	7.45	1.09	5.09	0.74	3.92	1.08	5.18	0.98	4.59	0.63	3.94	1.33	6.15	1.14	5.63
	1.19	7.02	0.81	4.62	0.50	3.52	0.79	4.64	0.63	3.89	0.47	3.57	0.95	5.50	0.83	4.93
2006	1.65	7.99	1.23	5.59	0.79	3.95	1.18	5.51	1.02	4.67	0.60	3.78	1.40	6.24	1.17	5.64
	1.31	7.62	0.94	5.10	0.53	3.55	0.86	4.98	0.65	3.91	0.44	3.34	0.96	5.49	0.83	4.85
All years	1.35	6.85	1.01	4.75	0.75	3.81	1.06	5.00	0.96	4.42	0.67	3.94	1.30	5.86	1.07	5.27
	1.05	6.36	0.73	4.27	0.49	3.38	0.76	4.47	0.61	3.72	0.49	3.55	0.92	5.21	0.76	4.58

* West does not include CA and South does not include FL or TX.

Table 11: **Estimated Profits for Different Loan Types** The table reports the mean and median broker profits as estimated in columns four through six of Table 9, for different types of loans. For each loan type, we provide the same summary statistics for total broker revenues, direct fees and yield spread premia. All values are measured in $1,000 dollars.

	Profit		Revenue		Direct Fees		YSP	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
				Loan Characteristics				
Rate - benchmark 30yr rate $< 2\%$	1.06	0.79	5.62	4.98	4.13	3.60	1.49	1.10
Rate - benchmark 30yr rate $\geq 2\%$	1.08	0.72	4.77	4.06	3.15	2.67	1.62	1.28
FRM	0.82	0.59	4.45	3.84	3.56	3.02	0.89	0.54
Hybrid	1.14	0.82	5.52	4.83	3.78	3.23	1.75	1.43
Balloon	1.35	1.00	6.36	5.70	4.91	4.31	1.45	0.98
Free-standing 1st lien	1.04	0.74	5.18	4.49	3.71	3.16	1.47	1.11
Piggyback	1.20	0.87	5.75	5.01	3.82	3.23	1.93	1.69
Full or limited doc	1.01	0.71	5.02	4.35	3.57	3.04	1.45	1.15
Stated doc	1.16	0.85	5.66	4.99	3.97	3.43	1.70	1.31
No prepay penalty	0.95	0.64	4.89	4.12	3.22	2.60	1.66	1.25
Prepay penalty	1.10	0.80	5.39	4.72	3.88	3.35	1.51	1.19
Purchase	1.01	0.72	5.08	4.32	3.28	2.72	1.80	1.48
Refi, no cash out	0.90	0.64	4.76	4.12	3.44	2.97	1.32	1.01
Refi, cash out	1.14	0.82	5.50	4.85	4.08	3.54	1.42	1.05
				Property Characteristics				
Primary residence	1.10	0.79	5.38	4.69	3.80	3.26	1.58	1.24
2nd home/investment property	0.79	0.56	4.34	3.62	3.07	2.56	1.27	0.90
One unit	1.04	0.75	5.19	4.51	3.66	3.13	1.53	1.20
Multi unit	1.42	1.00	6.31	5.61	4.54	3.89	1.78	1.31
				Borrower Characteristics				
Fico < 620	1.06	0.74	5.10	4.43	3.66	3.12	1.44	1.14
Fico ≥ 620	1.08	0.78	5.49	4.78	3.81	3.25	1.67	1.30
				Regulation and Neighborhood Variables				
Race, $\leq$66.7% white	1.24	0.90	5.73	5.04	4.28	3.71	1.45	1.07
Race, >66.7% white	0.94	0.68	4.95	4.31	3.34	2.87	1.61	1.28
Ethnicity, $\leq$20% hispanic	0.97	0.68	4.90	4.21	3.36	2.85	1.53	1.19
Ethnicity, >20% hispanic	1.27	0.95	6.02	5.41	4.45	3.99	1.57	1.24
Education, $\leq$15% w/ BA	1.04	0.73	5.04	4.35	3.70	3.14	1.34	1.05
Education, >15% w/ BA	1.12	0.81	5.67	4.97	3.77	3.24	1.90	1.54
Baseline anti-predatory regulation	1.02	0.71	4.63	4.04	3.28	2.83	1.35	1.08
Stricter state anti-predatory regulation	1.10	0.80	5.65	4.96	3.99	3.44	1.66	1.30
				Broker Variables				
Housing per broker, $\leq$4000	1.14	0.83	5.63	4.98	4.04	3.50	1.59	1.26
Housing per broker, >4000	0.94	0.64	4.67	3.99	3.21	2.70	1.47	1.13
Inactive broker	0.96	0.68	4.95	4.25	3.37	2.85	1.58	1.24
Active broker	1.19	0.86	5.64	4.98	4.14	3.59	1.50	1.16
				Location				
Metro areas	1.09	0.79	5.38	4.69	3.80	3.25	1.58	1.24
Non-metro areas	0.80	0.54	4.21	3.61	3.03	2.55	1.18	0.98
Total	1.07	0.76	5.27	4.58	3.73	3.17	1.54	1.20

Table 12: **Estimated Costs and Profits for Stratified Samples** The table reports the mean, median, standard deviation, and 1st and 99th percentiles of the estimated costs and profits for the frontier model estimated on stratified samples versus the full sample. The full sample specification results match those reported in columns four through six of Table 9. Stratified samples are formed for fixed-rate and hybrid mortgages, full or limited and stated documentation loans, mortgages to purchase and refinance, and mortgages originated in metro and non-metro areas. For each case and statistic, the first figure is for the model estimated on the stratified sample and the second figure corresponds to the value for the full sample specification restricted to the stratified sample. Costs and profits are measured in $1,000 dollars.

	Mean		Std. Dev.		1st Percentile		Median		99th Percentile	
Full Sample, N = 715,011										
Cost	4.23		1.67		1.67		3.86		9.07	
Profit	1.07		0.99		0.15		0.76		5.22	
FRM only, N = 168,338										
Cost	3.57	3.68	1.35	1.56	1.51	1.47	3.19	3.21	7.23	8.26
Profit	0.91	0.82	1.02	0.78	0.11	0.13	0.59	0.59	5.43	4.14
Hybrid only, N = 546,673										
Cost	4.43	4.39	1.72	1.67	1.78	1.82	4.11	4.08	9.43	9.24
Profit	1.11	1.14	0.99	1.04	0.17	0.16	0.81	0.82	5.21	5.44
Full or limited documentation only, N = 435,737										
Cost	4.03	4.03	1.58	1.59	1.67	1.66	3.60	3.60	8.65	8.74
Profit	1.01	1.01	0.97	0.95	0.15	0.15	0.71	0.71	5.09	5.00
Stated documentation only, N = 279,274										
Cost	4.56	4.53	1.77	1.74	1.67	1.69	4.37	4.37	9.53	9.41
Profit	1.13	1.16	1.01	1.05	0.16	0.16	0.83	0.85	5.32	5.52
Purchase only, N = 254,075										
Cost	4.07	4.15	1.67	1.73	1.69	1.57	3.64	3.72	9.08	9.18
Profit	1.02	1.01	1.02	0.96	0.11	0.14	0.70	0.72	5.34	5.11
Refinance only, N = 460,936										
Cost	4.37	4.27	1.70	1.64	1.71	1.75	4.01	3.92	9.21	9.00
Profit	1.03	1.10	0.97	1.01	0.14	0.16	0.74	0.79	5.08	5.27
Metro areas only, N = 649,367										
Cost	4.32	4.31	1.68	1.67	1.69	1.70	4.00	3.98	9.16	9.14
Profit	1.08	1.09	1.00	1.01	0.15	0.16	0.78	0.79	5.25	5.29
Non-metro areas only, N = 65,644										
Cost	3.37	3.44	1.31	1.43	1.59	1.53	3.00	3.03	7.64	8.17
Profit	0.86	0.80	0.92	0.81	0.12	0.13	0.56	0.54	4.84	4.23

Table 13: **Broker Compensation and Loan Performance** The table reports parameter estimates for Cox proportional hazard models for 60-day delinquency. Standard errors are shown in parentheses. The benchmark set contains all CA fixed-rate mortgages originated in 1999.

	Cox proportional hazard model for 60-day delinquency $h(t) = h_0(t) \times exp(Xb)$							
	I		II		III		IV	
				Broker Compensation				
Fees/loan amt (%)	0.066	(0.004)	0.055	(0.005)				
Fees/loan amt (%) × 1(2004-06)			0.030	(0.007)				
YSP/loan amt (%)	-0.053	(0.008)	-0.105	(0.010)	-0.126	(0.008)	-0.162	(0.010)
YSP/loan amt (%) × 1(2004-06)			0.108	(0.013)			0.077	(0.013)
Log brk profit					0.214	(0.011)	0.195	(0.014)
Log brk profit × 1(2004-06)							0.024	(0.014)
				Loan Characteristics				
Rate - benchmark 30yr rate	0.368	(0.006)	0.369	(0.006)	0.332	(0.006)	0.334	(0.006)
Hybrid	0.353	(0.015)	0.352	(0.015)	0.332	(0.015)	0.333	(0.015)
Balloon	0.110	(0.024)	0.117	(0.024)	0.118	(0.023)	0.121	(0.024)
Piggyback	0.344	(0.018)	0.366	(0.019)	0.264	(0.019)	0.271	(0.019)
Stated doc	0.197	(0.012)	0.198	(0.012)	0.221	(0.012)	0.221	(0.012)
Log loan amt	0.239	(0.019)	0.232	(0.019)	-0.021	(0.021)	-0.015	(0.021)
Log amt × 1(amt ≤ \$100K)	0.026	(0.004)	0.024	(0.004)	0.046	(0.004)	0.046	(0.004)
Log amt × 1(amt ≥ \$300K)	0.034	(0.004)	0.037	(0.004)	0.033	(0.004)	0.033	(0.004)
Prepay penalty	0.110	(0.013)	0.105	(0.013)	0.088	(0.014)	0.089	(0.014)
Refi	-0.101	(0.018)	-0.099	(0.018)	-0.096	(0.018)	-0.093	(0.018)
Refi w/ cash out	-0.083	(0.017)	-0.083	(0.017)	-0.094	(0.017)	-0.093	(0.017)
CLTV	0.013	(0.001)	0.013	(0.001)	0.015	(0.001)	0.014	(0.001)
				Property Characteristics				
2nd home/investment prop	-0.037	(0.0181)	-0.0348	(0.018)	0.001	(0.018)	-0.000	(0.018)
Multi unit	0.028	(0.0216)	0.0263	(0.022)	0.032	(0.022)	0.031	(0.022)
				Borrower Characteristics				
Fico (in 100)	-0.604	(0.016)	-0.605	(0.016)	-0.633	(0.016)	-0.633	(0.016)
Fico (in 100) × 1(Fico ≥ 620)	-0.025	(0.003)	-0.024	(0.003)	-0.023	(0.003)	-0.023	(0.003)
Debt-to-income	0.004	(0.001)	0.005	(0.001)	0.005	(0.001)	0.005	(0.001)
				Market Conditions				
Benchmark 30yr rate	0.362	(0.020)	0.372	(0.020)	0.360	(0.020)	0.369	(0.020)
Slope of yield curve	0.062	(0.015)	0.060	(0.015)	0.051	(0.015)	0.051	(0.015)
House prices	-0.006	(0.001)	-0.005	(0.001)	-0.006	(0.001)	-0.005	(0.001)

Continued on next page

Table 13 – continued from previous page

	Cox proportional hazard model for 60-day delinquency $h(t) = h_0(t) \times exp(Xb)$							
	I		II		III		IV	
	Neighborhood and Regulation Variables							
Race	-0.002	(0.000)	-0.002	(0.000)	-0.002	(0.000)	-0.002	(0.000)
Ethnicity	-0.005	(0.000)	-0.005	(0.000)	-0.005	(0.000)	-0.005	(0.000)
Education	-0.010	(0.001)	-0.011	(0.001)	-0.009	(0.001)	-0.009	(0.001)
Regulation (coverage)	-0.022	(0.003)	-0.019	(0.003)	-0.016	(0.003)	-0.014	(0.003)
Regulation (restrictions)	0.0364	(0.003)	0.035	(0.003)	0.040	(0.003)	0.039	(0.003)
Regulation (brokers, Pahl)	-0.020	(0.004)	-0.022	(0.004)	-0.022	(0.004)	-0.023	(0.004)
Regulation (brokers, KT)	0.0082	(0.003)	0.009	(0.003)	0.012	(0.003)	0.012	(0.003)
	Broker Variables							
Housing per brk (in 100,000)	-0.231	(0.130)	-0.254	(0.130)	-0.320	(0.130)	-0.325	(0.130)
Active broker	0.006	(0.023)	0.005	(0.023)	-0.019	(0.023)	-0.016	(0.023)
Broker fund rate (nominal)	0.005	(0.030)	0.007	(0.030)	0.020	(0.030)	0.019	(0.030)
	Location Dummies							
Non-metro areas	-0.017	(0.018)	-0.019	(0.018)	-0.022	(0.018)	-0.022	(0.018)
FL	-0.176	(0.031)	-0.146	(0.031)	-0.191	(0.030)	-0.181	(0.031)
TX	0.035	(0.030)	0.054	(0.030)	-0.002	(0.030)	0.010	(0.030)
West w/o CA	0.022	(0.025)	0.039	(0.025)	0.006	(0.025)	0.012	(0.025)
South w/o FL and TX	0.063	(0.027)	0.075	(0.027)	0.011	(0.027)	0.015	(0.028)
Midwest	0.152	(0.026)	0.164	(0.026)	0.140	(0.026)	0.143	(0.026)
Northeast	0.024	(0.025)	0.034	(0.025)	-0.039	(0.025)	-0.036	(0.025)
	Year Dummies							
2000	-0.118	(0.030)	-0.121	(0.030)	-0.111	(0.030)	-0.113	(0.030)
2001	0.218	(0.032)	0.211	(0.032)	0.253	(0.032)	0.251	(0.032)
2002	0.247	(0.048)	0.245	(0.048)	0.271	(0.048)	0.274	(0.048)
2003	0.261	(0.057)	0.252	(0.057)	0.272	(0.057)	0.276	(0.057)
2004	0.459	(0.052)	0.265	(0.057)	0.461	(0.052)	0.392	(0.054)
2005	0.669	(0.041)	0.478	(0.048)	0.665	(0.041)	0.598	(0.044)
2006	0.681	(0.033)	0.489	(0.041)	0.677	(0.033)	0.608	(0.037)
Number of observations	651,419							

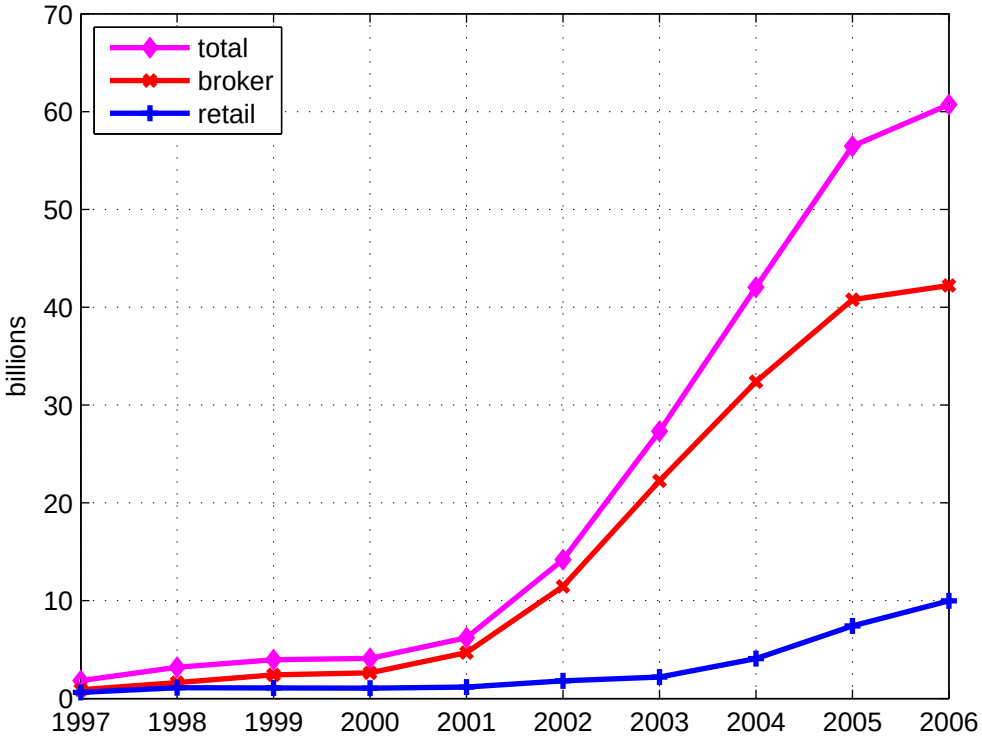

Figure 1: **Origination volume.** Annual loan amount funded by New Century from 1997 to 2006. Loans are originated either through the standard wholesale channel (broker), the retail channel (retail), or by correspondent brokers.

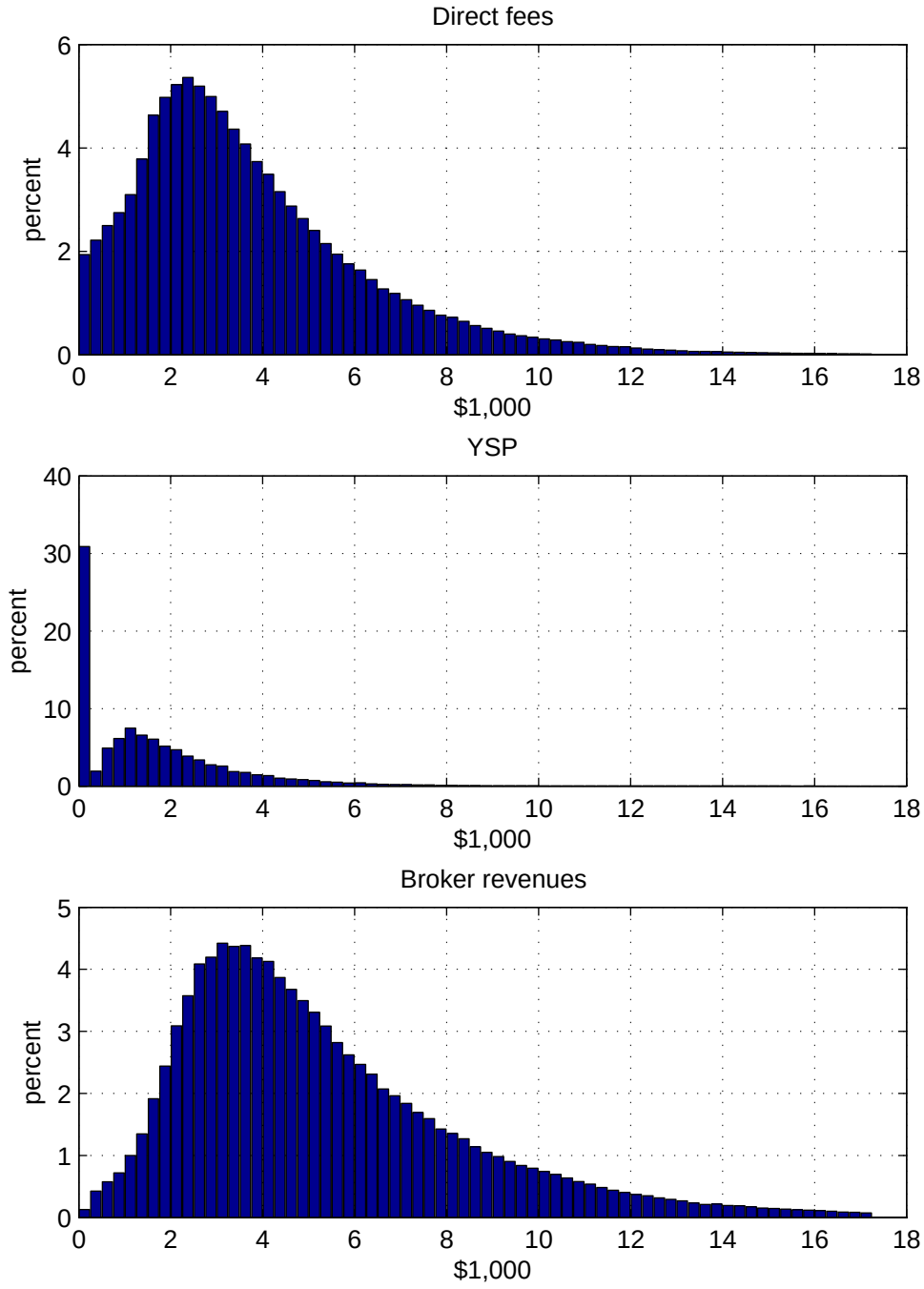

Figure 2: **Broker revenues** Unconditional distribution of direct broker fees, yields spread premia, and the total broker revenues for funded first-lien broker loans.

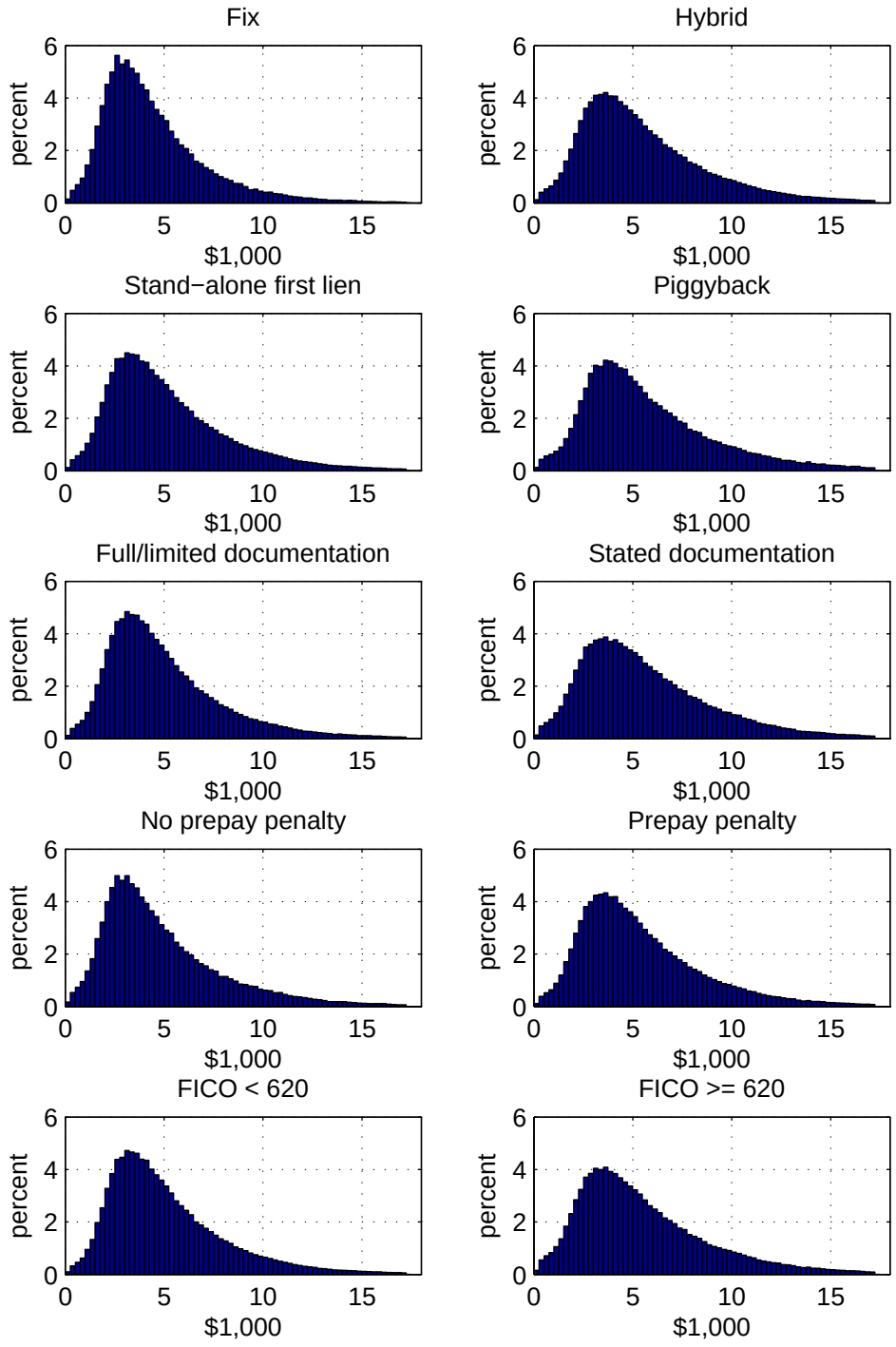

Figure 3: **Broker revenues by loan and borrower types** The unconditional distribution of broker revenues for fixed-rate, hybrid, free-standing 1st lien, piggyback, full or limited documentation, stated documentation loans, and for loans without or with prepayment penalties, and for borrowers with credit scores below 620 and for those with scores at or above 620.

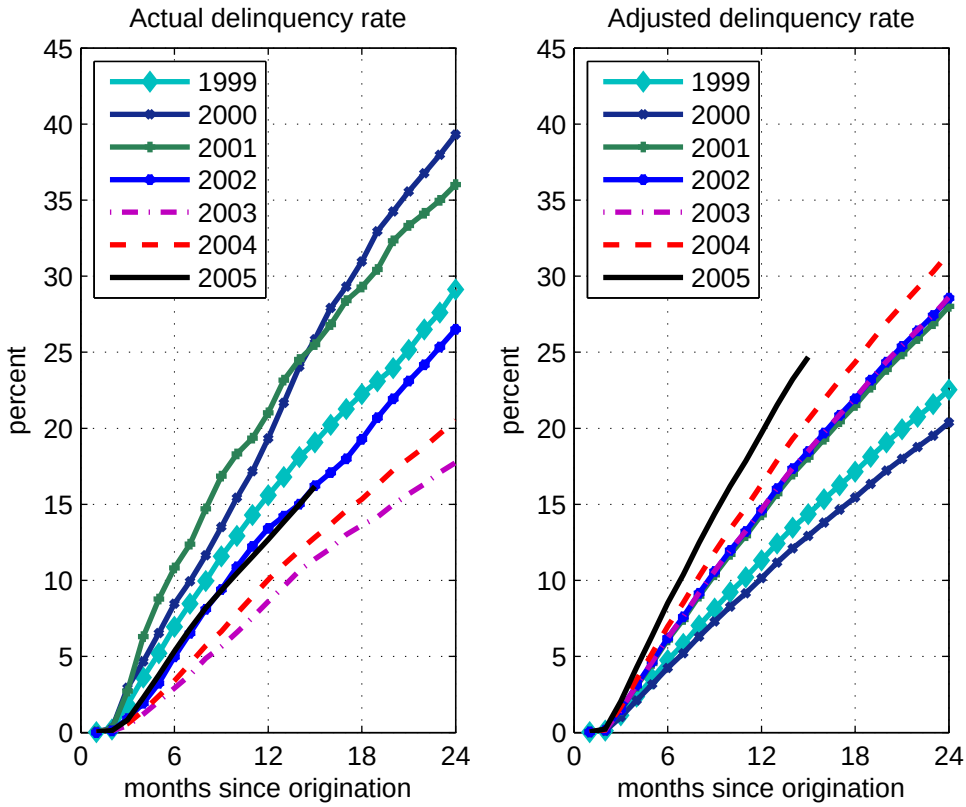

Figure 4: **Delinquency rates** The figures show the fraction of loans delinquent as a function of months from origination by year of origination. The actual delinquency rate (left panel) is defined as the cumulative fraction of loans that were past due 60 or more days, in foreclosure, real-estate owned, or defaulted, at or before a given age. The adjusted delinquency rate (right panel) is obtained by adjusting the actual rate for year-by-year variation in loan, borrower and broker characteristics, census and regulation variables, mortgage rates, and house price appreciation, based on the estimation results in Table 13, specification III.

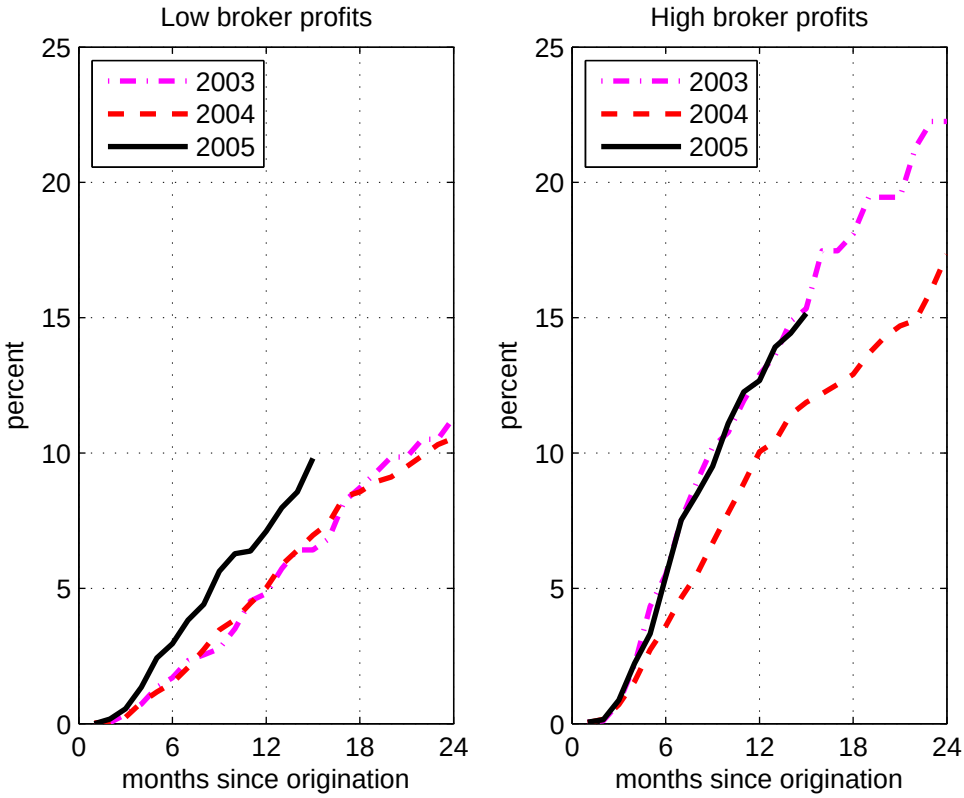

Figure 5: **Delinquency rates and broker profits** The figures show the fraction of loans delinquent as a function of months from origination by year of origination, for free-standing first lien hybrid mortgages with stated documentation originated in California. The left plot shows the 60-day delinquency rates for loans with low broker profits, and the right plot shows the corresponding rates for high-broker-profit loans. Broker profits are estimated using the model described in columns four through six in Table 9. High-broker-profit (low-broker-profit) loans are those in the upper (lower) tercile of the conditional broker profit distribution.

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

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 observations by dropping the observations with the lowest and highest 1% of broker revenue. In our current version we focus on loans that are either fixed-rate, hybrid, or have a balloon payment. We drop interest-only, various agency, and others type of loans that are less common. These steps generate a sample size of 715,011.

B. Moment Conditions for the Frontier Model

The model is:

$$\begin{aligned} f_{i,j} + y_{i,j} &\equiv w_{i,j} \\ &= X_{i,j}\gamma' + \epsilon_{i,j} + \xi_{i,j}, \end{aligned}$$

where $\epsilon_{i,j}$ is normally distributed with standard deviation σ and $\xi_{i,j}$ is exponentially distributed with mean parameter $\lambda_{i,j} = \exp(X_{i,j}\beta')$.[11] Both random variables $\epsilon_{i,j}$ and $\xi_{i,j}$ are assumed to be independent of each other, conditional on $X_{i,j}$.

With $q_{i,j} = \epsilon_{i,j} + \xi_{i,j}$, we derive the density of $q_{i,j}$ in order to compute the log-likelihood function for our parameter estimation. Using the formula for the cumulative distribution function (cdf) for sums of independent random variables, we obtain

$$\Pr(q_{i,j} \leq q) = \int_0^\infty \Phi\left(\frac{q-s}{\sigma}\right) \frac{1}{\lambda_{i,j}} e^{-s/\lambda_{i,j}}\, ds,$$

where Φ denotes the standard normal cumulative distribution function. Letting ϕ be the standard normal density, and omitting subscripts i, j to simplify notation, the density

[11] To keep things simple, we assume a constant variance σ^2 for the symmetric error term $\epsilon_{i,j}$. Extensions to the more general form of $\sigma_{i,j}$ in equation (9) are straightforward.

function for q is:

$$\begin{aligned}
\frac{1}{\sigma}\int_0^\infty \phi\left(\frac{q-s}{\sigma}\right)\frac{1}{\lambda}e^{-s/\lambda}\,ds &= \int_0^\infty \frac{1}{\sqrt{2\pi}\sigma}e^{-\frac{(q-s)^2}{2\sigma^2}}\frac{1}{\lambda}e^{-s/\lambda}\,ds \\
&= \int_0^\infty \frac{1}{\sqrt{2\pi}\sigma}\frac{1}{\lambda}e^{-\frac{q^2+s^2-2qs+2\sigma^2 s/\lambda}{2\sigma^2}}\,ds \\
&= \int_0^\infty \frac{1}{\sqrt{2\pi}\sigma}\frac{1}{\lambda}e^{-\frac{(s-(q-\sigma^2/\lambda))^2}{2\sigma^2}-q/\lambda+\frac{1}{2}(\sigma/\lambda)^2}\,ds \\
&= \left(1-\Phi\left(-\frac{q}{\sigma}+\frac{\sigma}{\lambda}\right)\right)\frac{1}{\lambda}e^{-q/\lambda+\frac{1}{2}(\sigma/\lambda)^2} \\
&= \Phi\left(\frac{q}{\sigma}-\frac{\sigma}{\lambda}\right)\frac{1}{\lambda}e^{-q/\lambda+\frac{1}{2}(\sigma/\lambda)^2}.
\end{aligned}$$

The third line follows from completing the square, the fourth line from the definition of the normal cdf, and the final line from the symmetry of the normal cdf.

Using the functional form for $\lambda_{i,j}$, the contribution to the log-likelihood for one observation therefore is:

$$\begin{aligned}
\mathcal{L}_{ij}\left(\gamma,\sigma,\beta;w_{i,j},X_{i,j}\right) &= \log\left(\Phi\left(\frac{w_{i,j}-X_{i,j}\gamma'}{\sigma}-\sigma e^{-X_{i,j}\beta'}\right)\right)+\log\left(e^{-X_{i,j}\beta'}\right) \\
&\quad -\left(w_{i,j}-X_{i,j}\gamma'\right)e^{-X_{i,j}\beta'}+\frac{1}{2}\sigma^2 e^{-2X_{i,j}\beta'}.
\end{aligned}$$

Let $(\hat{\gamma},\hat{\sigma},\hat{\beta})$ be the maximum likelihood estimates and let $\hat{q}_{i,j}$ be the empirical residuals for the model, that is, $\hat{q}_{i,j}=w_{i,j}-X_{i,j}\hat{\gamma}'$. Differentiating the overall log-likelihood $\mathcal{L}=\sum_{i,j}\mathcal{L}_{ij}$ with respect to the parameters we arrive at the moment conditions for the model:

$$\begin{aligned}
\frac{\partial\mathcal{L}}{\partial\gamma_k} &: \sum_{i,j}\left(\frac{\phi\left(\frac{\hat{q}_{i,j}}{\hat{\sigma}}-\hat{\sigma}e^{-X_{i,j}\hat{\beta}'}\right)}{\Phi\left(\frac{\hat{q}_{i,j}}{\hat{\sigma}}-\hat{\sigma}e^{-X_{i,j}\hat{\beta}'}\right)}(-1/\hat{\sigma})+e^{-X_{i,j}\hat{\beta}'}\right)X_{ij,k}=0, \\
\frac{\partial\mathcal{L}}{\partial\sigma} &: \sum_{i,j}\left(\frac{\phi\left(\frac{\hat{q}_{i,j}}{\hat{\sigma}}-\hat{\sigma}e^{-X_{i,j}\hat{\beta}'}\right)}{\Phi\left(\frac{\hat{q}_{i,j}}{\hat{\sigma}}-\hat{\sigma}e^{-X_{i,j}\hat{\beta}'}\right)}\left(-\frac{\hat{q}_{i,j}}{\hat{\sigma}^2}-e^{-X_{i,j}\hat{\beta}'}\right)+\hat{\sigma}e^{-2X_{i,j}\hat{\beta}'}\right)=0, \\
\frac{\partial\mathcal{L}}{\partial\beta_k} &: \sum_{i,j}\left(\frac{\phi\left(\frac{\hat{q}_{i,j}}{\hat{\sigma}}-\hat{\sigma}e^{-X_{i,j}\hat{\beta}'}\right)}{\Phi\left(\frac{\hat{q}_{i,j}}{\hat{\sigma}}-\hat{\sigma}e^{-X_{i,j}\hat{\beta}'}\right)}\hat{\sigma}-e^{X_{i,j}\hat{\beta}'}+\hat{q}_{i,j}-\hat{\sigma}^2e^{-X_{i,j}\hat{\beta}'}\right)e^{-X_{i,j}\hat{\beta}'}X_{ij,k}=0.
\end{aligned}$$

The properties of the joint distribution of $\epsilon_{i,j}$ and $\xi_{i,j}$ imply

$$E\left(q_{i,j}|X_{i,j}\right) = e^{X_{i,j}\beta'},$$

and

$$E\left(\epsilon_{i,j}|q_{i,j}\right) = \frac{\phi\left(\frac{q_{i,j}}{\sigma} - \sigma e^{-X_{i,j}\beta'}\right)}{\Phi\left(\frac{q_{i,j}}{\sigma} - \sigma e^{-X_{i,j}\beta'}\right)} q_{i,j}.$$

Furthermore, we can interpret

$$\frac{\phi\left(\frac{\hat{q}_{i,j}}{\hat{\sigma}} - \hat{\sigma} e^{-X_{i,j}\hat{\beta}'}\right)}{\Phi\left(\frac{\hat{q}_{i,j}}{\hat{\sigma}} - \hat{\sigma} e^{-X_{i,j}\hat{\beta}'}\right)}(-1/\hat{\sigma}) + e^{-X_{i,j}\hat{\beta}'}$$

and

$$\frac{\phi\left(\frac{\hat{q}_{i,j}}{\hat{\sigma}} - \hat{\sigma} e^{-X_{i,j}\hat{\beta}'}\right)}{\Phi\left(\frac{\hat{q}_{i,j}}{\hat{\sigma}} - \hat{\sigma} e^{-X_{i,j}\hat{\beta}'}\right)}\hat{\sigma} - e^{X_{i,j}\hat{\beta}'} + \hat{q}_{i,j} - \hat{\sigma}^2 e^{-X_{i,j}\hat{\beta}'}$$

as generalized residuals for the model, which must be orthogonal to the conditioning information.

Table A.1: **Descriptive Statistics for Regulation and Census Variables** The table reports the means for the regulation and neighborhood variables in our sample. The coverage and restriction variables are defined as indexes that count the number of additional types of mortgages covered and the additional number of restrictions impose over and above the HOEPA regulations. The mortgage broker regulations variables are measured by the index developed in Pahl (2007) that aggregates several types of mortgage broker regulations and the measure used by Kleiner and Todd (2007) that measures the financial bonding requirements for mortgage brokers. The regulations variables are measured by state and by year. The census variables are measured by zip code and year. The household income variable is the median household income. The means are reported for three periods, 1997-199, 2000-2003, and 2004-2006, by census divisions with CA, FL, TX broken out.

State(s)	Funded Loans		Regulation				Census			
	Num. of Loans	Percent	Anti-predatory Cvrge	Anti-predatory Restr	Broker Pahl	Broker KT	White (%)	Hispanic (%)	Education (%)	Household Income
1997-1999										
California	7,265	19.4	0.0	0.0	3.0	0.0	56.4	31.2	15.9	50.7
Florida	2,994	8.0	0.0	0.0	6.5	0.0	75.0	19.8	13.3	40.0
Texas	2,098	5.6	0.0	0.0	0.0	0.0	62.7	32.2	15.5	43.2
Pacific w/o CA	1,730	4.6	0.0	0.0	3.6	1.8	78.9	6.5	16.4	44.8
Mountain	3,529	9.4	0.0	0.0	1.8	0.8	78.1	23.3	15.8	44.0
West South Central w/o TX	444	1.2	0.0	0.0	3.3	1.9	65.6	3.7	14.2	35.0
East South Central	834	2.2	0.0	0.0	4.9	4.4	75.3	1.7	12.2	36.2
South Atlantic w/o FL	3,674	9.8	0.1	0.2	3.2	1.4	58.5	4.0	14.3	41.6
West North Central	2,396	6.4	0.0	0.0	1.9	1.2	78.9	3.9	16.8	45.8
East North Central	8,960	23.9	0.0	0.0	4.4	3.7	65.3	7.9	13.5	43.7
Mid Atlantic	2,220	5.9	0.0	0.0	4.8	0.5	75.0	5.1	12.0	36.2
New England	1,363	3.6	0.0	0.0	1.8	0.9	85.2	6.9	17.7	51.3
All	37,507	100.0	0.0	0.0	3.4	1.4	67.8	15.1	14.8	44.3
2000-2003										
California	69,752	30.5	4.7	1.3	3.0	0.0	56.2	33.8	14.3	49.2
Florida	19,738	8.6	0.0	2.4	6.0	0.0	75.2	21.1	13.7	41.3
Texas	12,983	5.7	1.7	3.4	6.0	2.5	64.5	31.2	16.1	45.8
Pacific w/o CA	7,788	3.4	0.0	0.0	4.4	2.1	78.0	7.0	16.7	46.8
Mountain	16,881	7.4	0.1	0.7	2.2	1.0	78.6	21.8	16.2	46.4
West South Central w/o TX	3,639	1.6	0.2	0.2	4.4	3.5	64.6	3.8	13.4	35.4
East South Central	7,916	3.5	0.0	0.3	4.8	5.7	69.4	1.7	12.2	36.8
South Atlantic w/o FL	14,546	6.4	1.5	1.9	3.9	2.5	63.6	4.7	17.2	49.8
West North Central	9,688	4.2	0.0	0.0	2.6	2.2	82.3	3.9	16.7	45.7
East North Central	39,763	17.4	1.9	1.5	4.6	3.9	67.9	7.8	13.2	44.8
Mid Atlantic	13,533	5.9	2.7	1.9	4.9	4.3	70.5	11.8	15.1	51.7
New England	12,266	5.4	3.8	5.6	3.3	2.0	81.4	9.1	16.3	49.5
All	228,493	100.0	2.3	1.7	3.9	1.8	67.1	18.9	14.8	46.7
2004-2006										
California	118,383	26.4	7.0	2.0	3.0	0.0	55.5	37.9	11.9	45.2
Florida	47,691	10.6	0.0	4.0	6.0	0.0	74.3	20.9	13.0	40.3
Texas	27,287	6.1	2.0	4.0	6.0	2.5	67.7	31.2	16.7	47.4
Pacific w/o CA	21,697	4.8	0.0	0.0	4.6	1.9	66.4	7.2	16.2	48.1
Mountain	39,028	8.7	0.9	1.8	3.2	1.3	78.8	22.1	15.1	46.7
West South Central w/o TX	6,123	1.4	2.8	4.6	5.7	4.1	72.4	3.9	13.8	37.2
East South Central	12,405	2.8	0.0	1.1	6.2	7.2	73.2	1.9	12.7	37.9
South Atlantic w/o FL	34,341	7.7	3.4	4.4	4.0	3.0	60.3	4.4	16.2	48.8
West North Central	15,554	3.5	0.0	0.0	2.7	2.7	83.0	3.5	16.1	44.7
East North Central	54,864	12.2	3.6	4.2	5.5	4.6	68.1	7.0	12.8	43.3
Mid Atlantic	46,711	10.4	5.2	4.3	5.8	4.8	66.7	12.4	13.8	48.7
New England	24,927	5.6	4.0	5.9	3.5	2.0	81.4	9.5	14.9	46.0
All	449,011	100.0	3.5	3.1	4.4	2.1	67.0	19.6	13.8	45.2

NEW CENTURY MORTGAGE® CORPORATION

View Details

2 Year ARM @ PAR

Traditional Rate Sheet

SO. CALIFORNIA

Effective 03/30/2007 | 888-623-LOAN(5626) | www.newcentury.com

FULL DOC

Mortgage Lates (last 12 months)	Max D/R / LTV / Credit Score*	55% / 65%	55% / 70%	55% / 75%	50% / 80%	50% / 85%	50% / 90%	50% / 95%
AAA 0x30 BK None Last 24 Months No NOD Last 36 Months	700 +	5.750	5.850	5.950	6.150	6.300	6.550	7.250
	680-699	5.950	6.050	6.150	6.300	6.450	6.700	7.400
	660-679	6.000	6.100	6.200	6.400	6.550	6.800	7.550
	640-659	6.05	[illegible]	6.250	6.450	6.650	6.900	7.650
	620-639	6.20	[illegible]	6.450	6.650	6.900	7.150	7.850
	600-619	6.300	6.450	6.550	6.750	7.000	7.250	8.050
Margin: 5.90								
AA 0x30 BK Rules - see matrix No NOD Last 24 months	660 +	6.300	6.400	6.500	6.650	6.800	7.050	7.800
	640-659	6.350	6.450	6.550	6.700	6.900	7.150	7.900
	620-639	6.500	6.650	6.750	6.900	7.150	7.400	8.100
	600-619	6.600	6.750	6.850	7.000	7.250	7.500	8.300
	580-599	6.750	6.850	6.950	7.100	7.400	8.000	9.050
	550-579	7.150	7.250	7.400	7.500	7.900	8.550	
	525-549	7.550	7.650	7.750	7.850	8.250		
Margin: 6.05	500-524	8.050	8.150	8.300	8.400	8.800		
A+ 1x30 BK Rules - see matrix No NOD Last 24 months	660 +	6.450	6.500	6.650	6.750	7.000	7.200	8.150
	640-659	6.550	6.600	6.700	6.800	7.050	7.250	8.200
	620-639	6.750	6.800	6.900	7.000	7.250	7.450	8.350
	600-619	6.850	6.900	7.000	7.100	7.400	7.600	8.500
	580-599	7.000	7.050	7.300	7.600	7.800	8.250	
	550-579	7.550	7.650	7.950	8.100	8.250	8.600	
	525-549	7.700	7.800	8.150	8.300	8.500		
Margin: 6.25	500-524	8.100	8.300	8.500	8.600	9.000		
A- 3x30 BK Rules - see matrix No NOD Last 24 months	660 +	6.800	6.900	7.000	7.100	7.350	7.600	8.500
	640-659	6.900	6.950	7.050	7.150	7.400	7.650	8.550
	620-639	7.100	7.150	7.250	7.350	7.600	7.900	8.800
	600-619	7.200	7.250	7.350	7.450	7.800	8.000	
	580-599	7.450	7.500	7.750	8.000	8.150	8.700	
	550-579	7.950	8.100	8.300	8.450	8.650	9.000	
	525-549	8.300	8.450	8.600	8.800	9.100		
Margin: 6.45	500-524	8.700	8.850	9.000	9.200	9.600		
B 1x60 BK Rules - see matrix No NOD Last 18 months	660 +	6.950	7.050	7.150	7.300	7.850	8.400	
	640-659	7.050	7.150	7.250	7.400	7.950	8.500	
	620-639	7.150	7.250	7.350	7.500	8.050	8.600	
	600-619	7.350	7.450	7.550	7.700	8.150		
	580-599	7.750	7.850	7.950	8.100	8.350		
	550-579	8.050	8.150	8.350	8.500	8.650		
	525-549	8.400	8.500	8.650	8.850	9.450		
Margin: 6.70	500-524	8.800	8.900	9.100	9.250			
C 1x90 BK Rules - see matrix No NOD Last 12 months	660 +	7.350	7.450	7.550	7.850			
	640-659	7.450	7.550	7.650	7.950			
	620-639	7.700	7.800	7.850	8.200			
	600-619	7.850	7.950	8.050	8.350			
	580-599	8.100	8.150	8.250	9.300			
	550-579	8.400	8.550	8.700	9.550			
	525-549	8.800	8.900	9.050				
	500-524	9.100	9.350	9.550				

STATED DOC

Mortgage Lates (last 12 months)	Max D/R / LTV / Credit Score*	55% / 65%	55% / 70%	55% / 75%	50% / 80%	50% / 85%	50% / 90%	50% / 95%
AAA 0x30 BK None Last 24 Months No NOD Last 36 Months	700 +	6.350	6.500	6.700	6.950	7.225	7.700	8.325
	680-699	6.550	6.700	6.90	[illegible]	7.375	7.850	8.475
	660-679	6.650	6.750	7.00	[illegible]	7.625	8.150	8.675
	640-659	6.750	6.850	7.050	7.350	7.675	8.250	8.775
	620-639	6.950	7.150	7.350	7.650	8.075	8.550	9.125
	600-619							
Margin: 6.15								
AA 0x30 BK Rules - see matrix No NOD Last 24 months	660 +	6.950	7.050	7.300	7.500	7.875	8.400	8.925
	640-659	7.050	7.150	7.350	7.600	7.925	8.500	9.025
	620-639	7.250	7.450	7.650	7.900	8.325	8.800	9.375
	600-619	7.400	7.600	7.750	8.150	8.525	8.950	
	580-599	7.700	7.750	7.950	8.250	8.725	9.300	
	550-579	8.000	8.150	8.350	8.500	9.075		
	525-549	8.400	8.550	8.700	9.000	9.525		
Margin: 6.30	500-524	8.900	9.000	9.150	9.250			
A+ 1x30 BK Rules - see matrix No NOD Last 24 months	660 +	7.150	7.200	7.450	7.750	7.925	8.600	
	640-659	7.300	7.400	7.550	7.850	8.075	8.700	
	620-639	7.600	7.700	7.850	8.050	8.425	8.950	
	600-619	7.900	7.950	8.050	8.200	8.675	9.300	
	580-599	8.000	8.100	8.350	8.750	9.025		
	550-579	8.350	8.500	8.850	9.050	9.325		
	525-549	8.650	8.750	9.100	9.450			
Margin: 6.55	500-524	9.250	9.450	9.650	9.750			
A- 3x30 BK Rules - see matrix No NOD Last 24 months	660 +	7.550	7.600	7.850	8.150	8.525		
	640-659	7.700	7.800	7.950	8.200	8.575		
	620-639	7.950	8.050	8.300	8.450	8.925		
	600-619	8.300	8.350	8.550	8.700	9.075		
	580-599	8.350	8.450	8.750	9.150	9.525		
	550-579	8.750	8.850	9.200	9.450			
	525-549	9.250	9.400	9.550	10.050			
Margin: 6.75	500-524	9.850	10.000	10.250				
B 1x60 BK Rules - see matrix No NOD Last 18 months	660 +	7.700	7.850	7.950	8.250			
	640-659	7.800	7.900	8.100	8.400			
	620-639	8.100	8.250	8.400	8.700			
	600-619	8.350	8.450	8.600	8.900			
	580-599	8.650	8.900	8.950	9.250			
	550-579	8.850	8.950	9.400	9.700			
	525-549	9.400	9.600	9.700				
Margin: 7.05	500-524	10.000	10.100	10.350				
C 1x90 BK Rules - see matrix No NOD Last 12 months	660 +	7.800	8.100	8.600				
	640-659	7.900	8.200	8.700				
	620-639	8.300	8.450	8.950				
	600-619	8.450	8.750	9.250				
	580-599	8.850	9.100	9.600				
	550-579	9.150	9.500	10.000				
	525-549	10.050	10.300					
Margin: 7.35	500-524	10.550	10.800					

Adjustments To Rate

Adjustments To Rate	+/- Rate
SPECIAL	
Purchase if LTV/CLTV <= 90%	-0.125
LTV/CLTV <= 60%	-0.125
3 year ARM special (see flyer)	-0.250
(see flyer)	-0.100
LTV/CLTV<=80%	-0.250
LOAN SIZE	
> $1,000,000	+0.375
$750,001 - $1,000,000	+0.250
$500,001 - $750,000	-0.125
$300,001 - $500,000	-0.250
$100,001 - $199,999	+0.250
$75,001 - $100,000	+0.500
$50,000 - $75,000	+1.000
	+0.350
Limited Docs (6 mos Bank Statements)	+0.375
Full Doc (12 mos Bank Statements)	+0.250
PROPERTY TYPES	
Rural	+0.500
3-4 Units (Full/Limited Doc)	+0.500
3-4 Units (Stated Doc)	+1.000
Condo LTV/CLTV > 80%	+0.250
OCCUPANCY	
N/O/O	+0.750
N/O/O Stated LTV > 80%	+1.250
2nd Home LTV/CLTV > 80%	+0.250
only)	
	+0.250
1 point YSP	+0.500
1.50 point YSP	+0.875
2 point YSP	+1.250
1 point Buydown (N/A with YSP)	-0.500
PREPAYMENT PENALTY**	
w/3 yrs Prepay)	+0.500
	+0.750
Waive Pre-pay Penalty	+1.000
PROGRAM	
3 Year ARM	+0.250
5 Year ARM	+0.600
40/30 Year ARM	+0.150
50/30 Year ARM	+0.200
Fixed (30, 20, 15 YR terms)	+0.700
Fixed (40/30 term)	+0.800
	+0.900
	+0.350
OTHER	
Bankruptcy discharged < 1 year	+0.250
Full Doc C- rates above C grade	+2.250
(C- grade Max 70% LTV - Full/Limited)	
MINIMUM PRODUCT RATES	
ARMs	5.650%
Fixed	6.350%

NOTE: Final calculated rate can't be lower than the minimum product rate.

TERMS AND CONDITIONS

Max YSP = 1 pt. If no pre-pay or Loan Amount > $750,000.