

The Attractions and Perils of Flexible Mortgage Lending

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Abstract

What are the effects of offering financial flexibility to households? I show that a mortgage program permitting back-loaded repayments increased a bank's volume by over 35%. Program loans exhibited superior performance, but this was due to borrower sorting by the bank. Using a regression discontinuity design, I find that the program-eligible borrowers attracted to the flexible program experienced quadruple the average delinquency rate. Essentially all of this negative performance impact of offering flexibility was driven by adverse selection, rather than by any treatment effect arising from the loan contract itself.

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Financial flexibility, the ability of a borrower to exercise some control over the amount and timing of repayments, is a central feature of many loans made to both consumers and commercial borrowers. The value of financial flexibility for corporations has been the focus of a burgeoning literature (Jagannathan, Stephens and Weisbach 2000, Graham and Harvey 2001, Gamba and Triantis 2008 and Sufi 2009). Less is known, however, about the importance of flexibility to consumers. Mortgages, in particular, commit households to long-term streams of repayments, typically in the face of both labor income uncertainty and limited access to additional borrowing. Flexible mortgages should help alleviate the severity of these problems. They allow borrowers to make limited payments when circumstances demand it, compensating in other periods when their resources are more abundant (Cocco 2013). In this paper I empirically assess the effects of offering financial flexibility to households on a bank's origination volume and loan performance. I consider a specialized mortgage program marketed by a U.S. bank to certain borrowers during 2004 and 2005. Two central points emerge from the empirical analysis. First, flexibility is very attractive to households- I estimate that offering the program increased the bank's volume of originations by over 35%. Second, though borrowers in the program exhibited good loan outcomes controlling for observable risk characteristics, I find that offering the program attracted borrowers with very negative unobservable qualities. Eligible borrowers drawn to the program were four times as likely to experience subsequent delinquency as an average borrower.

The bank in this study originated different versions of option adjustable rate mortgages (Option ARMs) that allowed for negative amortization. These loans offer significant flexibility to borrowers, and they became quite popular during the housing boom, rising by 2006 to over 12% of all originations and close to 40% of mortgages in some well-performing markets (Piskorski and Tchistyi 2010 and Krainer and Laderman 2011). In fact, Barlevy and Fisher (2011) show that across U.S. cities, the frequency of back-loaded mortgages allowing for lower upfront payments was strongly associated with subsequent speculative housing bubbles. In other words, back-loaded mortgages like Option ARMs may have played an important role in essentially financing the housing boom

and crisis. This paper therefore aims to enhance our understanding of the broader role of innovative mortgage products by elucidating the attractions and risks to banks of providing these financial contracts.

The bank offered high credit score borrowers a choice between Standard and Flexible Option ARM mortgage programs during the program period. Borrowers with lower credit scores were formally only given access to Standard loans, though exceptions were made. Both programs provided floating rate loans at essentially identical rate spreads. The main distinction was in the repayment terms. Initially, Flexible mortgages required slightly lower payments, but the difference grew over time. Standard loans could experience a payment increase annually, but Flexible loans had their payments fixed for three, five or ten years (depending on the specific loan contract). Consequently, Standard loan borrowers faced a schedule of increasing required payments over time, while Flexible borrowers had much more control over the timing of their payments. Given that the underlying rate spreads were largely the same, Flexible program borrowers were not paying less overall but simply had more discretion over when to pay. Formal eligibility for the Flexible program required that borrowers exceed a credit score threshold. In the post-program period the Flexible program was closed and only Standard loans were made available.

The formal eligibility threshold and the termination of the Flexible program in the post-program period allow me to assess, using a regression discontinuity difference-in-differences design, the causal impact on a bank's volume and loan performance of offering financial flexibility to households. The underlying pool of potential borrowers just above and below the eligibility cutoff should be expected to be quite similar in both the program and post-program periods. I examine discontinuities in outcomes around the eligibility criterion, and consider how these discontinuities differ across the two periods. Changes in these discontinuities provide evidence that outcomes for below- and above-threshold borrowers differ depending on whether the Flexible program is being made available by the bank. Given the essential similarity of the two sets of potential borrowers, any such difference in outcomes can be attributed to the offering of the Flexible program itself.

Using this method, an analysis of the volume of originations shows that there is a surge of borrowers with above-threshold credit scores during the program period that disappears after program termination. Quantifying this effect, I find that the program led to an increase of 36-42% in volume, providing clear evidence that loan products with flexible features can increase banks' business.

Offering flexibility does come with significant loan performance costs for the bank, though this is not immediately apparent from a casual analysis. Flexible loans exhibit lower delinquency risks, controlling for observable borrower and transaction characteristics. This result, however, neglects the fact that the bank made use of unobservable data (soft information) to direct only the very best borrowers into the Flexible program. A proper assessment of the impact of the Flexible program on performance requires comparing outcomes for borrowers who were formally program-eligible with those who were not. Exploiting the discontinuous impact of the credit score threshold on eligibility, I find that program-eligible borrowers were 22.8 percentage points more likely to become delinquent, relative to a sample mean delinquency rate of 7.3%. This is strong evidence that offering flexibility to households led to very bad outcomes for the lender.

This strong negative causal impact of offering flexibility may be decomposed into selection and treatment effects. Adverse selection could arise from the desire of worse borrower types to defer payments for as long as possible. There are two potential forms of treatment effects. In the first, the Flexible loans may cause default because of the large payment shock borrowers experience when the fixed payment period eventually ends (though rational borrowers should anticipate this). In the second, the smaller payments of Flexible borrowers will give them lower (and possibly negative) equity in their homes, which may lead them to optimally decide to default. I evaluate the first effect by considering loan outcomes only in the period before the first payment adjustment. During this time Flexible borrowers have lower required payments than Standard borrowers and do not experience a payment shock. Nonetheless, I find that program-eligible borrowers were much more likely to become delinquent even during this period. In fact, essentially the entire increase in overall

delinquency for program-eligible borrowers is exhibited before the payment adjusts, suggesting that payment shocks are not an important cause of the poor outcomes from offering flexibility.

To assess the second treatment effect, I analyze the borrower's home equity during the period before the first payment adjustment using zip code level price indices and assuming that the borrower made the minimum payment required under his mortgage contract. I then estimate the pre-payment shock delinquency regressions using fixed effects for the borrower's home equity rounded to the nearest percentage point. In other words, this test compares program-eligible and ineligible borrowers who have the same level of equity during a period in which the Standard loan payments are higher. This specification thus controls for both treatment effects: there is no payment shock and borrowers are only compared to others with very similar equity levels. In these tests I again find that the program-eligible borrowers are much likely to become delinquent, and the inclusion of home equity fixed effects has little impact on the estimated effect. This indicates that the negative effect of offering flexibility is essentially driven by adverse selection, rather than either of the treatment effects. This is consistent with previous findings of strong negative selection effects in the consumer finance market for credit cards (Calem and Mester 1995, Ausubel 1999) and mortgages (Ambrose and LaCour-Little 2001).

I also find that the effect is stronger during a narrow three-month window around the program closure, suggesting that the program termination led to even worse selection as weak eligible borrowers rushed to secure flexible loans. This finding also provides support for the argument that it is the program itself, not events in the general competitive environment, that led to worse loan performance for borrowers who qualified for the Flexible program.

The bank I study is of medium size, originating about \$2 billion worth of mortgages per year. While banks of this size clearly operate in ways that are quite different from mega-banks, they are responsible for a significant part of mortgage activity in the U.S. For example, in 2006 banks with volume of \$2 billion or less together originated mortgages worth \$593 billion, representing 30% of

all conventional mortgage lending.¹ Medium size banks are typically local lenders who continue to serve a key function in providing mortgages.

Households, like firms, are subject to liquidity shocks (Holmstrom and Tirole (1998)), and consumption smoothing considerations suggest that the ability to control the timing of their payments, as under flexible mortgages, should be valuable to them. Financial flexibility in their loan contracts would loosen the liquidity constraints that bind many consumers (Gross and Souleles (2002)). In the face of this demand for flexibility, the development of new mortgage products offering borrowers discretion over the timing of repayments would appear to represent a useful financial innovation. Moreover, Piskorski and Tchisty (2010) show that elements of Option ARM contracts can be optimal in supplying borrowers with flexibility. The strong demand for Flexible mortgages that I document is consistent with these arguments. As the loan outcome findings make clear, however, the benefits of this innovation may be severely limited by the types of adverse selection considerations that were central to the financial crisis (Tirole 2012). These products must be offered in a manner that mitigates the information effects I find here. Broadly, these results suggest that selection issues should be a first-order consideration in the design of any form of household credit product (such as credit cards or personal lines of credit) that supplies payment flexibility.

1 Data

The data in this paper describe 23,093 residential single-family mortgage loans originated by a U.S. financial institution in the period January 2004- October 2008. Loans made to insiders are excluded. These loans were retained by the bank and not securitized. The bank originated approximately \$2 billion of mortgages annually during the sample period, and it specialized in deposit-taking and residential mortgage lending. As described in Table 1, the data include pricing information and details on borrower and property attributes. This bank offers floating rate mortgages, and the

¹Source: MortgageDataWeb.com, based on Home Mortgage Disclosure Act filings

mean spread between the loan interest rate and the underlying index is 3.53 percentage points (various indices are used, including the prime rate, the Treasury bill rate and LIBOR). Many of the loans allow borrowers to make payments less than the current interest rate, thereby causing negative amortization. The mean loan-to-value (LTV) ratio is 73% and the mean borrower FICO credit score is 714.9. This relatively high mean FICO score reflects the fact that the bank made almost no subprime loans (e.g., only 0.3% of borrowers had FICO credit scores below 620). That these loans were made to high-quality borrowers and not securitized suggests that this bank was not directly affected by key drivers of default emphasized in other research (Mian and Sufi 2009 and Keys, Mukherjee, Seru and Vig 2010). Data is also provided on the purpose of the loan (home purchase, cash out refinance or rate/term refinance).

In common with broader market trends, the bank experienced significant delinquencies in its residential lending. Specifically, 7.3% of the loans in the data are delinquent (90 or more days past due).

1.1 The Standard and Flexible Programs

The bank offered two broad loan programs during the sample period, the Standard program and the Flexible program. Both programs offered floating interest rate terms that adjusted each month. The central distinction between the programs was that under the Standard program the borrower's initial payment rate was kept constant for a period of one year, after which the loan reamortized and the payment was adjusted to allow for full loan payoff at the end of the maturity period (subject to a 7.5% annual cap on the adjustment) . Under the Flexible program, the initial payment rate was maintained for a period of five years (in a small number of cases the payment rate was held constant for three years or ten years). During the payment period interest continued to accrue, so the loans offered the possibility of negative amortization. The payment rates specified the minimum required payment, so borrowers under the Flexible program essentially had the option to back-load payments if they wished to. Both Standard and Flexible loans had maximum levels of

negative amortization after which the payment adjusted automatically. The Standard and Flexible programs were essentially variations on what is known in the industry as an Option ARM, with the Flexible program offering a substantially longer period of potentially lower payments. The following is a summary of the key terms of the loans in the two programs.

Interest rate: Both programs offered floating rate loans, adjusting each month. No initial teaser rate was available.

Payments: Initial low payment under both programs. For the Standard program, this payment adjusted after one year, for the Flexible program it was kept fixed for five years (or three or ten years, in a small number of cases) before adjusting. After adjustment, the mortgage switched to the fully amortized payment, subject to an annual increase cap of 7.5%.

Negative amortization cap: Present for both programs. If a loan achieved the maximal negative amortization, this would trigger a shift to fully amortized payments, even if the time period specified above had not yet elapsed.

Offer period: Standard loans were offered during the entire sample period. Flexible loans were offered from January 2004 until December 2005.

During the sample period, 74% of Standard loans and 6% of Flexible loans experienced a shift to a higher payment. (Loans originated towards the end of the sample period and loans that either defaulted or were paid off before the constant initial payment period expired would not have time to experience such a shift.)

The mortgages differ in their level of documentation: a borrower chooses how much documentation to supply and receives a rate that depends on this choice. As I describe in Section 2, the empirical strategy in this paper makes use of formal eligibility thresholds for the Flexible program. There was no such threshold for the 4,003 no documentation loans (they were not eligible for Flexible loans), so I exclude them from the analysis. Sixty percent of the remaining loans were high documentation and the rest were low documentation. In Section 3.2 below, I provide some evidence

on variation in loan terms (loan-to-value ratio, loan amount, etc.) across the two programs.

2 Empirical Specification

The empirical analysis considers the effects of offering financially flexible loans to borrowers. Borrowers who are granted these loans likely differ in unobserved ways from those who are unable to obtain them, so one cannot simply contrast the outcomes of borrowers who received flexible loans with those who did not. To address this endogeneity problem, I make use of the special feature of the Flexible program that it was formally only supposed to be offered to borrowers with a credit score above certain thresholds.

This allows for a regression discontinuity analysis that contrasts borrowers just above and below the formal thresholds for eligibility in both the program and post-program periods. The program created a stark difference in the product offerings of the bank to above- and below-threshold borrowers, and this difference disappeared in the post-program period. Comparing the program and post-program periods, a change in the difference between above- and below-threshold borrowers can therefore be attributed to the Flexible program itself. In essence, this is a regression discontinuity difference-in-differences design.

The formal threshold for eligibility during the program period was a FICO score of 680 for low documentation loans and 640 for high documentation loans. The indicator variable I_C denotes mortgages originated to borrowers with credit scores above the formal threshold.

$$I_C = \begin{cases} 1 & \text{if credit score} \geq 680 \text{ and low documentation} \\ 1 & \text{if credit score} \geq 640 \text{ and high documentation} \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

The indicator variable I_P denotes mortgages issued by the bank during the period in which the Flexible program was in place.

$$I_P = \begin{cases} 1 & \text{if originated during program period} \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

I define mortgages to be *Program-Eligible* if the borrower's credit score exceeded the formal threshold and the mortgage was originated during the program period.

$$\text{Program-Eligible} = I_C * I_P \quad (3)$$

To analyze the impact of the flexible program, I estimate the following formal model:

$$\text{LoanCharacteristic}_{i,t} = \alpha + \beta \text{Program-Eligible}_{i,t} \quad (4)$$

$$+ \eta I_{C_{i,t}} + \sum_{j=1}^4 \omega_j^C C_{i,t}^j + \sum_{j=1}^4 \xi_j^C I_{C_{i,t}} C_{i,t}^j$$

$$+ \pi I_{P_{i,t}} + \sum_{j=1}^4 \omega_j^{CP} C_{i,t}^j I_{P_{i,t}} + \sum_{j=1}^4 \xi_j^{CP} I_{C_{i,t}} C_{i,t}^j I_{P_{i,t}}$$

$$+ \gamma * \text{controls}_{i,t} + \lambda_t + \epsilon_{i,t},$$

where $\text{LoanCharacteristic}_{i,t}$ is a transaction or borrower attribute for loan i originated in month t , $C_{i,t}$ is the borrower credit score centered around the threshold, $\text{controls}_{i,t}$ is a vector of loan and property controls including documentation type, λ_t is a month fixed effect for each of the 57 months in the sample (excluding the omitted month) and $\epsilon_{i,t}$ is an error term. The controls may include fixed effects for other mortgage characteristics (e.g. zip code), depending on the specification.

In this specification the main coefficient of interest is β , which measures the differential impact of an above-threshold credit score in the program period, relative to the post-program period. A significant estimated coefficient for β indicates that the threshold discontinuity in credit scores has a differential impact in the program period.

The pool of borrowers formally eligible for the program differed in quality from the pool of those who were not eligible. By focusing on borrowers in a narrow band around the formal threshold, however, specification (4) controls for general quality differences between eligible and ineligible borrowers. Macroeconomic conditions differed significantly in the program and post-program periods. The month-of-origination fixed effects account for variation in general market conditions over time.

I estimate (4) using OLS, despite the binary nature of some of the *LoanCharacteristic* variables, due to the large number of fixed effects along several dimensions and the resulting incidental parameters problem in non-linear maximum likelihood estimation (Abrevaya, 1997). OLS coefficients are estimated consistently even with multiple fixed effects. This approach is similar to the one used in the models of Card, Dobkin, and Maestas (2004) and Matsudaira (2008). The specification allows loan characteristics to be continuous in the borrower's credit score, with the shape of the probability function permitted to be different on either side of the eligibility threshold.

Borrowers can clearly influence their credit scores, but the possibility that they do so in an attempt to meet the formal Flexible program requirement does not invalidate the regression discontinuity design. As long as the manipulation is to some degree imperfect and noisy (which is highly likely, given that borrowers do not know the precise methodology for computing credit scores and have less than complete control over the timing of the reports of their creditors), the regression discontinuity model is identified (Lee, 2008). For underlying variables (such as credit score) that take on only discrete values, Card and Lee (2008) suggest clustering at the level of the variable itself, and I adopt this recommendation. In various specifications, I also double-cluster at other levels (e.g., month-of-origination), as appropriate. For some cross-sectional tests I contrast

the estimate of β in two samples, and examine the possibility that program eligibility matters more in certain contexts than in others.

As I will discuss in the analysis below, differences in outcomes between above- and below-threshold borrowers may arise from either selection (e.g., eligible borrowers who are attracted to the Flexible program will be more likely to apply) or treatment (e.g., the Flexible program has a causal effect on borrowers), and I will attempt to distinguish these effects. There may also be selection at a second level, as low documentation borrowers who fall just below the high threshold may in some cases have the ability to submit high documentation and become eligible, but have chosen not to. It is presumably costly to present high documentation or else all borrowers would do so, as it results in better terms. The contrast between eligible and ineligible borrowers may therefore be thought of as the contrast between those with free access to the program and those who must pay a fee to access it. In either case, however, the key point is that borrowers who present just above-threshold applications are granted easier access to the Flexible program than the largely similar borrowers who are just below-threshold.

3 Results

3.1 Flexible Program

I begin by analyzing the effects of the Flexible Program guidelines on actual loan allocations. While the Flexible Program defined a threshold credit score (680 for high documentation and 640 for low documentation applications) as the formal eligibility requirement, loan officers were granted discretion, under exceptional circumstances, to either disallow formally eligible borrowers or to permit formally ineligible borrowers to participate. To what extent were formally eligible borrowers more likely to receive loans under the Flexible Program?

To answer this question, I regress an indicator for Flexible loans on a dummy for above-

threshold credit scores, separate fourth-degree polynomials in credit score on both sides of the formal threshold, and month of origination fixed effects. As shown in the first column of Table 2, there is a discontinuous jump of 0.244 in the probability of a Flexible loan precisely at the threshold point. This jump is statistically significant (t -statistic= 4.87); reported t -statistics in this table are double-clustered at the levels of the credit score and the month-of-origination. In the overall sample, the frequency of Flexible loans is 32.0%, and the jump is therefore clearly quite large. While loan officers were granted discretion in applying the program guidelines, it is clear that the formal eligibility threshold has a material impact on the type of loan received by a borrower.

The threshold should matter only during the program period. To test this hypothesis, I repeat the previous regression in the program and post-program periods separately. As reported in Table 2, column two, in the program period above-threshold borrowers have a 0.272 higher probability of receiving a Flexible loan (t -statistic=4.90), compared to an overall frequency of 38.0% for Flexible loans. This finding is illustrated in Figure 1, which relates the estimated probability of provision of a Flexible loan to the credit score centered on the eligibility threshold. The polynomial is the fitted curve from the regression specification, and the points represent raw average Flexible loan provision probabilities for twenty equal-sized buckets of the centered score. The discontinuity at the threshold is evident in the graph.

The threshold has no impact on the provision of Flexible loans in the post-program period (coefficient=0.0136 and t -statistic=0.78), as detailed in Table 2, column three. The frequency of Flexible loans in the post-program period is 0.8%. As displayed in Figure 2, there is little Flexible loan provision in the post-program period, and no significant jump at the threshold. These results establish that the eligibility threshold had an impact only during the program period and that Flexible loans were essentially unavailable in the post-program period.

Table 2, column four displays the results from regressing the Flexible loan indicator on the *Program-Eligible* variable, an indicator for the program period, an indicator for above-threshold credit scores, distinct fourth-degree polynomials in credit score for both periods and on both sides

of the formal threshold, and month of origination fixed effects. In essence, this specification, as outlined in (4) with the Flexible loan indicator serving as the loan characteristic, combines all the variables from the second and third columns and makes use of the full sample. The coefficient of 0.258 on *Program-Eligible* (t -statistic=4.28) represents the estimated differential effect of formal eligibility on the probability of a Flexible loan in the program period, relative to the post-program period. It combines the information from both periods and supplies a summary measure of the effects of the formal threshold during the Flexible program.²

The inclusion of loan-level controls for the rate spread, the mortgage pay rate, the LTV, the maturity and indicators for refinancings and low documentation loans has little impact on the estimated effect of *Program-Eligible*. As shown in the fifth column of Table 2, the estimated coefficient of 0.263 and t -statistic of 4.16 in the specification with these controls vary little from the regression without them.

3.1.1 “Fuzzy” Design

The results in Table 2 clearly establish that formal eligibility had a large and significant impact on the probability that a Flexible loan was supplied. The results also indicate that while Flexible loan provision increases discontinuously at the formal threshold, some formally eligible borrowers received Standard loans and some formally ineligible borrowers received Flexible loans; in other words, this is a “fuzzy” regression discontinuity design. Although it is likely that loan officers made use of unobserved variables in deciding whether to provide a Flexible or Standard loan, this does not invalidate the identification in the empirical design. Identification arises here from a comparison of borrowers just above and below the threshold. These two classes of quite similar borrowers were offered Flexible loans with distinctly different probabilities. I study the impact of formal eligibility

²The insignificant coefficient on the Program Period indicator should be interpreted in light of the month-of-origination fixed effects that are included in the specification. This coefficient largely reflects the differential probability of a Flexible loan in the whole program period relative to the probability in one particular month (i.e., the omitted month-of-origination dummy). As such, it does not have much meaning for this study.

on borrowers, not the effect of which loan was ultimately granted (as the latter may be influenced by loan officer information, etc.). All that is required for identification in this “fuzzy” design setting is a discontinuous jump in the probability of Flexible loans at the threshold (Hahn, Todd and Van der Klaauw, 2001), and Table 2 presents clear evidence for that. The subsequent analysis will consider the impact of program eligibility on mortgage terms and loan outcomes.

3.2 Mortgage Terms

The main focus of the Flexible Program was to offer a profile of back-loaded repayments to selected borrowers. In this section I consider whether other loan terms differed between the Flexible and Standard Programs.

3.2.1 Loan Characteristics

Mortgage pricing is a natural first consideration. I regress the rate spread on the loan on *Program-Eligible* and the standard set of controls described in (4). The result, described in Table 3 Panel A, column 1, shows that Flexible loans do not have significantly different rate spreads (t -statistic=-1.07). The estimated coefficient is not only insignificant, but also small in magnitude (11.5 basis points); there is no evidence of any pricing effects.

As shown in columns two through six of Table 3 Panel A, *Program-Eligible* loans did not differ in their maturity, overall loan amount, LTV ratio, negative amortization caps or probability of being a refinancing from those that were ineligible.

3.2.2 Pay Rates

In the first column of Table 3 Panel B, I display the results from regressing the initial required pay rate on *Program-Eligible* and the controls. The estimated coefficient of -0.268 is marginally significant (t -statistic= -1.74). This suggests that the Flexible Program, in addition to fixing the

required payments for a longer period of time, also had lower initial payments. Given that the underlying rate spread was the largely the same as in the Standard Program, this represents a second respect in which Flexible Program loans allowed for greater back-loading.

The central impact of the program, however, was to keep the pay rate fixed for a longer period of time. For each loan I calculate whether the pay rate would increase after the first year, under the assumption that the minimum payment was made each month. In the sample of loans that were outstanding for at least one year, I regress an indicator for a pay rate increase on *Program-Eligible* and the controls. As detailed in Table 3 Panel B, column 2, program-eligible loans were 22.3% less likely to experience a pay rate increase (t -statistic=-3.00).

Flexible loans were extremely unlikely to experience a pay rate increase after 1 year- this could only occur if the negative amortization cap was achieved in 1 year, which almost never happened. Standard loans were subject to reamortization after 1 year, and this typically resulted in a pay rate increase. The variable *Program-Eligible* is positively correlated with a borrower having a Flexible loan (as discussed above), but this correlation is less than one. The coefficient on *Program-Eligible* in this specification is thus quite similar to its coefficient in the Flexible loan regressions described in the fourth and fifth columns of Table 2.

3.2.3 Supply Side Effects

The bank marketed its loans through a network of independent brokers. Were the terms offered to brokers more attractive for one loan program relative to the other? To test this hypothesis, I regress the rebate paid by the bank to the broker on *Program-Eligible*. As shown in the first column of Table 3, Panel C, *Program-Eligible* loans did not have higher rebates: the coefficient of 3.6 basis points and t -statistic of 0.16 are both very small. Nor did *Program-Eligible* borrowers pay more in direct points to their brokers, as shown in the second column of Table 3, Panel C. There is no evidence for differential payments to brokers across programs.

Overall, *Program-Eligible* borrowers received loans that had prices and terms that were generally the same as those granted to ineligible borrowers, and brokers received similar payments for originating loans to both types. The only observed difference is flexibility: *Program-Eligible* borrowers enjoyed a significantly longer fixed payment period at a somewhat pay rate.

3.3 Volume

A main purpose, presumably, in offering a new financial product is to increase sales volume. What was the impact of the Flexible Program on the bank's origination volume? I consider this question by calculating for each credit score the total number of mortgage originations in the program and post-program periods separately. I then scale these frequencies by the total number of originations in each period to generate an empirical density function. If the Flexible program generated increased volume for the bank, this should manifest itself in different density patterns in the program and post-program periods. In particular, above-threshold borrowers should be observed flocking to the bank during the program period, but not during the post-program period. This should lead to a discontinuity in volume at the eligibility threshold during the program period that disappears in the post-program period.

Testing this hypothesis requires an analysis of the relative discontinuities at the threshold in the scaled frequencies during the two periods. I regress the scaled frequencies on *Program-Eligible* and the usual controls (i.e., I estimate (4) with the scaled frequency as the dependent variable, and I include only one observation per credit score). As shown in the first column of Table 4, Program-Eligibility generates a jump of 0.00134 (t -statistic=2.52) in the scaled frequency. For credit scores in the range from ten below the threshold to ten above it, the average scaled frequency during the program period is 0.0037. This indicates that the Flexible program led to an increase of 36.2% in volume.

As a second approach, I consider the McCrary (2008) kernel estimate of the discontinuity in the density function at the credit score threshold in both the program and post-program periods.

The McCrary method estimates the density separately on both sides of the threshold and supplies an estimate for the log difference in the density heights. The credit score data are discrete, so I add random noise in the form of a $\text{Uniform}([0,1])$ random variable to each credit score to allow for density estimation. This noise does not result in any misclassification of credit scores as above- or below-threshold, so the estimation exhibits very little sensitivity to the particular random draw.

The estimated kernel density of credit scores during the program period is depicted in Figure 3. The thick line represented the density estimate and the surrounding thin lines depict the 95% confidence interval. The circles describe scaled frequencies. The bin size of 0.74 and bandwidth of 30.8 are selected using McCrary's automatic algorithm.

It is clear from Figure 3 that there was a sharp density break at the credit score thresholds during the program period. The bank made substantially more loans to borrowers eligible for the Flexible program. A simulation of 500 random noise draws yields an average estimated log difference in kernel heights of 0.263 and an average t -statistic of 4.66.

The density looks quite different in the post-program period, as described in Figure 4. In the analogous simulation for this sample, the average estimated log difference in kernel heights is -0.089 and the average t -statistic is -0.48. (The bin size of 1.94 and bandwidth of 29.5 are again selected using McCrary's algorithm.) Once the program terminated, there is no evidence that the bank make significantly more loans to above-threshold borrowers. Combining the two coefficients yields an estimated increase in volume of 42.2%. This is somewhat larger than the estimate from the polynomial approach, but both methods make clear that volumes of above-threshold credit score borrowers were much higher during the program period than during the post-program period. The Flexible program was clearly attractive to homeowners and induced eligible borrowers to approach the bank. The evidence described in Table 3 indicates that brokers were not compensated differently for originating Flexible loans, which suggests that the increased take-up rate of these loans was demand driven.

The 36%-42% increase in volume that I find is for all originations, irrespective of the particular loan type granted. As I discuss below, the bank did direct some program-eligible borrowers into the Standard program (and some ineligible borrowers into the Flexible program). This sorting is at the discretion of the bank. The analysis in this section, however, documents the causal impact of offering the Flexible program on overall volume.

Previous work has shown that financial flexibility creates value for firms (Billter and Garfinkel 2004) and that the desire to retain it can motivate corporate decisions (Sufi 2009, DeAngelo, DeAngelo and Whited 2010 and Kahl, Shivdasani and Wang 2010). The results in this paper establish that flexibility is also important to consumers and intermediaries that offer it can increase their market share.

3.4 Loan Performance

The evidence discussed in the previous section establishes that the Flexible program increased the bank's flow of originations. In this section I analyze whether loan outcomes differed for borrowers in the Flexible program. Did the Flexible program lead to better or worse performance?

I begin by regressing an indicator for delinquency (90 days or more past due) on a dummy for a Flexible loan, the usual polynomials in the borrower credit score, the loan rate spread, the pay rate, LTV, maturity, indicators for refinancings and low documentation and monthly fixed effects. The result, displayed in Table 5, column one, shows that Flexible loans were 3.23 percentage points less likely (t -statistic=-4.15) to become delinquent. (All t -statistics in this table are clustered by both credit score and month-of-origination.) The overall delinquency rate is 7.3%, so Flexible loans appear to have performed noticeably better. As I discuss in Section 3.5, however, the superior outcomes for Flexible loans may be driven by the bank's ex post sorting on unobservables to direct better borrowers to the program.

To better assess the overall impact of the Flexible program on loan outcomes, I estimate

(4), with delinquency as the loan characteristic. This specification provides evidence on the causal impact of program eligibility on mortgage performance. As described in Table 5, column 2, the coefficient on *Program-Eligible* is 22.1 percentage points and significant (t -statistic=2.40). This indicates that borrowers eligible for the Flexible program were much more likely to experience subsequent delinquency. The endogenous regression in the first column showed that Flexible borrowers were less likely to become delinquent, but the regression discontinuity result in column 2 shows that the causal impact of offering the Flexible program led to much worse outcomes for the bank. As Table 5, column 3 makes clear, including loan-level risk controls in the delinquency specification has little impact on the estimated coefficient on *Program-Eligible* (it is 22.8 percentage points in this regression) and leads to the same conclusion.

These findings are illustrated graphically in Figure 5, which depicts the change in delinquency probability from the program period to the post-program period for varying credit scores. The estimated polynomials for these changes in probabilities are depicted as curves and the mean changes for each bucket of five credit score points are shown as points on the connected lines. (The graph depicts the raw estimated probabilities without controls- the figure controlling for month of origination and loan terms is quite similar.) Figure 6 depicts the same series but focuses on a narrow window around the threshold.

As these figures show, there are varying changes in performance by credit score over time. The focus of this study, however, is specifically on the changes that occur around the centered credit score threshold of zero. Potential borrowers just above and just below this threshold should have very similar characteristics, and, in the absence of other factors, should have delinquency rates that generally move together over time. The polynomials in the figures illustrate, however, a sharp relative performance improvement for just above-threshold borrowers in the post-program period; they experience almost no increase in delinquency probability, while the just below-threshold borrowers experience a substantially higher increase in the probability of delinquency. The mean performance changes by credit score buckets yield a similar conclusion. This dramatically different change in

performance precisely at the eligibility threshold is driven by the closure of the Flexible program: once this program was no longer offered, the pool of just above-threshold borrowers attracted to the bank had significantly better relative outcomes. That is, above and below-threshold borrowers were very similar in all ways except that above-threshold borrowers were formally eligible for the Flexible program until it closed, and the below-threshold borrowers were never formally eligible for the Flexible program. The stark gap in the change in relative outcomes for the two groups is evidence that offering the Flexible program had the causal effect of significantly increasing delinquencies. Why do the below-threshold borrowers exhibit worse performance in the post-program period? This is likely driven by the deteriorating housing market conditions. The above-threshold borrowers were subject to the same change in conditions, but the positive selection that arose from discontinuing the Flexible program largely offset this effect, resulting in relatively little worsening of performance for these borrowers. The key point from the figures is the relative performance improvement experienced by above-threshold borrowers once the Flexible program was terminated.

The results from this regression discontinuity specification should be driven largely by observations close to the threshold. In column 4 of Table 5 I display the findings from the subsample of borrowers with credit scores within 50 points of the eligibility threshold. The coefficient on *Program-Eligible* is 32.4 percentage points (t -statistic=2.99) indicating that the estimated effect is indeed coming from points near the threshold, consistent with the visual evidence from Figures 5 and 6.

3.5 What is the Effect of Offering Flexibility to Borrowers?

The results in the first column of Table 5 showing that Flexible loans exhibited superior performance contrast starkly with the results in columns two through four documenting the negative causal effect of offering Flexible loans to borrowers. That is, the results in columns 2-4 show that offering flexibility to borrowers attracts a poor set of borrowers, but the results in column 1 show that Flexible loans have low delinquency rates. How can these findings be reconciled?

The key point is that the bank exercised some discretion over which formally eligible and ineligible borrowers actually received Flexible loans. As I discuss below, the results in Table 5 are consistent with two phenomena: offering Flexible loans results in negative ex ante selection of borrowers (as shown in columns 2-4), but the bank engaged in positive ex post sorting of borrowers into the Flexible program that generated the good performance exhibited in the first column.

To develop these points, it is useful to consider delinquency summary statistics for different time periods and loan programs. Although this is a broad analysis without controls that does not make use of the sharp discontinuities at the thresholds exploited by the regressions in Table 5, it does help develop intuition for the latter set of results. As displayed in the first two columns of Table 6, Panel A, Flexible loans had better performance during the program period (consistent with Table 5, column 1), and column three shows that there were very few Flexible loans in the post-program period. The first two columns of Table 6, Panel B show that above- and below-threshold borrowers had roughly the same performance in the program period, which is interesting because the higher credit score above-threshold borrowers should, in general, be expected to have lower delinquency rates. Of course, during the program period above-threshold borrowers were much more likely to have access to Flexible loans, which may have attracted worse types. In support of this idea, Table 6, Panel B columns 3 and 4 show that after the Flexible program closed, the above-threshold borrowers did have significantly better performance. This contrasting comparison between above- and below-threshold borrowers in the program and post-program periods shows that offering the Flexible program did indeed lead to ex ante negative selection of worse borrowers, just as indicated in Table 5, columns 2-4. The worsening performance of below-threshold borrowers in the post-program period, despite their continuing to be formally offered the same Standard mortgage, is consistent with deteriorating conditions in the housing market. The above-threshold pool, however, actually performs better in the post-program period as the positive selection effects of ending their access to the Flexible program offset the negative macroeconomic changes. (Similar contrasting effects across the two classes of borrowers are illustrated in Figures 5 and 6.)

Table 6, Panel C provides evidence for the role of ex post sorting by the bank. The panel shows that for both above- and below-threshold borrowers, during the program period those who received Flexible loans had significantly better performance than who received Standard loans. In fact, below-threshold borrowers in the Flexible program had much better outcomes than above-threshold borrowers in the Standard program. Why did these high credit score borrowers perform worse? These findings suggest that the bank engaged in ex post sorting of weak above-threshold borrowers out of the Flexible program and into the Standard program (and sorting of strong below-threshold borrowers in the opposite direction). Table 6, Panel D, displayed for completeness, again shows that in the absence of the Flexible program, above-threshold borrowers did better.

The overall picture that emerges is that offering the Flexible program attracted weak borrowers to the bank (i.e., resulted in negative ex ante selection). The bank then shifted some of the worst borrowers to the Standard program, generating good performance for Flexible loans (due to the ex post sorting).³ This good performance, however, masks the fact that providing the Flexible product actually brought the bank a large pool of unattractive borrowers and led to weak overall performance.

What was the effect of the program on bank profitability? The data do not include full information on losses, but White (2008) reports a mean loss ratio on foreclosed mortgages of 38% by mid-2008. Given the small average yield spread of 3.53 percentage points and the program-generated increase of 22.8 percentage points in the delinquency rate, it is clear that the Flexible program loans had negative returns and were not directly profitable for the bank, irrespective of any impact on volume. Any other potential advantages such as increased cross-selling of deposit services would have had to be very large to offset the direct costs. Of course, this outcome reflected a large decrease in housing prices that was likely not expected. It is difficult to assess the ex ante

³Could the bank not simply sort out all the bad types attracted to the Flexible program and perhaps deny them loans altogether? Though it was able to successfully divert some weaker types to Standard loans, the bank was presumably not able to successfully identify enough of the very poor borrowers in the low quality pool attracted to the Flexible mortgages. Improved loan officer incentives may improve sorting (Cole, Kanz and Klapper (2011) and Agarwal and Ben-David (2012)).

attractiveness of the program, though it is notable that program-eligible loans were not charged higher rate spreads, as shown in Table 3.

3.6 Selection versus Treatment

The negative causal impact on performance of offering Flexible loans that is documented in Table 5 may be explained either by selection (i.e., worse borrowers were attracted to the program) or by a treatment effect (i.e., the program itself induced negative behaviors on the part of borrowers). Selection could be driven by the desire of worse borrower types to defer payments for as long as possible. Treatment effects may come in one of two kinds. In the first, it may have been the case that borrowers in the Flexible loan program were unable to make the required payments once they achieved their maximal balances (or reached the end of their initial low payment periods) and received the shock of an adjustment to a higher payment. A treatment effect of this kind would likely require some non-rational behavior on the part of borrowers, as the Flexible program gave borrowers the right, but not the requirement, to make slower repayments (it is essentially an option), but it might be that some borrowers actually suffered from being given additional discretion (Laibson 1997, Campbell 2006 and Heidhues and Kőszegi 2010). The second treatment effect arises from the fact that borrowers in the Flexible program had the right to make smaller payments and may thereby have achieved less equity (and possibly negative equity) in their homes. As a result of this negative equity, perhaps it was optimal for Flexible program borrowers to default. In this subsection, I will decompose the negative causal effect of offering the Flexible program into selection and treatment factors.

3.6.1 Treatment Effect- Payment Shock

To provide some evidence on the first treatment effect (i.e., payment shock at the time of adjustment), it is useful to consider the performance of loans in the pre-adjustment phase. In this phase Flexible loans typically require uniformly lower payments than Standard loans. For each

loan, I calculate the time to the earliest payment adjustment, assuming that only the minimal payments are made. I regress an indicator for delinquency before the early payment adjustment on *Program-Eligible* and the usual controls. Table 7, column 1 details the result that program eligibility is associated with a 25.8 percentage point higher rate of pre-adjustment delinquency (t -statistic=4.15). Not only is this coefficient large, but it is quite similar to the estimated effect on overall delinquency described in Table 5, column three. This suggests that accounting for the first treatment effect of a payment shock has little impact on the delinquency findings in Table 5. Moreover, the rate of pre-adjustment delinquency is only 3.5%, so program-eligibility actually has a much larger proportional effect on pre-adjustment delinquency than on overall delinquency. It is clear that there is no payment shock that could lead to worse outcomes for Flexible loans during the period in which their required payments are lower than those of Standard loans, yet program-eligibility actually has a proportionately stronger impact on pre-adjustment delinquency. Analyzing only delinquencies that pre-date the earliest adjustment period by 90 days yields a similar result, as shown in Table 7, column 2.

It may perhaps be argued that Standard loans systematically experience earlier payment adjustments, so the tests in the first two columns based on the pre-adjustment period are perhaps biased in favor of finding worse outcomes for Flexible loans. To compensate for this differential, I define for each Standard loan the modified time to earliest payment adjustment as the maximum of the time to the earliest payment adjustment of the Standard loan and the mean time to the earliest payment adjustment for all Flexible loans originated in the same month. For Flexible loans the modified time to earliest payment adjustment is simply the same as the time to the earliest payment adjustment. This equalizes the time over which delinquency is measured and is in some sense biased in favor of finding worse outcomes for Standard loans as their pre-modified payment adjustment period will often include the time of their actual payment shock.

As a third test I regress an indicator for delinquency before the modified earliest payment adjustment on *Program-Eligible* and the standard controls. As shown in the third column of Table 9,

program eligibility is associated with a 28.0 percentage point higher rate of pre-modified adjustment delinquency (t -statistic=4.38). Even with this extension in the evaluation period of Standard loans, it is clear that program eligibility led to worse outcomes for Flexible loans before any payment shock and during periods in which the payments on Flexible loans were uniformly lower than for Standard loans.

3.6.2 Treatment Effect- Negative Equity

Flexible loans allowed for lower payments than Standard loans, and this, in turn, generally reduces a borrower's home equity. Did this treatment effect lead to greater delinquency by program eligible borrowers?

To examine this issue, I calculate the estimated home equity position at the last month before the modified payment adjustment period for each borrower using zip code level price indices and assuming that minimal required payments were made each month. (I do not use the equity position at the time of delinquency or loan payoff, as this timing decision is clearly endogenous.) I regress an indicator for delinquency before the modified earliest payment adjustment on *Program-Eligible*, the borrower's home equity position and the standard controls. As shown in the first column of Table 8, lower home equity is associated with a much higher probability of delinquency, as expected. For the purpose of this study, however, the key point is that the coefficient of 0.275 (t -statistic=4.23) on *Program-Eligible* is little changed from the estimated coefficient in Table 7, column 3 of 0.280. That is, including the impact of home equity has little effect on the negative estimated causal impact of the Flexible program.

To make this point in an even stronger fashion, I create a fixed effect for the borrower's home equity rounded to the nearest percentage point. In column 2 of Table 8 I display the results from regressing delinquency before the modified earliest payment adjustment on *Program-Eligible*, the home equity fixed effects and the usual controls. The estimated coefficient of 0.284 (t -statistic=4.22) is again effectively the same as in the specification without any controls for the borrower's equity.

That is, in considering a period during which the payments under the Flexible program are lower, and comparing mortgages with essentially the same level of (possibly negative) equity, program eligible borrowers are dramatically more likely to become delinquent. This specification controls for both treatment effects: delinquencies are measured before any payment shock for Flexible loans, and the comparison is between loans with the same equity level. The strong negative coefficient on *Program-Eligible* in this regression shows that it is the selection of borrowers with poor unobservable qualities into the Flexible program that leads to such negative outcomes. The total delinquency effect of program-eligibility is 22.8 percentage points, and this finding shows that essentially all of the total impact is driven purely by selection. (In fact, the higher coefficients in Table 7 and the first two columns of Table 8 indicate that program eligibility appears to have a particularly strong negative effect in the early life of the loan.) It is clear that selection is the primary driver of the observed delinquency due to the Flexible program.

The results from the basic delinquency regression, including equity first as a direct control and then as a fixed effect, are displayed in columns 3 and 4 of Table 8, respectively. The estimated coefficient in each column is similar to the 0.228 described in the third column of Table 5 (for the specification that omits any equity control). This provides additional evidence that borrower's equity has little impact on the basic program eligibility effect.

Was equity in fact lower for program eligible borrowers? The regression result in the fifth column of Table 8 shows that program eligible borrowers have about 5 percentage points less equity, but the estimated coefficient is not significant. A borrower's equity level is determined in part by his or her payments, but also by house price changes. Apparently the variation in house prices generates a fair amount of change in equity levels such that the correlation between program eligibility and equity is not statistically significant. Moreover, most of the observed delinquencies occur for loans that had been originated less than three years previously. While this does give rise to a period of roughly two years during which the Standard borrowers made larger payments than the Flexible borrowers, the difference in accumulated equity between the two loan types over

this time was not that large. The results in columns 1-4 make clear that even controlling for this relatively small difference in equity, the program eligible borrowers had much higher delinquency rates.

Overall, these results provide strong evidence in favor of the selection effect. They suggest that very different borrowers were attracted to the Flexible and Standard loan programs, and that this selection is responsible for the difference in mortgage outcomes. It is possible that later payment shocks to Flexible borrowers will further worsen their eventual performance after the close of the sample period, but the results in Tables 7 and 8 make clear that the dramatically worse outcomes of program-eligible borrowers that I observe are essentially entirely driven by selection. These findings are consistent with prior evidence from the credit card and mortgage markets that there is considerable adverse selection in consumer finance (Calem and Mester 1995, Ausubel 1999, Ambrose and LaCour-Little 2001). Previous work has shown that financial flexibility can be exploited ex post by consumer borrowers who are on the edge of default (Norden and Weber 2010). My findings demonstrate, however, that the ex ante negative selection effects of offering flexibility can be enormous. Moreover, the strong impact of selection cannot be discerned simply by considering the overall performance of flexible mortgage programs, as banks will often make use of soft information to direct their best borrowers to these loans.

3.7 Early Delinquency

The regressions described above explore the impact of *Program-Eligible* on whether a loan experiences delinquency during the sample period. Loans originated earlier in the sample will have a longer period over which to become delinquent, but this is accounted for by the inclusion of month fixed effects: delinquency rates are essentially measured relative to other loans originated in the same month. Nonetheless, as an additional check, I consider the effect of *Program-Eligible* on whether delinquency was experienced within a fixed time period.

In the first column of Table 9, I display the results from regressing early delinquency (i.e.,

an indicator for loans with time to delinquency below the median of 863 days) on *Program-Eligible* and the controls. Early delinquency is 23.3 percentage points more likely for program-eligible loans (t -statistic=2.45). The mean rate of early delinquency is 3.5%. The results for loans that became delinquent within three years, described in the second column of Table 9, are similar. The third column of Table 9 details the results from a Cox Hazard model of delinquency. (In this model each observation is for a given loan in a specific month.) *Program-Eligible* loans have a higher delinquency hazard (coefficient=1.53 and t -statistic=2.08), indicating that they become delinquent more quickly. This complements the findings described above that *Program-Eligible* loans have a higher overall delinquency rate.

3.8 Loan Performance Around Program Closure Date

The results delineated in Table 5 establish that offering the Flexible program to borrowers led to much worse mortgage outcomes. The bank announced the impending closure several weeks before shutting down the program. Were selection effects particularly pronounced in this period as weaker types rushed to get access to flexibility? In this section I analyze the change in loan performance in the switch-over period, a narrow 3-month window centered around the time of program termination.

Regressing a delinquency indicator on *Program-Eligible* and the standard controls in switch-over period sample, I find, as detailed in Table 10, column 1, that program-eligible borrowers were 40.5 percentage points more likely to experience subsequent delinquency (t -statistic=2.44). This is almost twice the delinquency effect described in Table 5, and suggests that performance particularly suffers when a flexible program is about to be shut down. It may make sense, therefore, to terminate programs of this kind without notice.

In the second column of Table 10, I describe the result from regressing pre-modified adjustment delinquency on *Program-Eligible* and the controls. Program eligible borrowers were 45.5 percentage points more likely to experience pre-modified adjustment delinquency (t -statistic=3.95), indicating that the bulk of the performance deterioration during the switch-over period is driven by worse

selection of borrowers. Apparently there was a rush of truly terrible eligible borrowers to obtain Flexible loans before the program ended. While this effect is quite pronounced, it does not drive the overall findings in Table 5. Columns three and four of Table 10 show that the negative effects of the Flexible program on loan performance, while most severe during the switch-over period, are also evident during the remainder of the sample (labeled here the non-switch-over period).

3.9 Timing of Program Termination

The results described above show that the Flexible program led to both a surge in volume and significantly worse loan performance for the bank. Could these findings be driven by the timing of the bank's termination of the Flexible program? For example, in the early period of the sample there may have been more originations and riskier loans made simply due to market conditions. The bank is unlikely to have closed the Flexible program for some random exogenous reason. Might it be that the closure was triggered by changing market conditions, and that these changes also drive the findings?

The empirical specification in this paper is designed precisely to address concerns of this type. Specifically, the regression discontinuity difference-in-difference model described in equation (4) includes fixed effects for each month in the sample. The identification is driven by relative comparisons between above- and below-threshold borrowers in the program and post-program periods. Any market-wide changes in overall conditions will be controlled for by the month fixed effects.

The volume results, therefore, are not estimated from raw changes in the bank's volume from the program period to the post-program period. Instead, the volume effect is estimated from the relative change in above- and below-threshold volume across the two periods, as displayed in Figures 3 and 4. The performance results are estimated from the same type of comparison, and therefore control for any variation in delinquency risk at different periods of the macroeconomic cycle.

While overall volume and performance certainly did change over time (and the bank's termi-

nation decision may well have responded to this fact), my approach depends only the assumption that any differences amongst the bank’s potential borrowers in a tight band around the formal eligibility threshold should have not changed significantly over time. The fact that I do find such stark volume and performance changes can be attributed to the one factor that differentiates above- and below-threshold borrowers over time: the fact that in the program period the above-threshold borrowers were far more likely to be offered a Flexible loan, while in the post-program period this was no longer true. The findings in Table 10 show that significant changes occurred right at the time of program termination.

4 Conclusion

This paper provides an analysis of the effects of offering consumers financial flexibility in the form of an option to back-load mortgage payments. Using a regression discontinuity difference-in-difference design, I show that borrowers found the Flexible program quite attractive, and that it boosted volume by over 35%. Though the program experienced good loan outcomes, this was due to the bank’s shifting borrowers with better unobserved qualities into Flexible loans. The eligible borrowers drawn to the program, however, experienced delinquency at quadruple the average rate, and I find that this was due to very negative selection. This poor performance was especially pronounced during a narrow three-month window around the program closure, suggesting that program termination led to even worse selection.

Although it is beyond the scope of this study, the marked preference by borrowers for flexible mortgages that I document may suggest that the introduction of these products encouraged a broader set of households to enter the home loan market. The implications for house prices could be quite different if these new borrowers had legitimate needs for consumption smoothing or, conversely, if they were motivated by pure adverse selection considerations. The results in this paper may therefore help facilitate an analysis of the potentially causal role that exotic mortgages are sometimes

argued to have played in promoting the pre-crisis housing price boom.

References

- Agarwal, S., and I. Ben-David. 2012. Do Loan Officers' Incentives Lead to Lax Lending Standards? Working Paper.
- Ambrose, B., and M. LaCour-Little. 2001. Prepayment Risk in Adjustable Rate Mortgages Subject to Initial Year Discounts: Some New Evidence. *Real Estate Economics* 2: 305–327.
- Ausubel, L. 1991. The Failure of Competition in the Credit Card Market. *American Economic Review* 81: 50–81.
- Ausubel, L. 1999. Adverse Selection in the Credit Card Market. Working Paper, University of Maryland.
- Balla, E., R. Carpenter and B. Robinson. 2010. Assessing the Effectiveness of the Paulson “Teaser Freezer” Plan: Evidence from the ABX Index. Federal Reserve Bank of Richmond Working Paper.
- Barlevy, G., and J. Fisher. 2011. Mortgage Choices and Housing Speculation. Federal Reserve Bank of Chicago Working Paper.
- Billett, M., and J. Garfinkel. 2004. Financial Flexibility and the Cost of External Finance for U.S. Bank Holding Companies. *Journal of Money, Credit, and Banking* 36: 827–852.
- Calem, P., and L. Mester. 1995. Consumer Behavior and the Stickiness of Credit-Card Interest Rates. *American Economic Review* 85: 1327–1336.
- Campbell, J. 2006. Household Finance. *Journal of Finance* 61: 1553–1604,
- Cocco, J. 2013. Evidence on the Benefits of Alternative Mortgage Products. *Journal of Finance* forthcoming.
- Cole, S., M. Kanz and L. Klapper. 2011. Incentivizing Calculate Risk Taking: Evidence from a Series of Experiments with Commercial Bank Loan Officers. Working Paper.
- Cook, D., R. Kieschnick and R. Van Ness. 2006. On the Marketing of IPOs. *Journal of Financial*

Economics 82: 35–61.

Cordell, L., K. Dynan, A. Lehnert, N. Liang and E. Mauskopf. 2009. Designing Loan Modifications to Address the Mortgage Crisis and the Making Home Affordable Program. Federal Reserve Board Working Paper.

DeAngelo, H., L. DeAngelo and T. Whited. 2011. Capital Structure Dynamics and Transitory Debt. *Journal of Financial Economics* 99: 235–261.

DeGeorge, F., F. Derrien and K. Womack. 2007. Analyst Hype in IPOs: Explaining the Popularity of Bookbuilding. *Review of Financial Studies* 20: 1021–1058.

Gamba, A., and A. Triantis. 2008. The Value of Financial Flexibility. *Journal of Finance* 63: 2263–2296.

Graham, J., and C. Harvey. 2001. The Theory and Practice of Corporate Finance: Evidence from the Field. *Journal of Financial Economics* 60: 187–243.

Gross, D., and N. Souleles. 2002. Do Liquidity Constraints and Interest Rates Matter for Consumer Behavior? Evidence from Credit Card Data. *Quarterly Journal of Economics* 117: 149–185.

Hahn, J., P. Todd and W. Van der Klaauw. 2001. Identification and Estimation of Treatment Effects with a Regression-Discontinuity Design. *Econometrica* 69, 201–209.

Heidhues, P., and B. Köszegi. 2010. Exploiting Naïvete about Self-Control in the Credit Market. *American Economic Review* 100: 2279–2303.

Holmstrom, B., and J. Tirole. 1998. Private and Public Supply of Liquidity. *Journal of Political Economy* 106: 1–40.

Hurst, E., and F. Stafford. 2004. Home Is Where the Equity Is: Mortgage Refinancing and Household Consumption. *Journal of Money, Credit and Banking* 36: 985–1014.

Inderst, R., and M. Ottaviani. 2009. Misselling through Agents. *American Economic Review* 99: 883–908.

Jagannathan, M., C. Stephens and M. Weisbach. 2000. Financial Flexibility and the Choice between Dividends and Stock Repurchases. *Journal of Financial Economics* 57: 355–384.

- Kahl, M., A. Shivdasani and Y. Wang. 2010. Why Do Firms Use Commercial Paper? University of North Carolina Working Paper.
- Keloharju, M., S. Knpfer and S. Torstila. 2008. Do Retail Incentives Work In Privatizations? *Review of Financial Studies* 21: 2061–2095.
- Keys, B., T. Mukherjee, A. Seru and V. Vig. 2010. Did Securitization Lead to Lax Screening? Evidence from Subprime Loans. *Quarterly Journal of Economics* 125: 307–362.
- Krainer, J., and E. Laderman. 2011. Mortgage Loan Securitization and Relative Loan Performance. Federal Reserve Bank of San Francisco Working Paper.
- Laibson, D. 1997. Golden Eggs and Hyperbolic Discounting. *Quarterly Journal of Economics* 112: 443–478.
- Lee, D. S. 2008. Randomized Experiments from Non-Random Selection in U.S. House elections. *Journal of Econometrics* 142:675–697.
- Mian, A., and A. Sufi. 2009. The Consequences of Mortgage Credit Expansion: Evidence from the U.S. Mortgage Default Crisis. *Quarterly Journal of Economics* 124: 1449–1496.
- Norden, L., and M. Weber. 2010. Credit Line Usage, Checking Account Activity, and Default Risk of Bank Borrowers. *Review of Financial Studies* 23: 3665–3699.
- Piskorski, T., and A. Tchisty. 2010. Optimal Mortgage Design. *Review of Financial Studies* 23: 3098–3140.
- Piskorski, T. and A. Tchisty. 2011. Stochastic House Appreciation and Optimal Mortgage Lending. *Review of Financial Studies* 24: 1407–1446.
- Ross, S. 1989. Institutional Markets, Financial Marketing, and Financial Innovation. *Journal of Finance* 44: 541–556.
- Sufi, A. 2009. Bank Lines of Credit in Corporate Finance: an Empirical Analysis. *Review of Financial Studies* 22: 1057–1088.
- Tirole, J. 2012. Overcoming Adverse Selection: How Public Intervention Can Restore Market Functioning. *American Economic Review* 102: 29–59.

White, A. 2008. Rewriting Contracts, Wholesale: Data on Voluntary Mortgage Modifications from 2007 and 2008 Remittance Reports. *Fordham Urban Law Journal* 36: 509–535.

Figure 1: Flexible Loan Provision during Program Period

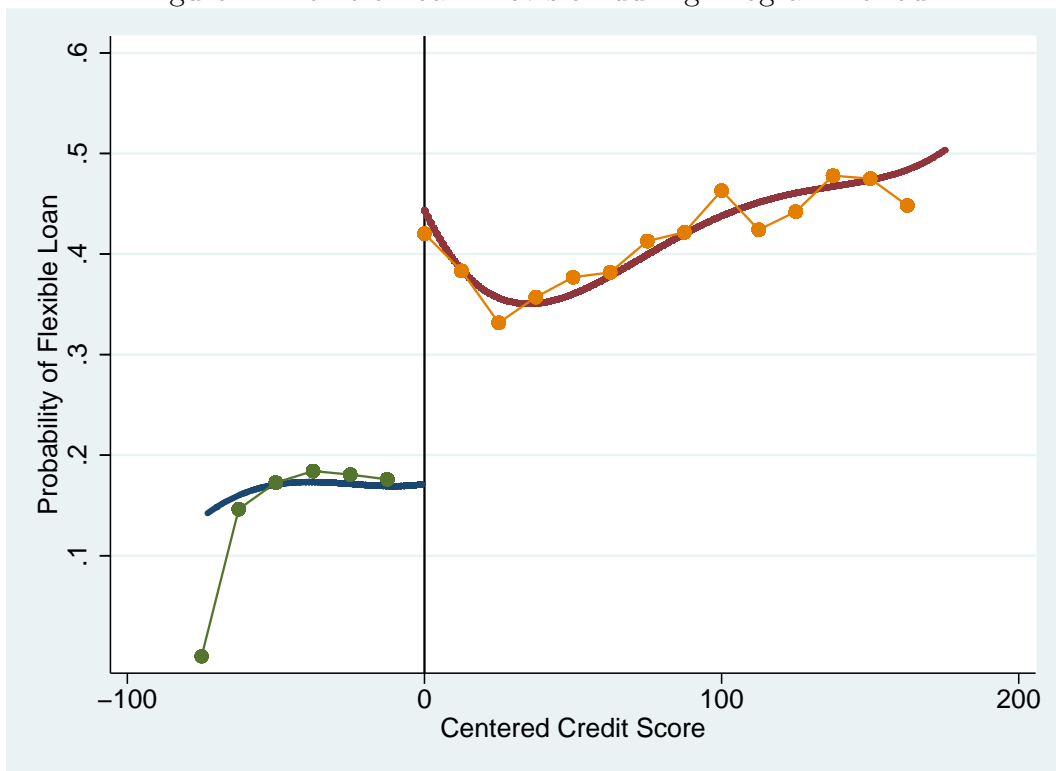


Figure 2: Flexible Loan Provision during Post-Program Period

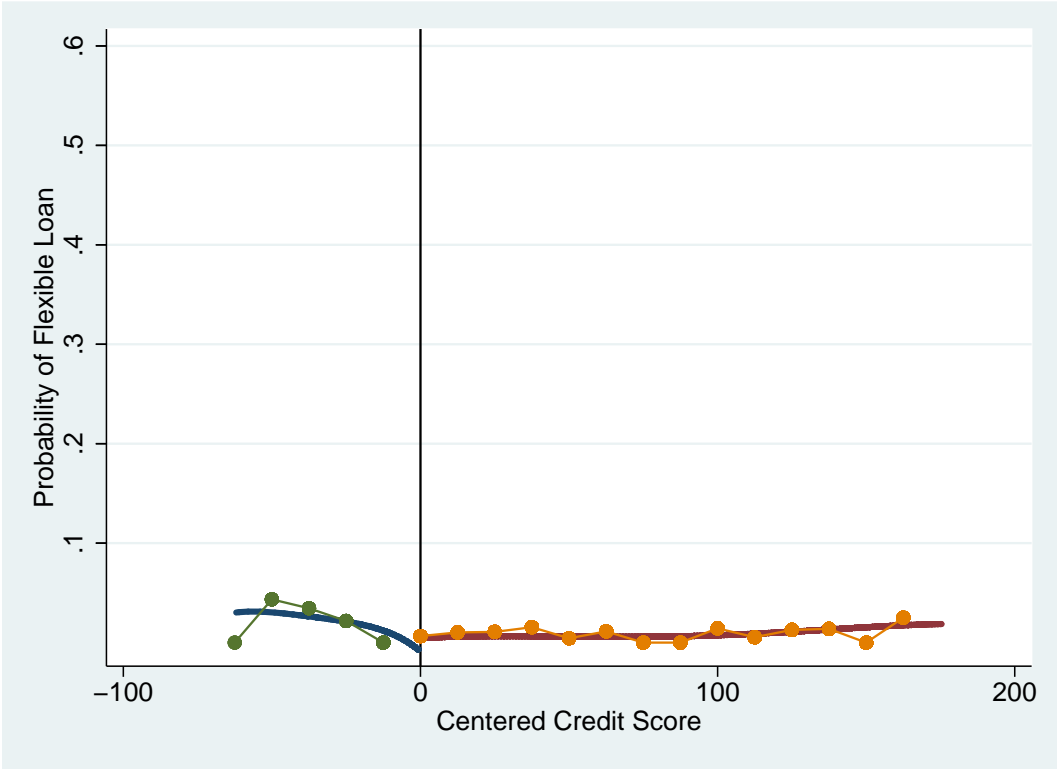


Figure 3: Density of Centered Credit Scores- Program Period

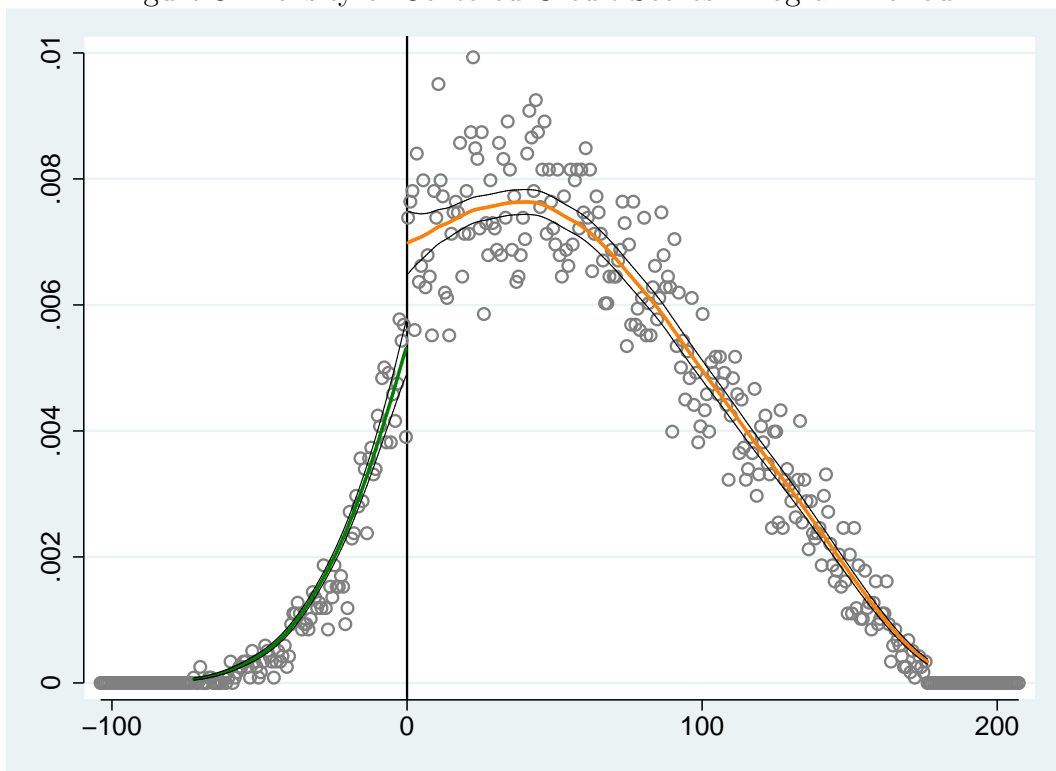


Figure 4: Density of Centered Credit Scores- Post Program Period

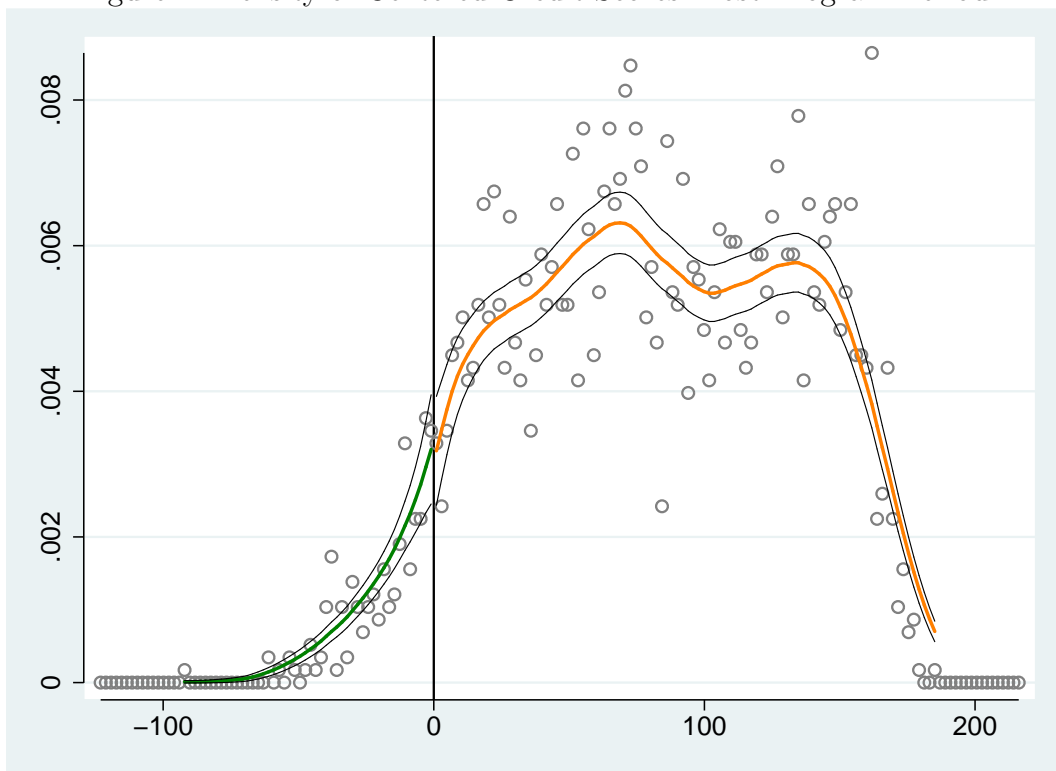


Figure 5: Changes in Delinquency Probabilities: Post-Program versus Program Period

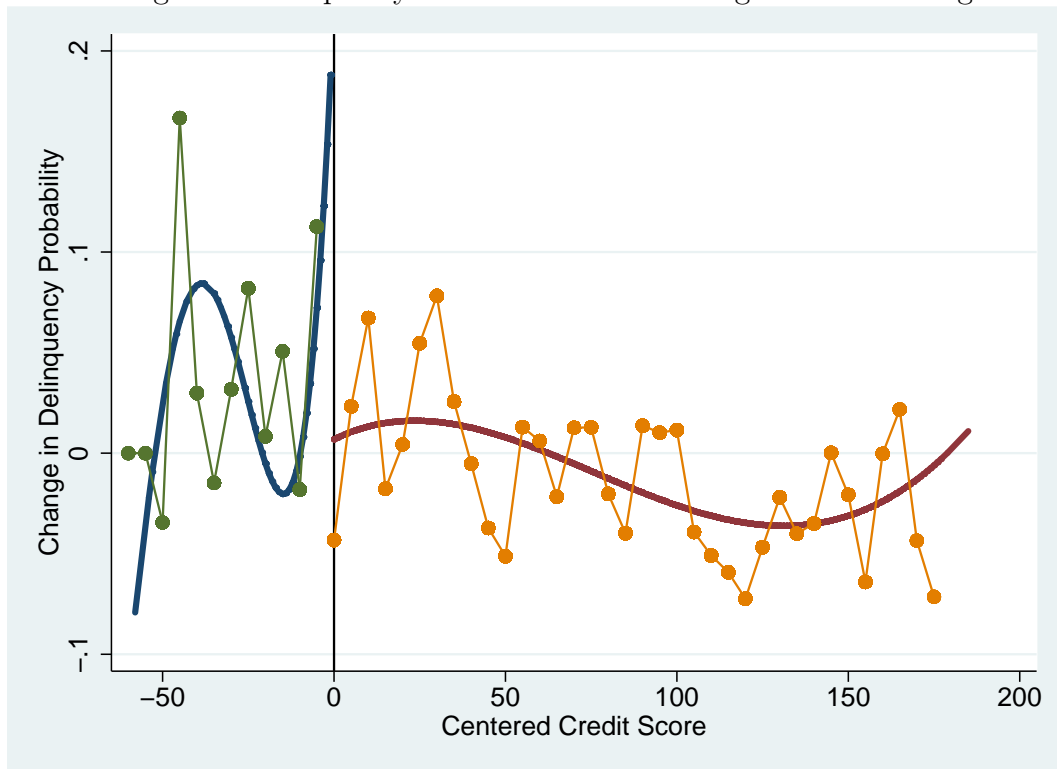


Figure 6: Changes in Delinquency Probabilities: Post-Program versus Program Period (View Close to Threshold)

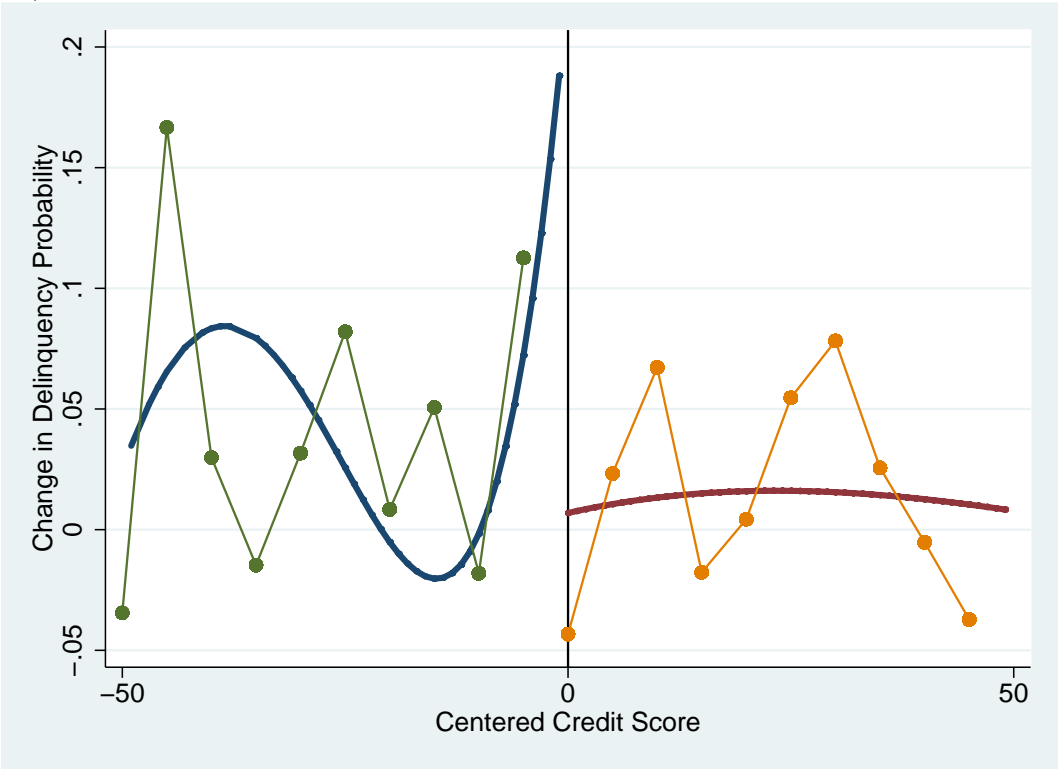


Table 1: Summary Statistics

Panel A describe statistics for the full sample and Panel B provides variable means in various subsamples. Observations are at the loan level. Rate spread is the interest premium paid by the borrower relative to an index. Maturity is the loan term in months. Credit score is the borrower's FICO score, LTV is the loan-to-value ratio, the loan amount is given in dollars, refinance is an indicator for a refinancing, the negative amortization cap is expressed as a percentage of the original balance, pay rate is the initial payment rate on the loan and flexible is an indicator for flexible loans. Distance describes the borrower's distance from the lender, equity details the borrower's estimated equity at the modified payment adjustment date, the rebate is the payment from the bank to the broker and broker points is the payment from the borrower to the broker. Documentation describe the level of information verification, delinquency is an indicator for whether a loan was 90 or more days past due. Credit score above threshold is an indicator for borrowers whose credit score exceed the formal eligibility threshold, program-eligible is an indicator for borrowers with above-threshold credit scores during the program period (January 2004- December 2005) and program period is an indicator for loans extended during the program period.

Panel A: Full Sample Statistics	Mean	Median	Standard Deviation	1 st %	99 th %
Rate Spread	3.53	3.60	0.53	2.25	4.74
Maturity	427.50	480.00	59.60	360.00	480.00
Credit Score	714.88	711.00	44.93	626.00	805.00
LTV	0.73	0.78	0.14	0.28	0.95
Loan Amount	435580.17	369550.00	305523.07	108000.00	1525000.00
Refinance	0.81	1.00	0.39	0.00	1.00
NegAm Cap	112.44	125.00	26.64	0.00	125.00
Pay Rate	2.12	1.95	1.07	0.50	6.05
Flexible Loan	0.32	0.00	0.47	0.00	1.00
Distance	166.18	111.46	139.38	4.81	391.30
Equity	0.05	0.00	0.34	-0.50	1.00
Rebate	1.84	2.00	0.88	0.00	3.25
Broker Points	0.20	0.00	0.45	0.00	2.00
High Documentation	0.60	1.00	0.49	0.00	1.00
Low Documentation	0.40	0.00	0.49	0.00	1.00
Delinquent	0.07	0.00	0.26	0.00	1.00
Credit Score Above Threshold	0.90	1.00	0.30	0.00	1.00
Program-Eligible	0.75	1.00	0.43	0.00	1.00
Program Period	0.84	1.00	0.36	0.00	1.00

Panel B: Subsample Means	Program	Program	Post-Program &	Post-Program &
	Period & Flexible Loan	Period & Standard Loan	Flexible Loan	Standard Loan
Observations	6023	10076	27	2964
Rate Spread	3.55	3.65	2.66	3.08
Maturity	417.69	429.88	440.00	439.22
Credit Score	724.12	705.86	721.33	726.69
LTV	0.70	0.75	0.62	0.70
Loan Amount	384832.35	399311.56	496559.22	661440.57
Refinance	0.87	0.79	0.89	0.77
NegAm Cap	121.87	115.53	114.81	82.32
Pay Rate	2.09	1.93	3.18	2.84
Flexible Loan	1.00	0.00	1.00	0.00
Distance	170.85	168.32	115.65	150.03
Equity	-0.00	0.01	0.19	0.26
Rebate	2.03	1.89	1.49	1.32
Broker Points	0.07	0.18	0.94	0.51
High Documentation	0.46	0.62	0.85	0.81
Low Documentation	0.54	0.38	0.15	0.19
Delinquent	0.03	0.10	0.00	0.06
Credit Score Above Threshold	0.95	0.86	0.89	0.93
Program-Eligible	0.95	0.86	0.00	0.00
Program Period	1.00	1.00	0.00	0.00

Table 2: Flexible Loans

Results from the regressions of an indicator for whether a loan has a Flexible repayment option (i.e., offered back-loaded payments) on borrower and transaction characteristics. The regressors with reported coefficients are a dummy for whether the centered credit score of the borrower was zero or above, an interaction of this dummy with an indicator for whether the loan was originated during the program period (this interaction is labeled “Program-Eligible”) (column 4-5), an indicator for whether the loan was originated during the program period (column 4-5), the rate spread on the mortgage (column 5), the initial required pay rate on the mortgage (column 5), the loan-to-value ratio (column 5) and the mortgage maturity (column 5). The regressions also include as controls fourth-degree polynomials in credit score for both periods, monthly fixed effects and indicators for refinancings (column 5) and low documentation loans (column 5). Reported t -statistics are heteroskedasticity-robust and clustered by both credit score and month of origination.

	Flexible?	Flexible?	Flexible?	Flexible?	Flexible?
Above-Threshold Credit Score	0.244** (4.87)	0.272** (4.90)	0.0136 (0.78)	0.0132 (0.76)	-0.0207 (-0.34)
Program-Eligible				0.258** (4.28)	0.263** (4.16)
Program Period				-0.0493 (-0.92)	-0.165** (-2.98)
Rate Spread					-0.269** (-12.88)
Pay Rate					0.154** (7.94)
LTV					-0.413** (-9.88)
Maturity					-0.000162** (-2.01)
Polyn. in Credit Score of Degree	4	4	4	4	4
Monthly F.E.	Yes	Yes	Yes	Yes	Yes
Sample	Full	Program	Post-Program	Full	Full
Observations	19056	16073	2983	19056	18727
Adjusted R^2	0.148	0.078	0.030	0.151	0.315

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$

Table 3: Loan Terms

Results from the regressions of loan characteristics on an indicator (labeled “Program-Eligible”) for whether the loan was originated during the program period to a borrower with a centered credit score of zero or above. The dependent variables in Panel A are the rate spread on the loan (column 1), the loan maturity (column 2), the log of the loan amount in dollars (column 3), the loan-to-value ratio (column 4) and an indicator for a refinancing (column 5). The dependent variables in Panel B are the initial required payment rate on the loan (column 1) and an indicator for whether the pay rate increased after the first year of the loan (column 2). The dependent variables in Panel C are the rebate paid by the bank to the broker (column 1) and the points paid by the borrower to the broker (column 2). The regressions also include as controls an indicator for whether the borrower centered credit score was zero or above, an indicator for loans generated during the program period, fourth-degree polynomials in credit score for both periods and monthly fixed effects. Reported t -statistics are heteroskedasticity-robust and clustered by both credit score and month of origination.

Panel A:	Rate Spread	Maturity	Loan Amount	LTV	NegAm	Refinance
Program-Eligible	0.115 (1.07)	0.319 (0.03)	0.134 (1.17)	0.00557 (0.31)	0.721 (0.28)	-0.0537 (-0.66)
Polyn. in Credit Score of Degree	4	4	4	4	4	4
Monthly F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19056	19056	19056	19056	18800	19056
Adjusted R^2	0.255	0.254	0.153	0.069	0.807	0.050

Panel B:	Pay Rate	Pay Rate Increase
Program-Eligible	-0.268* (-1.74)	-0.223** (-3.00)
Polyn. in Credit Score of Degree	4	4
Monthly F.E.	Yes	Yes
Observations	18999	14937
Adjusted R^2	0.628	0.130

Panel C:	Rebate	Broker Points
Program-Eligible	0.0355 (0.16)	0.0227 (0.15)
Polyn. in Credit Score of Degree	4	4
Monthly F.E.	Yes	Yes
Observations	19056	19056
Adjusted R^2	0.201	0.386

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$

Table 4: Volume

Results from the regression of the scaled frequency of originations by centered credit score and period on an indicator (labeled “Program-Eligible”) for whether the loan was originated during the program period to a borrower with a centered credit score of zero or above and from McCrary (2008) kernel density discontinuity estimations. Frequencies of originations are calculated separately for each centered credit score during both the program and post-program periods and scaled by the total number of originations in each period, and these scaled frequencies are labeled “Volume”. The regression in column 1 includes as controls an indicator for whether the borrower centered credit score was zero or above, an indicator for loans generated during the program period and a fourth-degree polynomial in credit score for both periods, as specified in the table. The reported t -statistic is heteroskedasticity-robust. The log-difference in the density heights on either side of the threshold of zero are reported for the program (column 2) and post-program periods (column 3).

	Volume	Volume Density	Volume Density
Program-Eligible	0.00134** (2.52)		
Above-Threshold Credit Score		0.263** (4.66)	-0.089 (-0.48)
Sample	Full	Program	Post-Program
Estimation Method	OLS-Polyn. in Credit Sc.	McCrary	McCrary
Observations	502		
Adjusted R^2	0.896		

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$

Table 5: Loan Performance

Results from the OLS regressions of various delinquency indicators on borrower and transaction characteristics. The dependent variable is an indicator for delinquency. The regressors with reported coefficients are an indicator for Flexible loans, an indicator (labeled “Program-Eligible”) for whether the loan was originated during the program period to a borrower with a centered credit score of zero or above, an indicator for instrumented Flexible loans, the rate spread on the mortgage, the initial required pay rate on the mortgage, the loan-to-value ratio and the mortgage maturity. The regressions also include as controls an indicator for whether the borrower centered credit score was zero or above, an indicator for loans generated during the program period, fourth-degree polynomials in credit score for both periods and indicators for refinancings and low documentation loans. Monthly fixed effects are included in all specifications. Reported t -statistics are heteroskedasticity-robust and clustered by both credit score and month of origination.

	Delinquent?	Delinquent?	Delinquent?	Delinquent?
Flexible	-0.0309** (-4.15)			
Program-Eligible		0.221** (2.40)	0.228** (2.47)	0.326** (2.95)
Rate Spread	0.0267** (5.26)		0.0348** (5.55)	0.0318** (3.34)
Pay Rate	-0.00380 (-1.17)		-0.00839** (-2.24)	-0.0144* (-1.83)
LTV	0.270** (8.61)		0.283** (8.19)	0.391** (8.91)
Maturity	0.000163** (4.48)		0.000168** (4.74)	0.000183** (2.68)
Polyn. in Cred. Sc.	4	4	4	4
Monthly F.E.	Yes	Yes	Yes	Yes
Sample	Full	Full	Full	Centered Cred. Sc. $\in [-50, +50]$
Estimation Method	OLS	OLS	OLS	OLS
Observations	18727	19056	18727	8502
Adjusted R^2	0.076	0.038	0.075	0.074

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$

Table 6: Loan Performance- Summary Statistics

Summary statistics of mean delinquency rates across different time periods, mortgage programs and borrower credit scores. The terms “Ab. Thresh.” and “Bel. Thresh.” refer to borrowers with credit scores above and below the formal eligibility threshold, respectively.

Panel A:				
Mean Delinquency Rate	0.030	0.102**	0	0.060
Sample	Flexible	Standard	Flexible	Standard
Period	Program	Program	Post-Program	Post-Program
Observations	6023	10076	27	2964

Panel B:				
Mean Delinquency Rate	0.075	0.073	0.056	0.118**
Sample	Ab. Thresh.	Bel. Thresh.	Ab. Thresh.	Bel. Thresh.
Period	Program	Program	Post-Program	Post-Program
Observations	14358	1741	2788	203

Panel C:				
Mean Delinquency Rate	0.031	0.105**	0.022	0.083**
Sample	Ab. Thresh.	Ab. Thresh.	Bel. Thresh.	Bel. Thresh.
	Flexible	Standard	Flexible	Standard
Period	Program	Program	Program	Program
Observations	5716	8642	307	1434

Panel D:				
Mean Delinquency Rate	0	0	0.056	0.12**
Sample	Ab. Thresh.	Bel. Thresh.	Ab. Thresh.	Bel. Thresh.
	Flexible	Flexible	Standard	Standard
Period	Post-Program	Post-Program	Post-Program	Post-Program
Observations	24	3	2764	200

Stars indicate a coefficient that is larger than the adjacent coefficient.

Comparisons are between columns 1 and 2 and between columns 3 and 4.

* $p < 0.10$, ** $p < 0.05$

Table 7: Loan Performance- Delinquency before Payment Adjustment

Results from the regressions of various delinquency indicators on borrower and transaction characteristics. The dependent variables are indicators for delinquency before payment adjustment (column 1), delinquency 90 days before payment adjustment (column 2) and delinquency before modified payment adjustment (column 3). The regressors with reported coefficients are an indicator (labeled “Program-Eligible”) for whether the loan was originated during the program period to a borrower with a centered credit score of zero or above, the rate spread on the mortgage, the initial required pay rate on the mortgage, the loan-to-value ratio and the mortgage maturity. The regressions also include as controls an indicator for whether the borrower centered credit score was zero or above, an indicator for loans generated during the program period, fourth-degree polynomials in credit score for both periods and indicators for refinancings and low documentation loans. Monthly fixed effects are included in all specifications. Reported t -statistics are heteroskedasticity-robust and clustered by both credit score and month of origination.

	Delinquent Pre-Adj.?	Delinquent 90 days Pre-Adj.?	Delinquent Pre- Mod. Adj.?
Program-Eligible	0.258** (4.15)	0.253** (3.95)	0.280** (4.38)
Rate Spread	0.00857** (2.23)	0.00920** (2.49)	0.0155** (3.79)
Pay Rate	0.00376 (1.38)	0.00280 (1.09)	-0.000143 (-0.05)
LTV	0.132** (7.65)	0.122** (7.58)	0.165** (9.42)
Maturity	0.0000792** (3.06)	0.0000777** (2.81)	0.000124** (4.66)
Polyn. in Cred. Sc.	4	4	4
Monthly F.E.	Yes	Yes	Yes
Observations	18727	18727	18727
Adjusted R^2	0.043	0.044	0.041

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$

Table 8: Negative Equity and Delinquency

Results from the regressions of delinquency indicators and homeowner's equity on borrower and transaction characteristics. The dependent variables are an indicator for delinquency before modified payment adjustment (columns 1-2), an indicator for delinquency (columns 3-4) and homeowner's equity at the time of modified payment adjustment. The regressors with reported coefficients are an indicator (labeled "Program-Eligible") for whether the loan was originated during the program period to a borrower with a centered credit score of zero or above, the homeowner's equity at the time of modified payment adjustment, the rate spread on the mortgage, the initial required pay rate on the mortgage, the loan-to-value ratio and the mortgage maturity. The regressions also include as controls an indicator for whether the borrower centered credit score was zero or above, an indicator for loans generated during the program period, fourth-degree polynomials in credit score for both periods and indicators for refinancings and low documentation loans. Monthly fixed effects are included in all specifications. Fixed effects for homeowner's equity rounded to the nearest percentage point are included in columns 2 and 4. Reported t -statistics are heteroskedasticity-robust and clustered by both credit score and month of origination.

	Delinquent Pre- Mod. Adj.?	Delinquent Pre- Mod. Adj.?	Delinquent?	Delinquent?	Equity
Program-Eligible	0.275** (4.23)	0.284** (4.22)	0.224** (2.40)	0.239** (2.61)	-0.0532 (-1.45)
Equity	-0.0984** (-7.90)		-0.0667** (-4.78)		
Rate Spread	0.0140** (3.35)	0.0155** (3.70)	0.0338** (5.16)	0.0344** (5.17)	-0.0147* (-1.82)
Pay Rate	-0.000875 (-0.31)	-0.00158 (-0.56)	-0.00887** (-2.31)	-0.00876** (-2.33)	-0.00799** (-2.11)
LTV	0.0438** (3.22)	0.0883** (5.98)	0.200** (6.85)	0.205** (7.27)	-1.235** (-32.04)
Maturity	0.000128** (4.78)	0.000133** (4.64)	0.000171** (4.83)	0.000169** (4.60)	0.0000395 (1.01)
Polyn. in Cred. Sc.	4	4	4	4	4
Monthly F.E.	Yes	Yes	Yes	Yes	Yes
Equity F.E.	No	Yes	No	Yes	No
Observations	18709	18709	18709	18709	18709
Adjusted R^2	0.050	0.053	0.077	0.075	0.656

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$

Table 9: Loan Performance- Early Delinquency

Results from the OLS regressions (columns 1-2) and Cox hazard model (column 3) of various delinquency indicators on borrower and transaction characteristics. The dependent variables are indicators for delinquency before 863 days (the median time to delinquency, in column 1), delinquency before 3 years (column 2) and delinquency (column 3). The regressors with reported coefficients are an indicator (labeled “Program-Eligible”) for whether the loan was originated during the program period to a borrower with a centered credit score of zero or above, the homeowner’s equity, the rate spread on the mortgage, the initial required pay rate on the mortgage, the loan-to-value ratio and the mortgage maturity. The regressions also include as controls an indicator for whether the borrower centered credit score was zero or above, an indicator for loans generated during the program period, fourth-degree polynomials in credit score for both periods and indicators for refinancings and low documentation loans. Monthly fixed effects are included in all specifications. Reported t -statistics are heteroskedasticity-robust and clustered by both credit score and month of origination.

	Delinquent Early?	Delinquent in 3 Years?	Delinquent?
Program-Eligible	0.233** (2.45)	0.237** (2.53)	1.526** (2.08)
Equity			-0.295** (-10.53)
Rate Spread	0.0238** (4.62)	0.0343** (5.40)	0.826** (11.08)
Pay Rate	-0.00772** (-2.53)	-0.00918** (-2.41)	-0.396** (-10.40)
LTV	0.150** (5.17)	0.244** (6.37)	8.574** (19.18)
Maturity	0.0000992** (3.09)	0.000146** (4.11)	0.00339** (6.02)
Estimation Method	OLS	OLS	Cox Hazard
Observations	18727	18727	454260
Adjusted R^2	0.074	0.086	

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$

Table 10: Loan Performance in a Narrow Time Period Around Program Closure

Results from the regressions of an indicator for delinquency on borrower and transaction characteristics in varying time periods. The regressors with reported coefficients are an indicator (labeled “Program-Eligible”) for whether the loan was originated during the program period to a borrower with a centered credit score of zero or above, the rate spread on the mortgage, the initial required pay rate on the mortgage, the loan-to-value ratio and the mortgage maturity. The regressions also include as controls an indicator for whether the borrower credit score was zero or above, an indicator for loans generated during the program period, a fourth-degree polynomial in credit score, monthly fixed effects and indicators for refinancings and low documentation loans. The sample in columns 1 and 2 is a 3-month window around the time of the program closure, and the sample in columns 3 and 4 is the full period excluding this 3-month window. Reported t -statistics are heteroskedasticity-robust and clustered by both credit score and month of origination.

	Delinquent?	Delinquent Pre- Mod. Adj.?	Delinquent?	Delinquent Pre- Mod. Adj.?
Program-Eligible	0.405** (2.44)	0.455** (3.95)	0.213** (1.96)	0.264** (3.23)
Rate Spread	0.0843** (5.65)	0.0603** (3.52)	0.0326** (4.89)	0.0126** (3.13)
Pay Rate	-0.0154** (-2.15)	-0.00579 (-0.39)	-0.00785* (-1.92)	0.000454 (0.16)
LTV	0.546** (6.60)	0.372** (4.49)	0.257** (7.36)	0.146** (9.71)
Maturity	-0.0000253 (-0.11)	-0.0000204 (-0.13)	0.000179** (5.09)	0.000131** (5.01)
Polyn. in Cred. Sc.	4	4	4	4
Monthly F.E.	Yes	Yes	Yes	Yes
Period	Switch-over	Switch-over	Non-switch-over	Non-switch-over
Observations	1250	1250	17477	17477
Adjusted R^2	0.097	0.080	0.072	0.035

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$

Data Appendix

Variable Definitions:

Broker points- the payment from the borrower to the broker.

Credit score- the borrower's FICO score.

Credit score above threshold- an indicator for a borrower whose credit score meets or exceeds the formal eligibility threshold.

Delinquency- an indicator for whether a loan is 90 or more days past due.

Distance- the borrower's distance from the lender headquarters.

Documentation- the level of information verification (either high or low).

Equity- the borrower's estimated equity at the time of the modified payment adjustment.

Flexible loan- an indicator for a mortgage extended under the Flexible program, which allowed for payments above the initial pay rate after a period of five years (or three or ten years, in a small number of cases).

LTV- the loan-to-value ratio

Modified time to earliest payment adjustment- for Standard loans, the maximum of the time to the earliest payment adjustment of the Standard loan and the mean time to the earliest payment adjustment for all Flexible loans originated in the same month. For Flexible loans the modified time to earliest payment adjustment is simply the time to the earliest payment adjustment.

Maturity- the loan term in months.

Negative amortization cap- the maximum level of indebtedness the borrower is permitted, expressed as a percentage of the original balance.

Pay rate- the initial required payment rate on the loan.

Payment adjustment time- earliest time at which the mortgage would require the borrower to make payments greater than the pay rate, assuming that only the minimal payments are made.

Program-eligible- an indicator for borrowers with above-threshold credit scores during the program period.

Program period- an indicator for loans extended during the period in which Flexible mortgages were formally available (January 2004- December 2005).

Rate spread- interest premium paid by the borrower relative to an index.

Rebate- the payment from the bank to the broker

Refinance- an indicator for a refinancing (as opposed to a loan used to support a new home purchase)

Standard loan- an indicator for a loan extended under the Standard program, which allowed for payments above the initial pay rate after one year.