Banking Competition and Shrouded Attributes: Evidence from the US Mortgage Market

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Nov 20, 2017

Abstract

We document that banking deregulation increases competition, increased competition leads banks to offer lower initial rate on adjustable-rate mortgages (ARMs) to attract borrowers, but they also shroud these contracts by designing them with back-loaded resetting rates. Shrouding helps banks to offset about 73% of their losses from price discount due to competition. Deregulation increases the proportion of naïve borrowers, and banks shroud more where there is higher proportion of naïve borrowers. These results support the theory that sophisticated firms can exploit consumer biases by designing exploitative contracts. Although competition reduces firm revenues and benefits consumers initially, the overall effect is mitigated by the banks shrouding strategy.

Keywords: Deregulation; competition; shrouding; behavioral bias

JEL: G21, G28, R21, R31

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I. INTRODUCTION

It is important to understand market responses to changes in the regulation and deregulation of credit markets and financial intermediaries. A growing literature shows that banking deregulation plays an important role in affecting asset prices through increasing credit supply. It significantly lowers borrowing costs to small firms (Rice and Strahan 2010), increases the credit supply in the mortgage market and thus helps increase housing prices (Favara and Imbs 2015), and it increases the supply of complex products (Di Maggio, Kermani, and Korgaonkar 2015). However, little has been done to explore how banks respond in designing their contracts in response to deregulation and competition. This paper examines whether and how banking competition affects banks' responses in the mortgage market. Specifically, we focus on adjustable-rate mortgage (ARM) contracts in the United States, since ARM contracts are extremely complex, with different add-on attributes, and consumers are known to pay limited attention to their contract terms in the mortgage market (Bucks and Pence 2008; Amromin et al. 2011).

Empirically, it is challenging to identify the causal effect of bank competition on banks' responses because of well-known identification issues. The provision of credit, changes in contracts, and the dynamics of asset prices are endogenous to current and expected market conditions, as well as other exogenous shocks. This paper overcomes these difficulties by exploiting the changes in interstate banking restrictions across state borders generated by the Interstate Banking and Branching Efficiency Act (IBBEA) and uses the deregulation to identify the causal effect of bank competition on contract design. The IBBEA was passed by US Congress in 1994, permitting banks and bank holding companies to expand their lending business across state lines. Even though unrestricted interstate baking was fully allowed once the law took effect in 1995, US states retained the right to erect roadblocks to branch expansion through (i) mandating age restrictions on bank branches and (ii) limiting the amount of total deposits any one bank can hold. This paper evaluates the effects of these time-varying deregulations on banks' design of ARM contracts.

In particular, we are interested in answering three questions: (i) Dose competition increase after deregulation? (ii) Does increased competition lead banks to shroud more on attributes of ARM contracts and thus exploit consumers' inattention

after deregulation? (iii) What is the impact of deregulation on bank revenue through possible shrouding behavior? Our analysis uses a difference-in-differences approach on a large sample of mortgage loans that originated between 1994 and 2005. We focus on ARM contracts with many complex features, such as an initial teaser rate, an initial fixed term or teaser period, a reset margin, a reset index, a first reset cap, periodical reset caps, and a lifetime cap.[1]

We begin our analysis with the recent theoretical literature that explores optimal supply responses when consumers exhibit behavioral bias. Theory predicts that sophisticated firms can exploit consumer biases by designing exploitative contracts (Gabaix and Laibson 2006; DellaVigna 2009; Kőszegi 2014; Heidhues and Kőszegi 2015). In our setting, there are two types of price components in an ARM contract: The base price is the initial teaser rate constant over the fixed term and the add-on price is the adjustable rate afterward as well as fixed term itself. There are also two types of borrowers: Myopic borrowers do not consider the pricing terms (index plus margin) after the fixed term, while sophisticated borrowers consider such terms and can refinance before the interest rate is reset to a higher rate but is subject to certain substitution costs. The theory predicts that a shrouded price equilibrium exists with a lower initial teaser rate and a higher margin when the proportion of naïve borrowers is larger than a given threshold. In the market segments with more naïve borrowers, it is more likely to observe a shrouded price equilibrium.

Our results show that deregulation increases significantly with new bank entrants in deregulated states and they exploit ARM borrowers by offering them lower initial rate and shrouding the back-loaded add-on prices. The initial rate spread[2], fixed term, and reset margin in ARM contracts are 5 basis points (bps) (or 6% of the average ARM spread) lower, 8 months (or 13%) shorter, and 11 bps (or 4%) higher in deregulated states than in fully regulated states. This is equivalent to a reduction of roughly $264 in initial interest payment annually before the first reset and a subsequent

[1] There are caps on interest rate increases as well as on payment increases. We focus on interest rate caps because they are more common. We do not focus on fixed-rate mortgages (FRMs), which are characterized by one fixed interest rate over the life of the loan and the amortization term.

[2] The initial teaser is defined as the spread over the rate on fixed-rate 30-year mortgages originating in the same month and same market.

increase of $532 in interest payment per year after reset[3]. The gains from shorter fixed terms, higher margin and slower prepayment of borrowers in deregulated states combined can offset 73% of the losses from lower initial price. Proportion of deceptive loans, those with relative lower initial rate and higher margin also increases significantly by 4-11% based on different measures. Other pricing terms are not as important in bank's pricing strategy affected by competition. Our placebo test shows that the differences between the deregulated and regulated states only become significant in the years following the deregulation, suggesting a causal effect of deregulation on the changes in banks' pricing strategy.

We find there is a great heterogeneity in the estimated effects on ARM contract terms across borrowers, lenders and markets. The effects on rate spread, margin and fixed terms are very similar for financially constrained borrowers and unconstrained borrowers. However, they are much stronger for home purchase loans, first-time homeowners, the primary mortgage insurance (PMI) loans and borrowers with low credit score (FICO), who lack experience and are un-sophisticated in mortgage market. For example, banks exploit borrowers with low FICO scores (< 620) the most by offering them the shortest fixed terms (by 12 months) and highest margin (by 17 bps) in deregulated states than in fully regulated states. Broker loans have much lower rate spread than retail bank loans (by 9 vs 3 bps) in deregulated states, while retail banks shroud more through shorter fixed terms (by 8 vs 5 months) and higher margin (by 13 vs 4 bps) in deregulated states than in regulated states. We also show that deregulation increases shrouding more in the MSAs with more naïve borrowers, measured by ex post prepayment behavior of borrowers. Banks exploit borrowers in MSAs with more naive borrowers by offering them higher margin by 17 to 21 bps in deregulated states than in fully regulated states. All these results are consistent with the theoretical prediction.

We consider a number of possible explanations. One of them is that competition increases naïve borrowers. The theory of shrouded attributes implies that a shrouded

[3]We calculate the impact of deregulation on gross loan payment in Table VIII. The reduction for interest payment before reset is $1322 and the increase in interest payment after reset is $959. The average fixed term is 60 month, so the annual interest payment reduces by 1322/60*12=$264. Conditional on not prepaying before reset, the number of months before prepayment is 21.6 months. So the annual interest payment increases by 959/21.6*12=$532. The dollar savings to the consumer are similar in magnitude to Choi, Laibson, and Madrian (2011).

price equilibrium exists when the proportion of naïve borrowers is larger than a given threshold. Theory implicitly assumes that the proportion of naïve borrowers is independent of market competition and steady over time for liquid market. By relaxing this assumption, we show that competition increases the proportion of naïve borrowers above a threshold so that an unshrouded price equilibrium switches to a shrouded price equilibrium. We test this by investigating the impact of banking deregulation on the proportion of naïve borrowers, using borrowers' prepayment behavior to measure their naïveté. We find that, based on both the full sample and various subsamples, deregulation significantly increases the proportion of naïve borrowers who are more likely to prepay in later years after the first reset and banks increase shrouding accordingly. We further argue that there are multiple mechanism on how this can happen. First, more loans are originated in new markets in deregulated states where there are more naïve borrowers; Second, rapid development of technology and state laws during the sample period may have resulted in lower threshold for the fraction of naïve consumers; Third, several papers have documented evidences that borrowers may be naïve due to their inattentiveness.

We also test for several explanations based on changes on the demand side, such as shift in demand due to higher demand for housing, expected increasing future income, higher switching cost for refinancing, expected rise in future interest rate and financial stress that would prevent them from refinancing on time. None of these are supported by our empirical results. We find that characteristics of the borrowers change very little following the deregulation and our main results are very robust across various subsamples. Hence, our estimated effects on ARM pricing terms are not due to change on the demand side but by increased competition.

Finally, we explore the impact of banking deregulation on mortgage performance, as well as firm revenues and consumer benefits. We find the overall default risk decreases significantly by 2.3% (or 40% reduction) following the banking deregulation and performance improves even after the first reset, suggesting that our baseline results are not driven by unobservable borrower quality. In other words, banks did not lower credit quality. We also find that deregulation increases prepayments much more in later years after the reset than in early years and increases the overall duration of loan payment after reset, leaving more time for banks to reap profits from the higher

reset rate. By shrouding on fixed term and margin as well as exploiting slower prepayment of naïve borrowers, banks are able to earn $960 more after the first reset in deregulated states than fully regulated states, which account for 73% of losses from lower initial rate. Our results suggest that, although competition reduces firm revenues and benefits consumers initially, the overall lifetime effect is very limited with banks' shrouding strategy.

This paper makes important contributions to several increasingly related strands of the literature. First, this paper contributes to the broad understanding of the effects of banking deregulations. We use the same deregulation events as Rice and Strahan (2010) and Favara and Imbs (2015) but study them from the completely different perspectives. Regardless of whether mortgage banks collect deposits or are chartered by federal and state regulators, they are all affected by increased competition and respond to the shock. The key difference between this paper and others is that, we further investigate banks' optimal pricing strategies in ARM contracts, consistent with theoretical arguments in Gabaix and Laibson (2006). Our findings support theoretical predictions that banks respond to competition by shrouding more on back-loaded add-on price attributes. Our results show that initially competition reduces firm revenues and benefit consumers, however, overall lifetime effect is very limited with banks' shrouding strategy.

The second contribution of this paper is to provide empirical evidence for the theoretical work that explores the optimal supply responses of firms when consumers exhibit behavioral biases. For example, firms could shroud add-ons in equilibrium when consumers are myopic (Gabaix and Laibson 2006; Miao 2010) or vary in their tastes for add-ons (Ellison 2005). Firms could design contracts for investment goods with lump-sum fees when consumers are hyperbolic discounters and mispredict their future consumption (DellaVigna and Malmendier 2004). The empirical literature on price shrouding mostly analyzes the demand elasticity of consumers to infer profitability and the results suggest that shrouding raises profitability (Ellison and Ellison 2009; Brown, Hossain, and Morgan 2010; Ru and Schoar 2015). Less empirical work has focused on firms' responses when competition changes or whether competition can eliminate firms' exploitation behavior. The theory shows that competition does not eliminate firms' exploitation (Gabaix and Laibson 2006). Our results show that competition can increase add-on prices when there are more naïve

borrowers and may even intensify firms' exploitation under certain conditions instead of eliminating it.

Lastly, our findings are related to the literature about the impact of competition on firm behavior. It is well documented that markets with more competition sometimes exhibit high markups, such as the mutual fund market (Hortacsu and Syverson 2004) the credit card market (Agarwal et. al 2016). Gabaix and Laibson (2006) show that firms' optimal response to naïve consumers can explain the high markups. Gabaix et al. (2015) show that idiosyncratic demand shocks driven by standard noise distributions can produce large equilibrium markups that are insensitive to competition and that competition could increase the markups for heavy-tailed distributions. Our results showing that competition can increase add-on prices are consistent with the implicit prediction of Gabaix and Laibson (2006). We also empirically show that the proportion of naïve borrowers must increase with competition to increase prices. Moreover, competition can destroy ethical behavior (Shleifer 2004) and induce firms to take costly actions that they might not otherwise (Syverson 2011). Our results are consistent with the literature that competition increases the magnitude of banks' strategies to exploit naïve borrowers. Standard equilibrium models imply that competition reduces price and thus firm revenues. Our empirical results show that the overall effect is rather limited, since firms respond to competition by increasing add-on prices.

Our findings have important implications for public policies regarding the design of banking regulatory policies after the financial crisis. In the wake of the crisis, the US government has implemented various banking and mortgage market policies through the Dodd–Frank Act, the Consumer Financial Protection Bureau, the Federal Reserve, and other agencies. Our results show that these policies have significant implications on credit supply and demand years later and can distort the behaviors of lenders as well as of borrowers.

II. THEORETICAL FRAMEWORK

In this section, we present our empirical predictions by starting with the theoretical model developed by Gabaix and Laibson (2006). They define two types of goods or services: base goods and add-ons. Take a bank account as an example: Most banks prominently advertise the virtues of their accounts but their marketing materials do not

highlight the costs of such accounts, including automated teller machine usage fees, bounced check fees, and minimum balance fees, that is, the so-called add-ons. Banks choose to shroud these fees. In this example, the base good refers to the opening of a bank account, while the shrouded attributes are all the add-on price features. In our setting, the base good refers to a mortgage used to finance a home purchase or refinancing, while the add-ons are the price features of an ARM after the fixed period. Since the interest rate paid after the initial reset is generally higher than the initial teaser rate, banks make more money if the borrowers keep the mortgage.

Consider, in period 0, a firm that has to decide whether an add-on should be shrouded or unshrouded. Gabaix and Laibson (2006) state that shrouding means to hide the add-on cost in the fine print or to publish it in an obscure location. Unshrouding is assumed to be free, so unshrouding a price is equivalent to advertising that price. The firm will have to select prices for the base good p and the add-on $\hat{p}$. In the next period, period 1, consumers pick a firm to buy the base good. There are two types of consumers: sophisticated and myopic. Sophisticated consumers—comprising a fraction $1 - \alpha$ ($\alpha < 1$) of the population—always take the add-on and its price into consideration, whereas myopic consumers (comprising a fraction α of the population) do not all observe the add-on information. Only a fraction λ of the myopic ones consider the add-on price if the latter is directly stated in the advertisement. In period 1, sophisticated consumers and informed myopic consumers initiate a costly effort, e, that enables them to substitute away from the future use of the add-on, while uninformed myopic consumers will not consider exerting such substitution. The add-on fee $\hat{p}$ is assumed to be bounded by $\overline{p} > e$, where $\overline{p}$ could represent legal and regulatory constraints or the cost of a firm's reputation. Sophisticated and informed myopic consumers will exert a substitution effort only if $e < \mathrm{E}(\hat{p})$.

In our setting, uninformed myopic borrowers do not consider the terms of an interest rate reset (index and margin) after the fixed period. Sophisticated borrowers, on the other hand, consider such contract terms. They can refinance mortgages before the first reset, which incurs a refinance cost e. Myopic borrowers do not indulge in refinance shopping either. The add-on price, such as the reset margin in an ARM contract, is bounded by $\overline{p}$, the legal constraints to an extremely high margin. In the next period, consumers observe the actual add-on price and are given an opportunity to

purchase the add-on. Those who previously engaged in substitution efforts have a lower incentive to purchase the add-on.

Let $D(x_i)$ be the probability of a consumer applying for a mortgage, where x_i denotes the anticipated net surplus from obtaining a mortgage at bank i less the anticipated net surplus from obtaining a mortgage at an alternative bank. Let μ be the degree of competition in the banking industry, which equals the average profit per consumer, $\mu = \frac{D(0)}{D'(0)}$. Sophisticated consumers form the rational expectations about the add-on price of the firm and its competitors, $\mathrm{E}(\hat{p})$ and $\mathrm{E}(\hat{p}^*)$, respectively, with p^* being the prices set by its competitors. For sophisticated consumers, the net surplus from obtaining a mortgage at bank i is $x_i = [-p_i - \min\{\mathrm{E}(\hat{p}), \mathrm{e}\}] - [-p^* - \min\{\mathrm{E}(\hat{p}^*), \mathrm{e}\}]$. Naïve consumers do not consider add-on prices, so the net surplus is $x_i = -p_i + p^*$. Let $\alpha^+ = \frac{e}{\bar{p}}$ be the ratio of the substitution cost and the upper bound of the add-on price. Gabaix and Laibson (2006) then derive the following proposition.

Proposition 1. A shrouded price equilibrium exists under the condition that the fraction α of myopic consumers is greater than α^+, under which firms shroud the add-on price. The prices of the base good and the add-on are $p = -\alpha\bar{p} + \mu$ and $\hat{p} = \bar{p}$, respectively. An unshrouded price equilibrium exists under the condition that the fraction α of myopic consumers is less than α^+, that is, a symmetric equilibrium in which firms do not shroud the add-on price. The prices of the base good and the add-on are $p = -e + \mu$ and $\hat{p} = e$, respectively.

This shrouded price equilibrium is inefficient, since sophisticated borrowers pay a cost e to substitute away from add-on consumption. It also shows that high markups for the add-on are offset by low or negative markups on the base goods, which implies that the add-on will be the "profit center" and the base good will, in turn, be the "loss leader." Sophisticated consumers prefer to give their business to firms with higher prices that are shrouded because these consumers end up with a subsidy from policies designed for myopic customers. The unshrouded price equilibrium is efficient, since all consumers purchase the add-ons and the total profit of the industry is μ.

Proposition 1 emphasizes the conditions about the two price equilibria and the corresponding prices. It implicitly assumes that the proportion of naïve borrowers is independent of market competition and steady over time. It does not explicitly specify the relation between firm competition and equilibrium prices when conditions for different equilibrium conditions change. We build on the work of Gabaix and Laibson (2006) and derive a new proposition implied by Proposition 1 under changing equilibrium conditions.

Proposition 2. If we consider the impact of banking deregulation on banks' ARM pricing strategies, we have three implicit predictions. *Prediction 1* is that if competition does not change the relation between the fraction of myopic consumers and α^+, banking deregulation increases the competition for borrowers and thus *p* will decrease but $\hat{p}$ will remain unaffected. *Prediction 2* is that, if competition increases the proportion of myopic consumers above a threshold α^+, an unshrouded price equilibrium switches to a shrouded price equilibrium and banking deregulation will reduce *p* and increase $\hat{p}$. *Prediction 3* is that, if competition reduces the proportion of myopic consumers below a threshold α^+, a shrouded price equilibrium switches to an unshrouded price equilibrium and banking deregulation will reduce both *p* and $\hat{p}$.

In our setting, there are many local market segments for mortgage borrowers. The above predictions implies clear heterogeneous effects. It is more likely to observe a shrouded price equilibrium in the market segments with more myopic consumers. If competition increases the proportion of myopic consumers in some market segments, these market segments are more likely to switch to shrouded price equilibrium.

Why is there a switch from one equilibrium to the other? Based on *Proposition* 1, the switch depends on the relation between α and $\frac{e}{\bar{p}}$. When the relation changes, equilibrium conditions change and there could be a switch in equilibrium. There are three ways banking deregulation can change the conditions: through an increase in α, the proportion of naïve borrowers; through a reduction in *e*, the opportunity costs of refinancing; and through an increase in $\bar{p}$, the regulatory constraints on add-on prices. Note that whether competition increases or reduces α, *e* and $\bar{p}$ cannot be predicted by the theory of shrouded attributes; they depend on the market settings. In Section IV, we show our main empirical results support *Prediction* 2.

III. Data and Identification

A. Data

The data used in this paper are from three sources. First, a proprietary loan-level sample is drawn from the population of all prime conventional conforming mortgages securitized by a national insurer between 1994 and 2005, covering mortgage originations during the sequential deregulations. Borrowers enter into a mortgage contract for one of the following reasons: to purchase a house, to refinance an existing mortgage to lower the payment or rate, to refinance to extract home. Homebuyers can be first timers or existing homeowners. Prime loans are for borrowers with good credit, as opposed to subprime loans, which are intended for those with blemished credit (typically with a credit score below 620). Conventional loans differ from government loans guaranteed by agencies such as the Federal Housing Administration. Conforming loans have loan amounts at or below conforming loan limits, which have been $417,000 since 2006 for single-family one-unit properties. Loans with a balance above the limits are called jumbo loans.

Compared to FRMs, ARMs are considered more complex mortgage contracts with many add-on features, although, with floating rates, both types are fully amortized over a total 30-year period. To make ARMs more appealing, borrowers are offered an initial teaser rate for a number of years at a deep discount from the prevailing primary market rate for 30-year FRMs (or fully indexed rate). The spread between the two rates is used to proxy for the attractiveness of the initial ARM rate and is adopted throughout this paper. Badarinza, Campbell, and Ramadorai (2015) find that the ARM spread is an important determinant of consumers' choice of ARMs. The fixed terms are one, three, five, seven, and ten years and, once the term expires, the rates are adjusted once a year based on an index plus the margin.[4] Usually, the lower teaser rate is offered with shorter fixed term to price for lender's interest rate risk. Prime ARM loans are indexed primarily on the 12-month London Interbank Offered Rate (LIBOR) and the constant maturity Treasury rate, usually a 50/50 split, which leaves the reset margin as a main

[4] Thus, ARMs are labeled 1/1, 3/1, 5/1, 7/1, and 10/1 hybrid ARMs, respectively. The most popular subprime mortgage product is the 2/28 ARM, with the first two years at a fixed rate, but these conditions are not offered in prime mortgages.

add-on pricing feature available to lenders. The shorter the fixed period, the sooner lenders can gain from the full indexed rate at reset.

There are also other add-on features, such as various rate and payment caps and floors that distinguish one ARM product from another. Rate caps are also a common feature, including the initial cap applied to the first reset, periodic caps applied to each of the subsequent resets, and a lifetime cap applied to cumulative rate shocks over the life of the loan. For example, 5-2-5 ARMs prescribe that the initial rate shock be no more than 5%, the following rate shock be no more than 2%, and the lifetime rate shock be no more than 5% over the teaser rate.

Each mortgage is then tracked until the borrower exits the loan by either prepaying or defaulting. These prepayment and default decisions are also analyzed. The prepayment risk of ARM contracts is not as significant as that of FRMs, since borrowers, by design, can automatically receive the benefit of a lower rate without refinancing. Prepayments usually occur when the floating rate after the reset is above the primary market rate for FRMs. The direct consequence of borrowers experiencing a payment shock due to a higher interest rate is actually the default risk when borrowers cannot survive extra payments.

The variables used in the main analysis are summarized in Table I. We also split the sample into two subsamples: those in regulated states and those in partially and fully deregulated states, and report the summary statistics in Table A.1 in Appendix. The sample contains about 1.54 million ARM loans. The average loan amount at origination is $184,476 and the average initial teaser rate is 5.26%. This represents a spread of -0.96% over the prevailing primary market rate for 30-year FRMs in the same month. The average reset margin is 2.55% following an average fixed period of five years. Among all prime ARMs, 5/1 ARMs are the most popular. The index used to price these loans implements a 50/50 split between LIBOR and Treasury rates. The initial, periodic, and lifetime rate caps are 3.35%, 2%, and 5.55%, respectively. The credit quality of prime ARMs is much better than that of prime FRMs, with an average credit score (FICO score) of 721, loan-to-value ratio (LTV) of 73%, and backend debt-to-income ratio of 34%. The incomes of prime borrowers are high, with an average of $7,171 monthly, or about $86,000 annually. Of all loans, 14% have at least one piggyback. These loans typically have a combined LTV of more than 80% and subordinated financing helps

borrowers avoid paying for PMI as mandated by federal charter to government-sponsored enterprises.

In our paper, 58% of transactions in the sample are for refinancing and the other 42% are for home purchases. One-third of these home purchases are made by first-time homebuyers, who do not have a great deal of experience owning a home or managing a mortgage account. A total of 47% of loans in the sample are originated by mortgage brokers, while the other 53% are originated by retail banks. A total of 78% of the lenders in the sample operated in the state prior to the interstate deregulation, while 50% of them operated in the local county prior to the deregulation. These two types of incumbent lenders operated in the state and county prior to deregulation for an average of 7.2 years and 5.7 years, respectively. On average, there are 35 lenders competing in a state and 21 lenders competing in a county market. Including new entrants, the average time in the market is 1.5 years prior to the deregulation.

Prime loans typically have a much lower default rate because of the borrower profile. In our sample, for performance as of June 2015, the average cumulative default rate is around 5%, including 2% during the fixed period and 3% after that. Our sample period includes an unprecedented refinancing boom induced by a low interest rate in 2003 and extraordinarily stimulating monetary policy interventions after the crisis. As of June 2015, 86% of all mortgages were prepaid, including 70% during the fixed period and 16% afterward. When we plot the prepayments by months from the first reset date, overall, 25% of loans, including 9% of loans still active as of 2015 and 16% prepaid after the fixed period, apply the fully indexed reset rates. Total payments after the fixed term account for 37% of total loan payments as of 2015 and potentially much more over a lifetime, suggesting that a significant number of ARM borrowers are affected by add-on prices.

The second source of data is the US Bureau of Economic Analysis. These data include county-level economic control variables such as the income per capita, population, and median housing price. We also calculate the county-level Herfindahl–Hirschman Index (HHI) at the county level based on the Home Mortgage Data Act (HMDA) between 1994 and 2005. The HHI is a common measure of market concentration. It is calculated as the sum of the squares of the market share of each firm competing in a county. The higher the HHI, the lower the market competition.

The third data source is the time-varying deregulation index calculated by Rice and Strahan (2010). Although the IBBEA authorized free interstate banking in 1994, the US states retained the right to oppose out-of-state branching by imposing restrictions on (i) de novo interstate branching, (ii) the minimum age of the target institution in case of mergers, (iii) the acquisition of individual branches without the acquisition of the entire bank, and (iv) statewide deposit caps controlled by a single bank or bank holding company. Rice and Strahan's index takes the value of zero for states free of these restrictions and the values one to four to capture the total number of the barriers described above. The index is reversed in our analysis to create deregulation index so that high values refer to deregulated states. We plot the sample distribution by the state deregulation index over time in Figure A.1 in the Appendix. There were all four restrictions on interstate branching in 1994 and thus all states have index values of zero. Since 1995, an increasing number of states began to remove restrictions and about 90% of the states remove at least one restriction, leaving 10% of the loans in states with all four restrictions by 2005.

B. Identification Strategy

This paper explores the effect of banking deregulation across state borders on banks' pricing strategies. We exploit the changes in interstate banking restrictions across state borders and adopt a difference-in-differences strategy to identify the causal effect of bank competition on contract design. The banks in the deregulated states are the treated group while those in the other states are the control group. Because of the time-varying nature of the deregulations, the estimated effect captures the differences in deregulated states relative to those in states that were still regulated. We estimate

$$Y_{i,t} = \beta_1 D_{s,t-1} + \beta_2 \boldsymbol{Z}_{i,t} + \beta_3 \boldsymbol{X}_{c,t} + \alpha_c + \gamma_t + \epsilon_{c,t} \qquad (1)$$

where $Y_{i,t}$ is the outcome of interest including the ARM spread, fixed term, margin, prepayment, and default; $D_{s,t-1}$ is the time-varying deregulation index for states in year *t-1*; $\boldsymbol{Z}_{i,t}$ represents mortgage-level characteristics, such as the FICO score, the combined LTV, and whether the loan is for refinancing or home purchase, whether the buyer is a first timer and whether the mortgage has a piggyback loan or not; $\boldsymbol{X}_{c,t}$ summarizes time-varying county-specific controls, which include the log of income per capita, the population, housing prices, and the HHI of loan origination; α_c denotes zip

code fixed effects; and γ_t denotes origination month fixed effects. In all the regressions, standard errors are clustered by state.

IV. EMPIRICAL FINDINGS

A. Baseline Results

The deregulation changes banks' pricing strategies by increasing their competition. We show the first-stage impact of deregulation Table II based on data including both FRMs and ARMS. We report the summary statistics for the FRM sample in Table A.2 in Appendix. Consistent with Rice and Strahan (2010), we multiply the coefficient of the index by four to calculate the effects of full deregulation.

In Panel A of Table II, we show the effect of deregulation on several outcome variables aggregated at county level. Column (1) and (2) shows that the number of banks increases significantly following the deregulation, by 40% for all lenders and 368% for new entrants, those just entering the deregulated markets, vs those conducting businesses since much before. Therefore, banking competition increases significantly, also evidenced by the decrease of HHI (not reported). As anticipated, Columns (3)~(6) show that the number of loans increases by 14% and the ARM volume increases by similar magnitude. Among transaction types, refinancing transactions increase the most by 17%, followed by new home purchases. These results are consistent with those of Favara and Imbs (2015) and show a clear first stage in which deregulation increases bank entry and competition and increases loans that originated in more deregulated states.

Since ARM borrowers are typically more affluent, educated and creditworthy, as evidenced by the comparison of the summary statistics in Tables I and A.2 in Appendix, it's possible that the volume increase reflect more increase in low-income borrowers during these years. In Panel B, we report results on the effect of deregulation on ARM share controlling for borrower's characteristics based on loan-level data. Column (1) shows that when borrower and loan characteristics are controlled, the likelihood of an ARM loan is originated in deregulated states is 1.3% higher than in regulated states. Columns (2)~(5) show that the growth is predominantly driven by retail lenders and incumbent lenders, not mortgage brokers and new entrants.

We now show the results of deregulation on ARM contracts at the individual level. Table III presents the baseline results based on the full sample of ARM loans. Column (1) in Panel A is a regression on the initial rate spread over the market rate of FRMs in the same month,[5] a more front-loaded pricing feature used to attract borrowers. Column (2) and (3) report the results for the reset margin and years of fixed terms, respectively, which are considered more back-loaded pricing features since they are not revealed until the first reset. The results suggest that the initial rate spread, initial fixed term, and reset margin of ARMs in deregulated states are, respectively, 5 bps (or 6%) lower, 8 months (or 13%) shorter, and 11 bps (4%) higher than in fully regulated states. We also re-estimated the Column (1) while controlling for fixed term given there is typically an inverse relation between the two. The estimated effect of reregulation on rate spread from that regression is 7 bps lower, suggesting the reduction of rate spread is not merely a result of shorter fixed term, but incremental even on similar fixed terms. These results support *Prediction* 2 in *Proposition* 2 of Gabaix and Laibson (2006): Banking deregulation reduces the initial teaser rates and increases margins, suggesting a switch from an unshrouded price equilibrium to a shrouded price equilibrium.

The net gains from lower rates spread, shorter fixed term and higher margin can be substantial for banks. With 70% of all loans prepaid before the first reset in our sample, the mortgage payments after the first reset still accounts for 21% of the cash flows for all loans. We calculate the impact of deregulation on gross loan payment in Table VIII. The reduction for interest payment before reset is $1322 and the increase in interest payment after reset is $959. The average fixed term is 60 month, so the annual interest payment reduces by 1322/60*12=$264. Conditional on not prepaying before reset, the number of months before prepayment is 21.6 months. So the annual interest payment increases by 959/21.6*12=$532. The dollar savings to the consumer are similar in magnitude to Choi, Laibson, and Madrian (2011). With the gains from shrouding on back-loaded pricing terms in ARM contract, lenders can offset 73% (=959/1322) of the losses due to lower initial price.

The effects of lower initial rate and higher margin at resets reflect bank's pricing strategy targeted on more affluent, more creditworthy and likely more confident ARM

[5] To provide some basis for the teaser rate, we also regress on the original note rate of the FRMs and their performance metrics. These results are reported in Table A.3 in the Appendix. The results suggest that the fixed rate in deregulated states is actually 7 bps higher than that in regulated states.

borrowers. Grubb (2009) finds that, when selling to overconfident consumers, both monopolists and competitive firms design an optimal pricing strategy initially charged at zero marginal cost but followed by steep marginal charges. The results in Panel A suggest a similar finding, that banks significantly increase the price of two back-loaded features while lowering the upfront price with increasing competition.

To quantify exact share of borrowers affected by the deregulation, we define three measures of deceptive loans based on relative ranking of rate spread as well as margin: Deception 10|90 is defined as one if the rate spread of the ARM loan is below 10^{th} percentile while the margin is above 90^{th} percentile and zero otherwise; Deception 25|75 is defined as one if the rate spread of the ARM loan is below 25^{th} percentile while the margin is above 75^{th} percentile and zero otherwise; Deception 50|50 is defined as one if the rate spread of the ARM loan is below 50^{th} percentile while the margin is above 50^{th} percentile and zero otherwise. Hence the degree of deception decreases in the three measures. Columns (4)~(6) report results on the effect of deregulation on the proportion of three deceptive loan cohorts. The likelihood of deceptive loans increases significantly by 4%, 8% and 11% respectively based on three different measures in deregulated states compared to fully regulated states.

We also test the effects of deregulation on other terms in ARM contracts, including various rate caps. These results are reported in Panel B of Table III. There is little difference in the periodic caps, suggesting they are not effectively used by banks to compete in the mortgage market. However, the initial cap in deregulated states is 21 bps lower than in fully regulated states, while the lifetime cap in regulated states is 48 bps higher. The initial cap applies to the first rate reset after the fixed term expires, while the lifetime cap applies to the lifetime of the loans but, in reality, becomes effective at a much later stage of the loan. These results are consistent with those in Panel A that banks shroud on add-on price feature that would come in effect in the later stage of the loans.

B. Placebo Test

What drives the deregulation index? Interstate branching deregulation cannot be assumed to be exogenous, since deregulation occurs through a political process between interest groups, legislators, and constituents. One concern is that contract design may

be correlated with demand for credit in the state or with the supply-side bargaining power of interest groups. We offer three pieces of evidence to establish the causal relation from deregulation to contract design.

First, Rice and Strahan (2010) show that there is no contemporaneous correlation across states between economic conditions and the deregulation index. They show that states where large (expansion-minded) banks are strong relative to small (insulated) banks are more likely to deregulate early. Since differences in the relative bargaining power of large versus small banks tend to be very persistent, we follow Rice and Strahan and add fixed effects to control for time-invariant unobservables. Second, Favara and Imbs (2015) explore the idea that if deregulation is triggered by current or expected economic conditions, then every lender should react and expand credit. They show that commercial banks (affected by the deregulation) expand credit, while independent mortgage banks (unaffected by the deregulation) do not expand credit. Hence, it is unlikely that deregulation is triggered by current or expected economic conditions. Third, we use our loan-level data to test the identification assumption of our difference-in-differences strategy. The identification assumption of our estimation strategy is a common trend between the treatment and control states before deregulation. We add lags and leads of the deregulation index to check the pre-trends in our loan-level dataset. The specification we use is

$$Y_{i,t} = \sum_{\tau=t-4}^{t+2} \beta_{1\tau} D_{s,\tau} + \beta_2 \boldsymbol{Z}_{i,t} + \beta_3 \boldsymbol{X}_{c,t} + \alpha_c + \gamma_t + \epsilon_{c,t} \qquad (2)$$

where $D_{s,\tau}$ includes four lags and two leads of the deregulation index.

Figure I plots the coefficients of $\beta_{1\tau}$ from the regression. The dependent variables are the ARM rate spread, the reset margin, and the fixed term in Panels A to C, respectively. We normalize to zero the coefficient for the year of deregulation and plot the remaining coefficients relative to it. There are two main points from all panels in Figure I. First, there does not seem to be a persistent difference between the treatment and control states in the ARM spread, the reset margin, or the fixed term before the deregulation or in the year of deregulation. These results support the common trend assumption. Second, after deregulation, all the coefficients of the ARM spread become significantly negative, all the coefficients of the margin become significantly positive,

and all the coefficients of the fixed term become significantly negative. These results support a jump in trends in these outcomes after deregulation.

C. Heterogeneity across Borrowers, Lenders and Markets

Theory predicts that banks shroud more when and where the proportion of naïve borrowers is larger (Gabaix and Laibson 2006; DellaVigna 2009; Kőszegi 2014; Heidhues and Kőszegi 2015). We test this prediction by analyzing the heterogeneous effects among different types of borrowers. We identify several subsamples where there are high proportion of naïve borrowers: financially constrained borrowers, home purchasers versus refinancers, first-time homebuyer versus existing homebuyers, borrowers choosing a single-lien mortgage to pay for mortgage insurance versus those taking out piggybacks to avoid paying insurance[6], and borrowers with a low credit score versus those with a high credit score. Borrowers in these transactions are either less financially sophisticated or lack experience in managing mortgage accounts and are thus more subject to behavioral bias. These results are reported in Tables A.4 and A.5 in Appendix.

In Panel A of Table A.4, effects on rate spread, margin and fixed terms are significant and of similar magnitude for financially constrained borrowers (CLTV>= 80) and those less so, suggesting financial constraints are an unlikely reason for increased shrouding. In Panel B, ARM loans for home purchase are exploited more than refinance loans, mainly through higher margin (by 12 vs 7 bps) in deregulated states. In Panel C, ARMs for first-time homeowners appear to be a prime target for shrouding and are exploited much more, compared to existing home buyers, through lower rate spread (by 9 vs 5 bps) and shorter fixed term (by 10 vs 7 months) in deregulated states, compared to those in regulated states. These results suggest that lenders' optimal strategy with first-time homebuyers is to lure them into ARM contacts with ultra-low initial rates with much shorter teaser period. In Panel D, the PMI loan borrowers are more exploited, compared to compared to piggyback loan borrowers,

[6] In the United States, the federal charters of Fannie Mae and Freddie Mac require borrowers with an LTV above 80% to pay for PMI coverage. The premium charged by PMI companies can be quite costly, anywhere from 1% to 10% in a single payment. As the securitization market expanded in early 2000s, lenders bypassed the requirement of PMI coverage by increasingly offering one or more piggybacks. Agarwal, Ambrose, and Yao (2015) find that, even with similar risk profiles and combined LTV levels, borrowers who select the piggyback structure perform much better than those who stick to the PMI structure.

with lower rate spread (by 7 vs 0.3 bps) but much shorter teaser period (by 7 vs 4 months) in deregulated states.

Our last type of borrowers is measured by their credit score, a widely used measure to gauge borrower creditworthiness in underwriting and pricing decisions. We divide the sample into five bins based on the FICO score to obtain a complete picture of how banks' pricing strategies vary along the spectrum of borrowers' credit quality. These results are plotted in Figure II as well as reported in Table A.5. Generally, as the credit score improves from a low of 620 to a high of 780, banks offer longer fixed periods and lower teaser spreads to be commensurate with the expected credit risk. On the other hand, banks exploit borrowers with worst FICO scores (< 620) the most by offering them the shortest fixed terms (by 12 months) and highest margin (by 17 bps) in deregulated states than in fully regulated states.[7]

Different lenders can have different profit structures, allowing us to test banks' responses to the deregulation that are optimal to their respective business models. The results are reported in Table A.6 in Appendix. The revenues of brokers are largely from an upfront commission and hence they have more incentive in upfront pricing features because of their originate-to-sell model. Several papers have documented that broker originate lower-quality loans than retail banks as a result of this business model[8]. On the contrary, retail banks have more incentives to shroud on add-on prices because of their originate-to-hold or originate-to-securitize model. In Panel A, we find that broker loans have much lower rate spread than retail bank loans (by 9 vs 3 bps) in deregulated states. The retail banks shroud more through shorter fixed terms (by 8 vs 5 months) and higher margin (by 13 vs 4 bps) in deregulated states than those in regulated states. Hence brokers try hard to lure borrowers into ARM contracts using lower initial rate while retail banks charge more back-loaded add-on prices, a striking difference. We also find, in Panel B, that, compared to incumbent lenders, new entrants from out of state shroud more aggressively in the face of increased competition. The effects for

[7] A credit score of 620 and below is considered a rule-of-thumb criterion for identifying subprime borrowers (Keys et al. 2010). We therefore also explore banks' pricing strategies for borrowers with scores below and above 620. It turns out that the reset margin reflects the largest difference in banks' pricing strategies between these two groups. The reset margin of subprime borrowers in deregulated states is 17 bps higher than in fully regulated states, compared to only around 9–12 bps higher for those with a credit score above 620. Subprime borrowers are also offered much shorter fixed terms. Altogether, borrowers with the worst credit quality and who have no alternative loan opportunities are the most adversely affected by banking deregulation and competition.

[8] For example, Agarwal, et al. (2015) find that broker loans are 30% more likely to default whole controlling for other loan attributes using Cox Proportional Hazard Model.

loans originated by new entrants, compared to incumbent, are lower rate spread (by 8 vs 2 bps), shorter teaser period (by 12 vs 8 months) as well as higher margin (by 12 vs 10 bps) in deregulated states than that in fully regulated states.

Our last and ultimate test for heterogeneous effect of competition on ARM contract terms is across markets where there are different proportion of naïve borrowers. The two measures of the fraction of naïve borrowers for each region are defined based on ex post prepayment behavior of the borrowers: borrowers who have not refinanced before the first reset to avoid higher fully-indexed rate are considered naïve compared to those who have refinanced in time; borrowers who have refinanced with inadequate rate savings are considered naïve compared to those who have done so with at least 50 bps rate savings. We divide all MSAs in the sample based on whether the proportion of naïve borrowers in each MSA is above or below its median level and repeat the baseline regressions in these four types of markets. The results are reported in Table A.7 in Appendix.

In Panel A, the sample is split into MSAs above or below the median value for proportion of borrowers who have not refinanced before the first reset. There are more naïve borrowers in the MSAs above the median. Consistent with the theory, we find that ARM loans are exploited more in these MSAs than elsewhere in deregulated states. The effect of deregulation on ARM spread is 8 bps lower for MSAs above the median proportion of naïve borrowers compared to insignificant effect for those below. Similarly, margin is 17 bps higher compared to only 8 bps higher and the likelihood of deceptive loans increases by 6.8% compared to only 0.8%. The effect on fixed term is slightly higher in the MSAs with more naïve borrowers. In Panel B, we find very similar results based on classification of MSAs based on alternative measure of proportion of naïve borrowers, suggesting the results are very robust.

In sum, we find that the deregulation increases shrouding more in the subsample s where there are higher proportion of naïve borrowers: home purchasers, first-time homebuyers, borrowers choosing a single-lien mortgage, and borrowers with a low FICO score. The effects on ARM contract terms are also much stronger in the MSAs with more naïve borrowers, measured by ex post payment behavior of borrowers. All these results are consistent with the theoretical prediction that lenders should shroud more when the proportion of naïve borrowers is larger.

V. EXPLANATIONS

We have documented that deregulation reduces rate spread and fixed terms and increases margins. Why does deregulation increase bank shrouding? There are several potential explanations: First, banking deregulation increases the proportion of naïve borrowers in the market and a new equilibrium in the market emerges with more shrouding; Second, borrowers choose the shrouding contract because of their higher demand, more optimistic income expectation or higher switching cost. Third, our results may be affected by the financial crisis when some borrowers happened to experience negative equity and be unable to refinance in a timely manner; Forth, borrowers choose the shrouding contract due to expectations of rising interest rate environment which would favor higher add-one prices.

A. Banking Competition Increases Naïve Borrowers

Theory predicts that lenders shroud more when the proportion of naïve borrowers is larger (Gabaix and Laibson 2006; Heidhues and Kőszegi 2015). Gabaix and Laibson's (2006) theory shows that the fraction of myopic consumers (α) determines the state of equilibrium, because more sophisticated consumers can always consider the costs and benefits of add-on prices in contracts and refinance before the rate reset. The original theory implicitly assumes that the proportion of naïve borrowers is independent of market competition and steady over time, which may be true in liquid markets such as for hotels and printers. However, in the less liquid housing market, the composition of buyers/consumers very likely changes over time, where the theory's prediction is less unambiguous. If competition increases the proportion of naïve borrowers above certain threshold so that an unshrouded price equilibrium switches to a shrouded price equilibrium, the theory predicts that competition reduces initial rates and increases the reset margin. Thus one possible explanation to more shrouding is that the deregulation causes an increase in naïve borrowers, consistent with *Prediction* 2.

According to Gabaix and Laibson, sophisticated borrowers differ from naïve ones in that they exert costly substitution efforts early while naïve borrowers will not. In our case, the substitution effort is the prepayment before the first reset, since it helps borrowers to avoid paying an expensive rate at and after reset. Keys, Pope, and Pope

(2014) find that borrowers generally refinance their mortgages too late and consequently incur substantial losses. On the other hand, Agarwal, Rosen, and Yao (2015) note that some borrowers err by refinancing too early without obtaining sufficient rate savings.[9] We here define naïve borrowers based on the borrower's refinancing inattentiveness: The first measure is the proportion of those who prepay late after the first reset; the second is the proportion of those who are the opposite of naïve borrowers, based on those who refinance with enough rate savings at a market rate significantly (at least 50 bps) below their previous rate; the third is the proportion of those who wait longer to refinance based on the number of months from the first reset date to the prepayment date; our last one is borrowers who have not refinanced before the first reset, which is a direct measure of naïve borrowers based on ex post performance.

The results are reported in Panel A of Table IV. Columns (1) to (3) show that deregulation has no effect on prepayment before the first reset but increases the refinancing in the first year and later years after the reset significantly by 80 bps and 320 bps, respectively. More borrowers choose to prepay in the later years than within the first year after reset. Column (4) shows 4.6% fewer borrowers refinance with adequate savings of at least 50 bps in deregulates states than fully regulated states. Columns (5) and (6) show that borrowers wait one and two months longer, respectively, to refinance both over the life of the loan as well as after the reset. These results suggest that there are more naïve borrowers following the deregulation. Hence, our results in Tables III and IV support *Prediction* 2.

We also explore the heterogeneity of prepayments and results are reported in Table A.8 in Appendix. The results suggest that loans originated by retail banks, for new home buyers, first-time home buyers, and PMI borrowers are more likely to refinance in the later years after reset as well as less likely to refinance before the reset. These are also the subsamples for which banks increase shrouding on add-on prices following the deregulation. The results collectively confirm that these are subsamples contain higher proportion of naïve borrowers, which lead banks to increase shrouding

[9] An extensive literature estimates the optimal time for a borrower to refinance (Dunn and McConnell 1981; Hendershott and van Order 1987). Recently, Agarwal, Driscoll, and Laibson (2013) have derived a closed-form solution showing that it is optimal to refinance when the refinancing rate is between 100 bps and 200 bps below the original mortgage rate.

at origination. Hence, our results based on both the overall sample and the subsamples support *Prediction* 2: if competition increases the proportion of myopic consumers in some market segments, these market segments are more likely to switch to shrouded price equilibrium.

How can banking competition increase naïve borrowers? Why don't banks target naïve borrowers before deregulation? Our first explanation is that competition reduces prices and thus reduces marginal revenue for banks, especially in their existing markets. In response, banks would search for new markets where they can exploit higher marginal revenue. Although the marginal costs of banks are also larger in new markets, the marginal revenue from naïve borrowers in new markets may be large enough to overcome costs due to less competition. In Table V, we provide indirect evidence based on the subset of loans in new counties where banks have no prior business till deregulation. In Columns (1), the dependent variable is whether borrowers are in new counties. We find that deregulation significantly increases the likelihood of mortgages in new counties by 0.7%. Correlation analysis suggests that new counties have a much higher HHI, so they are less competitive. In Columns (2) to (7), we analyze the correlation between the new county and the measurements of naïve borrowers. We find that borrowers from new counties are less likely to refinance before the first reset, by 27%, and by 7% within one year after the rest. They are more likely to refinance in later years after the reset, by 15% and wait 12 months longer after the reset to refinance. There are 21% fewer borrowers in new counties who would refinance with adequate savings. The results show that borrowers from new counties are much more naïve than elsewhere.

Our second explanation is there may be a reduction in e or an increase in $\overline{p}$ that results in lower threshold for the fraction of naïve consumers, defined as $\alpha^{+} = \frac{e}{\overline{p}}$. First, during our sample period, prevailing mortgage rate has fallen sharply from well above 8% in 2000 to well below 6% during the 2003-2005 period. Lower rate provides significant refinancing incentives for existing homeowners. At the same time, repaid development of electronic or automated data collection, underwriting and transaction have contributed to streamlining the refinancing process. Second, starting in 1999, a number of states adopted anti-predatory-lending (APL) laws restricting the terms of

mortgage loans to riskier borrowers[10]. APL seeks to restrict various unfair and deceptive practices that would steer borrowers into loans with high interest rates as well as exorbitant and hidden fees. It has significantly increased the regulatory constraint of add-on terms in ARM contract since Di Maggio, Kermani and Korgaonkar (2016) find that following the OCC's preemption of APL laws, non-OCC lenders have significantly increased their origination of ARMs.

Our third explanation is that borrowers may be naïve due to their inattentiveness. There have been evidences based on the Survey of Consumer Finances that ARM borrowers tend to underestimate or not know how much their interest rates could change (Bucks and Pence 2008). Anderson et al (2015) show that inattention can help to explain the inability of household to respond to refinance incentives. Atlas, Johnson and Payne (2016) confirm that consumers with greater present bias and long-term discounting tend to choose mortgages that minimize up-front costs. Alexandrov and Koulayev (2017) show that close of half of consumers did not shop before taking out a mortgage and even worse, much more do not even realize there is a great price dispersion in mortgage contracts. These evidence supports the explanation that some borrowers have limited attention about future rates, and they do not exert costly substitution efforts to avoid higher interest rate.

B. Standard Models without Consumer Biases

When we assume all borrowers understand the mortgage contract correctly, several standard models without consumer biases may be able to explain our results. One could be the standard price discrimination model in which banks charge higher margin to borrowers who have higher demand for mortgage loans (Ellison 2005). There are two crucial components in this model. First, the search cost for prices of different products should not be small. This allows firms to use high add-on price to price discriminate different types of consumers. Second, individuals have heterogeneous preference over the product, due to different marginal utility. In our setting, the heterogeneity of demand for mortgage might come from the higher demand for housing or expected rising income. For example, borrowers with higher demand for housing are willing to pay

[10] As of January 2007, 20 states and the District of Columbia had APL laws in effect. On January 7, 2004, the Office of Comptroller and Currency (OCC) adopted sweeping regulations preempting a brand range of state laws including APL with respect to national banks.

higher price or higher interest rate. When the supply of credit expands, credit may be allocated to borrowers who are less established but with an expected rising income. These borrowers prefer ARMs because lower teaser rates and higher future rates fit their income growth well.

We provide several evidences to show that the standard price discrimination model cannot explain our results. First, the search cost for mortgage terms from other banks are relatively low so that high add-on prices are not sustainable. For example, the availability of online services such as bankrate.com have made it relatively easy for perspective borrowers to obtain rate sheets from competing lenders. Second, even if the search cost is large enough, the model can only explain our main results if competition attracts new borrowers who have higher demand for housing and are willing to pay higher interest rates. We test the effect of deregulation on borrower profile and report the results in Table VI. If the theory holds, we anticipate more borrowers after deregulation are married and have higher income, or younger and have lower income. In Table VI, we find no significant differences in age, gender, education, marriage, income and FICO score between borrowers in deregulated states and regulated states, suggesting this price discrimination model is not consistent with our results[11].

Another model is the standard switching cost model in which banks charge high margin to borrowers who have high switch cost to refinance from other banks (Klemperer 1995; Farrell and Klemperer 2007). Switching costs binds consumers to firms of their early choices even if add-on prices are greater than marginal costs. The switching cost model can only explain our results when competition increases switching costs. Since 2000, more and more loans are refinanced by different servicers. Agarwal et al. (2015) document, from 2005-2009, only 28% of conforming loans are refinanced by the same servicers while vast majority, 72% of borrowers have switched servicers in their refinancing transactions. Thus, neither of standard models without consumer biases can reasonably explain our main results.

[11] We also test the expected risking income hypothesis by repeating the regressions in Table III based on split sample around median age and median income. If the hypothesis holds, we anticipate the effect of deregulation on contract terms is only significant in the subsample of younger and lower-income borrowers. The results in reported in Table A.9. We find that deregulation have significant effects on pricing terms in all four subsamples, not supporting the standard price discrimination model.

C. Expected Rising Interest Rate

Another explanation is different expectation of future interest rate on the demand side. Since we only observe equilibrium ARM contracts, it is possible that banks always offer two types of contracts: One (contract A) has a higher initial rate and a lower margin and the other (contract B) has a lower initial rate and a higher margin. Consumers may be more likely to choose contract A before deregulation and contract B after deregulation, even without any change in bank contract design. This would also be consistent with the observed effects but driven by the demand side. To explore this alternative explanation, we restrict the case to periods when consumers are more likely to choose contract A based on expected future interest rates. Naïve borrowers should always choose contract B because they do not pay attention to future rates. Sophisticated borrowers' choices, however, depend on expected future rates: If they expect the rate to decrease, they would choose contract B because they can refinance early; they are more likely to choose contract A if they expect a rising interest rate. Therefore, expected rate increases define a market scenario in which both types of consumers choose contract A.

We adopt two methods to define the scenario with an expected rate increase. Koijen, van Hemert, and van Nieuwerburgh (2009) empirically find that the simple household decision rule based on the spread between the five-year Treasury bond yield and the one-year T-bill is the most predictive measure of the ARM share. We therefore determine that borrowers have more incentives to choose contract A when the spread is greater than zero. Alternatively, Agarwal, Rosen, and Yao (2015) define the up-move scenario as the period when the mortgage rate in a given month is at least 50 bps more than its minimum in the past six months and the down-move scenario as the period when the rate is at least 50 bps lower than its maximum in the past six months. The borrower selection hypothesis implies that we should observe a decrease in the ARM spread and an increase in the reset margin only when the spread is greater than zero, or in an up-move scenario. Table VII presents the results. We find that deregulation reduces the ARM spread and the fixed term, raising the margin in all scenarios. Therefore, the results do not support the explanation of interest rate expectation.

D. Financial Constraints

Another possible explanation is financial constraints. If borrowers have financial constraints at the time of loan originations, they might prefer the mortgage contract with lower initial rate and higher margin for the short-term benefit. The hypothesis can only explain our results if competition attracts more financially constrained borrowers or our main results are only significant in the subsample of financially constrained borrowers. In Table VI, we show that there are no significant differences in characteristics of borrowers between deregulated states and regulated states. Also in Table A.2, we show the effects on pricing terms in deregulated states are significant in both subsamples of the financially constrained borrowers and those not.

We also test if our main results are only true during the financial crisis years when large chunk of borrowers experienced negative equity and were unable to refinance in time. Panel B in Table IV report our baseline results based on the subsample with the first rate reset before January 2007, when borrowers were not affected by negative equity. The results are very similar to those in Panel A, with slightly greater magnitude. We also restrict the sample more to when the first reset before January 2006. The results are very similar too (not tabulated here). In addition, we study the correlation between the deregulation index in 2005 and the severity of the financial crisis at the state level. We measure the severity of the financial crisis by the cumulative decline of Federal Housing Finance Agency home prices from Q1 2007 to Q4 2010. The correlation is only 0.052. There seems to be no evidence that deregulated states were disproportionally affected by the financial crisis.

VI. EX POST PERFORMANCE AND LENDER REVENUE

Finally, we explore the impact of banking deregulation on ex post mortgage performance as well as lender revenues. Banks bear the credit loss from foreclosure, repurchase, and accrued interests when borrowers default on a mortgage. Banks' revenues are greater with fewer defaults and less credit loss. Based on the life of a loan, we calculate the gross total loan payments a borrower makes to a lender as a measure of the lender's gross revenue. We also calculate the net revenue by deducting expected

losses (assuming an average loss severity of 50%) from the gross revenue. Based on when the loan is defaulted or prepaid, we separately regress the defaults as well as lender revenues before, one year after, and more than one year after the first reset.

Table VIII reports the results for the default and gross lender revenues. A lender's net revenue regressions are very consistent with gross revenues of greater magnitude and are not included in the table. The results in Columns (1) to (3) show that the default of loans that originated in deregulated states is 1.1% lower before the first reset, 0.4% lower within one year after the reset and 0.8% bps lower more than one year after the reset than in fully regulated states. The combined effect on default risk is a reduction of 2.3%[12]. This is a considerable improvement, accounting for 45% of the total default rate of 5%. The results also suggest that the increased margin after deregulation is not driven by an unobservable borrower quality, which is similar to the results of Gurun et al. (2013).

Columns (4)~(6) of Table VIII shows that the total revenue from loan payments is reduced by $360, not statistically significant, as a result of net losses during the fixed term and net gains after the first reset in deregulated states compared to regulated states. The estimated dollar amount is very similar to our back-of-envelop calculations based on baseline results in Section IV.A. Banks lose $1,320 from the payment before the first reset due to offering lower rate spread that is partially offset by shorter teaser period. However, banks gain $960 from payment after the fixed term, which account for 73% of the initial loss. This is very close to our back-of-envelop calculations based on main results in Section IV. Therefore, although competition reduces firm revenues due to price reduction, the lifetime effect is very limited due to firm's strategy of shrouding more on add-on prices. Our results also suggest that, although competition benefits consumers initially based on lower rate, the overall lifetime effect is very limited due to firms' shrouding strategy.

[12] Besides the note rate, we also estimate the effect of deregulation on the performance of 30-year FRMs as a placebo test. The results are reported in Table A.3 in the Appendix. They suggest that the lifetime default rate is lower for FRMs originated in deregulated states than in fully regulated states, but not for the default rate in the first 36 months after origination. The improvement in default is largely due to the late life of the loan. The prepayments at that time are slightly slower in deregulated states, by a statistically significant but not economically significant amount, with a 17-bps difference over 10–20 years.

VII. Discussions and Conclusions

Increased competition has a causal effect on banks' pricing strategies to compete for consumers and profits. This conjecture is tested using an exogenous shock due to the sequential lifting of the interstate banking restriction across states since 1994. Theory predicts that firms have different optimal supply responses when consumers have behavioral biases and firms could shroud add-on attributes in equilibrium when consumers are myopic. We test the effect of banking deregulation on banks' shrouding strategies for ARM contracts, which are known to have complex add-on features.

We find strong evidence that banking deregulation increases competition and increased competition due to deregulation leads banks to shroud key pricing terms of ARM contracts and thus exploit consumer inattention in ARM pricing. On average, ARM borrowers receive 5 bps lower the initial rate spread, 8 months shorter initial fixed term and 11 bps higher reset margin in deregulated states than in fully regulated states. Banks do so by choosing a pricing strategy that is optimal to their profit structure. The lower initial rate reflects the direct effect of competition, which is significantly offset by banks' shrouding strategy on fixed term and margin. The shorter fixed term, higher margin in the contract along with slower prepayment after reset of the naïve borrowers have effectively helped banks to overcome vast majority (73%) of the losses from lower initial rate. Proportion of deceptive loans, those with relative lower initial rate and higher margin also increases significantly by 4-11% based on different measures.

We run a placebo test that shows there does not seem to be a persistent difference between the treatment and control states in these pricing terms of ARM contracts till after the year of deregulation. Right after deregulation, all the coefficients of the ARM spread become significantly negative, those of the margin become significantly positive, and those of the fixed term become significantly negative. The results support that deregulation causes the change in banks' pricing strategy.

There is a great heterogeneity in the estimated effects on ARM contract terms across borrowers and lenders. The effects on rate spread, margin and fixed terms are significant and of similar magnitude for financially constrained borrowers, but are much stronger for home purchase loans, first-time homeowners, the PMI loans and

borrowers with lower FICO. On the lender side, mortgage brokers rely more on initial rate to lure borrowers into ARM contract while retail banks shroud more on back-loaded feature (both fixed term and margin) to compete. Entrant lenders compete more aggressively in the face of increased competition by offering lower initial rate, but shrouding more with shorter fixed term and higher margin.

We provide several potential explanations: First, banking deregulation increases the proportion of naïve borrowers in the market and a new equilibrium in the market emerges with more shrouding; Second, borrowers choose the shrouding contract because of their higher demand, more optimistic income expectation or higher switching cost. Third, our results may be affected by the financial crisis when some borrowers happened to experience negative equity and be unable to refinance in a timely manner; Forth, borrowers choose the shrouding contract due to expectations of rising interest rate environment which would favor higher add-one prices. Our results support the first but rule out the three alternative explanations based on changes in demand. We show that borrowers in the reregulated states are more likely to prepay later, especially more than one year after the first reset when higher margin takes effect, and are less likely to refinance when market were low with sufficient rate savings. Overall, their duration after reset is much longer in the deregulated states than in regulated states. We also show banks find more naïve borrowers by entering in new markets following the deregulation.

Finally, banks shroud on consumers to earn more revenues. We examine the ex post performance of ARM loans and find that the overall default risk decreases significantly by 2.3% following the banking deregulation. By shrouding on fixed term and margin as well as exploiting slower prepayment of naïve borrowers, banks are able to earn $960 more after the first reset in deregulated states than fully regulated states, which account for vast majority of losses from lower initial rate. Our results suggest that, although competition reduces firm revenues and benefits consumers initially, the overall lifetime effect is very limited with banks' shrouding strategy.

Some of our results also support the contention that myopic consumers can learn to become sophisticates. For example, a mortgage that is used to refinance an existing mortgage is more likely to be refinanced early than a mortgage for home purchase. This

suggest that borrowers who have experience of refinance are more sophisticated, and they are more likely to refinance early to avoid higher rates and payments after the reset.

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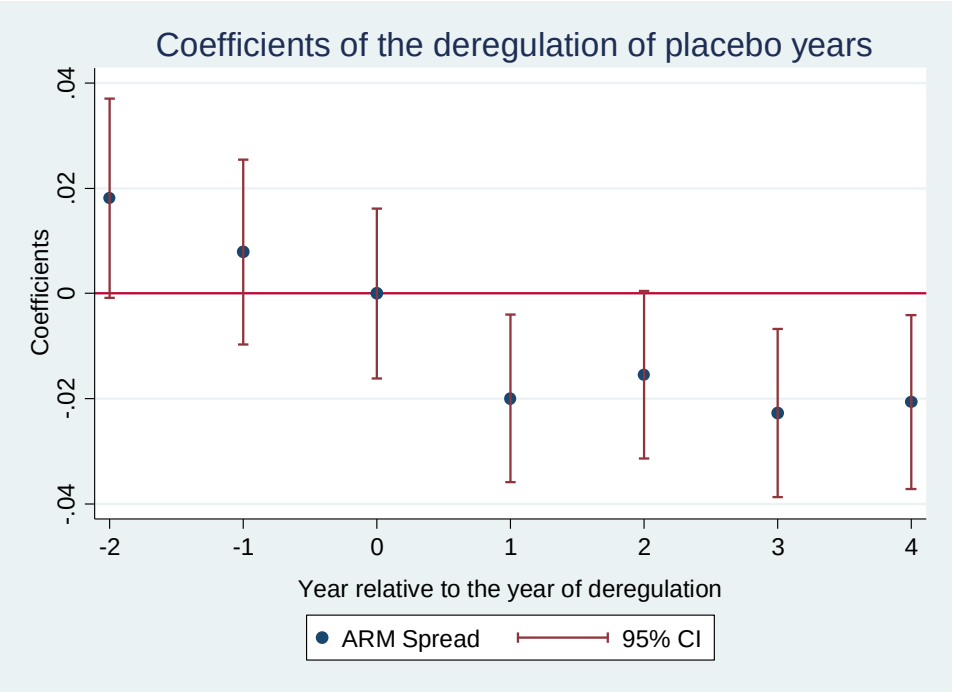
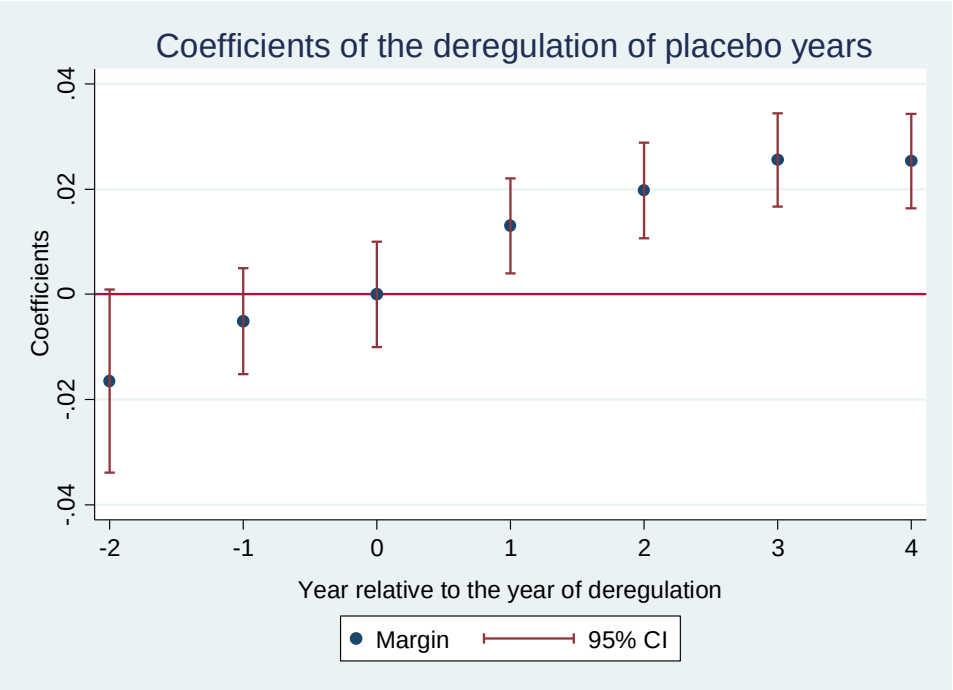
Figure I Coefficients of the Deregulation of Placebo Years

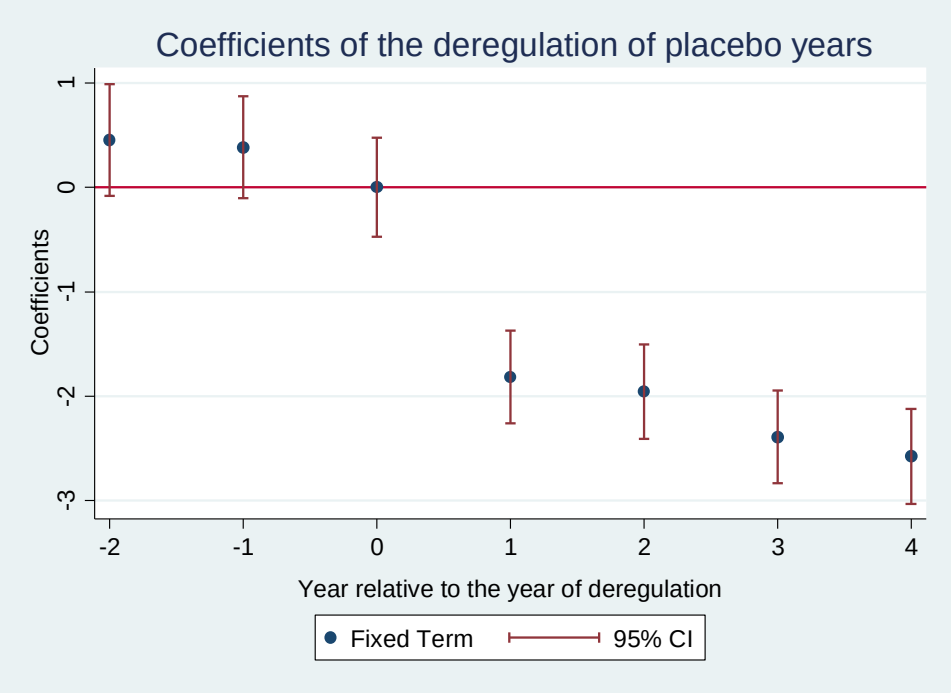
Panel A: ARM Spread



Panel B: Margin



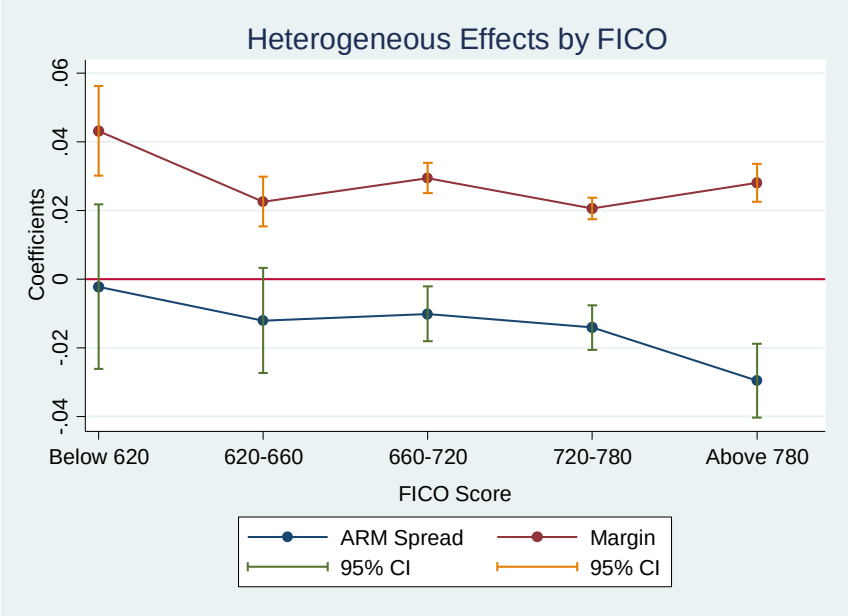
Panel C: Fixed Term



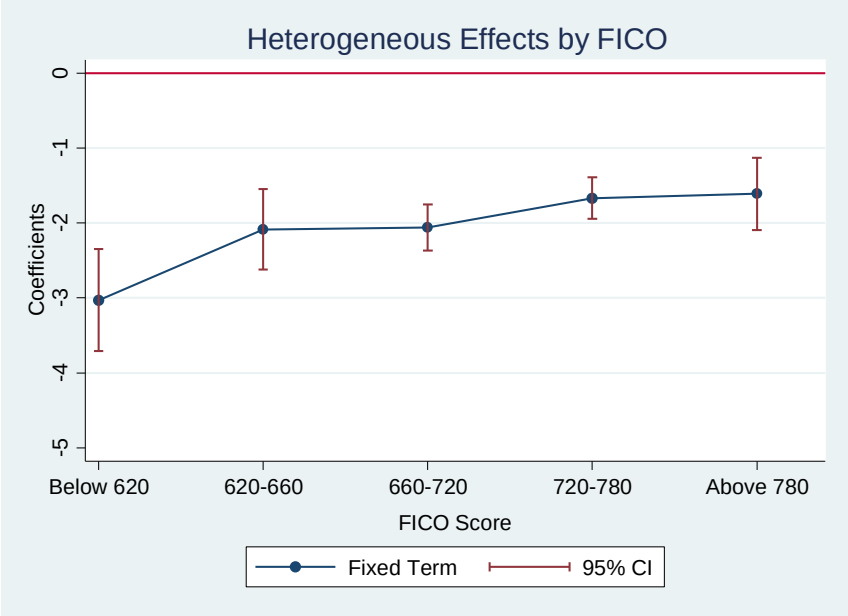
Note: This figure plots the coefficients of deregulation of the placebo years. The dependent variable is the ARM spread, the reset margin, and the fixed term in Panels A to C, respectively. The vertical axis shows the coefficients over time. Each panel shows the 95% conference interval. The horizontal axis is the number of years relative to the year of deregulation.

FIGURE II Heterogeneous Effects of the Deregulation, by FICO Score

Panel A: ARM Spread and Margin



Panel B: Fixed Term



Note: This figure shows the heterogeneous effects of the deregulation by the FICO score. The horizontal axis represents the different groups of FICO scores. The vertical axis represents the regression coefficients from Equation (1) for each FICO score group. Panel A shows the coefficients for the dependent variables for the ARM spread and the margin. Panel B shows the coefficients for the fixed term dependent variable.

TABLE I Borrower Characteristics for Prime ARMs

variables	count	mean	sd	min	max
Origination amount	1,538,761	184,476	75,722	5,000	720,000
Origination rate	1,538,761	5.26	0.98	1	12.8
Rate Spread	1,538,761	-0.96	0.68	-7.40	6.91
Margin	1,538,761	2.55	0.35	0	10.75
Fixed term	1,538,761	59.96	18.43	12	120
Initial Interest Cap	1,538,761	3.35	1.50	1	6.625
Period Cap	1,538,761	1.98	0.14	1	6
Life Cap	1,538,761	5.55	0.81	2	18
LIBOR	1,538,761	0.50	0.50	0	1
Constant Maturity Treasure	1,538,761	0.48	0.50	0	1
FICO	1,538,761	721.31	53.29	300	899
Loan To Value	1,538,761	73.03	16.13	1	149
Combine Loan To Value	1,538,761	76.69	2418.44	1	3,000,000
Second Lien	1,525,339	0.14	0.35	0	1
Backend	1,538,761	33.67	13.84	.368	99.994
Refinance	1,538,761	0.59	0.49	0	1
First Time Home Buyers	1,538,761	0.14	0.34	0	1
Income	1,538,756	7171.17	5089.76	255	271,300
Broker	1,538,761	0.47	0.50	0	1
Incumbent vs Entrance in state	1,538,761	0.78	.0.41	0	1
Incumbent vs entrance in County	1,538,761	0.50	0.50	0	1
Number of banks in state	1,538,761	35.12	10.95	1	61
Number of banks in County	1,538,761	20.58	8.71	1	48
Year of Entry	1,538,761	-1.50	3.02	-12	10
Default	1,538,761	0.049	0.22	0	1
Default before reset	1,516,697	0.020	0.14	0	1
Default after reset	1,516,697	0.030	0.17	0	1
Default one year after reset	1,516,697	0.025	0.16	0	1
Default within one year of reset	1,516,697	0.0048	0.07	0	1
Prepay	1,538,761	0.86	0.34	0	1
Prepay before reset	1,538,761	0.70	0.46	0	1
Prepay after reset	1,538,761	0.16	0.37	0	1
Prepay one year after reset	1,538,761	0.085	0.28	0	1
Prepay within one year of reset	1,538,761	0.077	0.27	0	1
Number of months from origination to prepay	1,538,761	31.36	28.71	0	253
Number of months from reset to prepay	1,538,761	3.514	12.40	0	239

Notes: The results presented in this table are obtained using data from 1994 to 2005. The origination amount reflects how much borrowers borrow from the lenders. The origination rate reflects the initial teaser rate. The rate spread refers to the difference between the origination rate and the fixed rate. The fixed term refers to number of years before the rate is reset to the sum of the index and margin rates. The initial interest rate cap refers to the maximum rate the interest rate can be adjusted on its first scheduled reset date. The period cap refers to the value that limits the amount the interest rate can be adjusted at each subsequent adjustment date. The life cap refers to the limit of the total amount by which the interest rate can be adjusted over the life of the loan. FICO refers to the credit score. The second lien is an indicator whether there are subordinate debts issued against the same house. The broker takes on the value of one if the loan is originated by a mortgage brokerage instead of commercial bank branch. The value for incumbency versus entrance in the state/county is zero if the bank was not in the state/county before the deregulation and one otherwise.

TABLE II Impact of Deregulation: First Stage

Panel A: Aggregate Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
	Number of Lenders		Number of Loans			
	All	#Entrants	All	#ARMs	#New Purchases	# Refinance
Deregulation Index	0.1017**	0.9230***	0.0358***	0.0350***	0.0247**	0.0416***
	(0.0486)	(0.0298)	(0.0120)	(0.0123)	(0.0110)	(0.0112)
Implied Effect of Full Deregulation	40%	368%	14%	14%	10%	17%
Year FE	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
County Controls	Y	Y	Y	Y	Y	Y
Observations	17198	17198	17198	17198	17198	17198
Adjusted R-Squared	0.273	0.198	0.380	0.322	0.226	0.493

Panel B: Loan-Level ARM Share

	(1)	(2)	(3)	(4)	(5)
Sample	All	ARMs			
Dep	ARMs	Retail Lenders	Brokers	Entrants	Incumbents
Deregulation Index	0.0032***	0.0042***	0.0007***	-0.0004	0.0028***
	(0.0004)	(0.0005)	(0.0001)	(0.0009)	(0.0003)
Implied Effect of Full Deregulation	1.3%	1.7%	0.3%	-0.2%	1.1%
Observations	3002723	1474718	1527811	523371	2479110
Adjusted R-squared	0.984	0.975	0.998	0.962	0.993
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y

Notes: The results presented in this table are obtained using data from 1994 to 2005. In Panel A, the data is summarized at county and year level. In Panel B, the data is at the loan level. The deregulation index takes the values zero to four, depending on four important provisions: (1) the minimum age of the target institution, (2) de novo interstate branching, (3) the acquisition of individual branches, and (4) a statewide deposit cap. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.

TABLE III Impact of Deregulation on Borrowers' Loan Contracts

Panel A: Spread, Margin, Term and Share of Deceptive Loans

	(1) ARM Spread	(2) Margin	(3) Fixed Term	(4) Deception 10|90	(5) Deception 25|75	(6) Deception 50|50
Deregulation Index	-0.0135***	0.0267***	-1.9045***	0.0109***	0.0204***	0.0273***
	(0.0028)	(0.0014)	(0.1004)	(0.0008)	(0.0014)	(0.0019)
Implied Effect of Full Deregulation	-0.054	0.107	-7.62	4%	8%	11%
Month FE	Y	Y	Y	Y	Y	Y
Zip Code FE	Y	Y	Y	Y	Y	Y
Borrower Controls	Y	Y	Y	Y	Y	Y
Mean of Dep Var	-0.959	2.546	59.957	0.044	0.082	0.109
Observations	1,511,832	1,511,832	1,511,832	1511832	1511832	1511832
Adjusted R-Squared	0.383	0.255	0.078	0.071	0.152	0.213

Panel B: Rate Caps

	Contract		
	(1) Initial Cap	(2) Period Cap	(3) Lifetime Cap
Deregulation Index	-0.0546***	-0.0000	0.1195***
	(0.0062)	(0.0007)	(0.0077)
Implied Effect of Full Deregulation	-0.218	0	0.478
Month FE	Y	Y	Y
Zip Code FE	Y	Y	Y
Borrower Controls	Y	Y	Y
Observations	1,511,832	1,511,832	1,511,832
Adjusted R2	0.183	0.097	0.172

Notes: The results presented in this table are obtained using loan-level data from 1994 to 2005. The deregulation index takes the values zero to four, depending on four important provisions: (1) the minimum age of the target institution, (2) de novo interstate branching, (3) the acquisition of individual branches, and (4) a statewide deposit cap. In Panel A, Deception 10|90 is defined to equal one if the arm spread is below 10 percentile and margin is above or equal the 90 percentile; Deception 25|75 equals one if the arm spread is below 25 percentile and margin is above or equal the 75 percentile; Deception 50|50 equals one if the arm spread is below 50 percentile and margin is above or equal the 50 percentile. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.

TABLE IV Refinance Inattentiveness

	Prepayment					
	(1)	(2)	(3)	(4)	(5)	(6)
	Refinanced				Duration	
	Before reset	>One year after reset	<=One year after reset	When rates were low	Overall	After reset
Panel A: Overall Sample						
Deregulation Index	-0.0032	0.0079***	0.0020*	-0.0116***	0.1990*	0.4025***
	(0.0020)	(0.0014)	(0.0011)	(0.0017)	(0.1197)	(0.0724)
Implied Effect of Full Deregulation	-0.013	0.032	0.008	-0.046	0.796	1.61
Observations	1,511,832	1,511,832	1,511,832	1,511,832	1,511,832	1,511,832
Adjusted R-squared	0.093	0.029	0.013	0.385	0.074	0.031
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y
Panel B: Restrictive sample with first reset before Jan 2007						
Deregulation Index	-0.0144***	0.0104***	0.0029*	-0.0133***	0.0636	0.5337***
	(0.0023)	(0.0020)	(0.0016)	(0.0022)	(0.1434)	(0.1073)
Implied Effect of Full Deregulation	-0.058	0.042	0.012	-0.053	0.254	2.13
Observations	371868	371868	371868	371868	371868	371868
Adjusted R-squared	0.146	0.082	0.039	0.396	0.245	0.090
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y

Notes: The results presented in this table are obtained using data from 1994 to 2005. For Column (1), the dependent variable takes the value one if the period of the prepayment is before the fixed term and zero otherwise. For Column (2), the dependent variable takes the value one if the period of prepayment is one year after the fixed term and zero otherwise. For Column (3), the dependent variable takes the value one if the period of prepayment is within one year of the fixed term and zero otherwise. For Column (4), the dependent variable takes the value one if the average mortgage rate in the economy in the prepayment month is at least 50 bps below the actual interest rate for the loan and zero otherwise. For Column (5), the dependent variable is the number of months between the prepayment time and the origination time. For Column (6), the dependent variable is the number of months between the prepayment time and the end of the fixed term. Panel A is based on the overall sample while Panel B excludes loans whose first reset was after 2007, since that may have been affected by negative equity during the financial crisis. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.

TABLE V Does Competition Increase Naïve Borrowers?

	(1)	Prepayment					
		(2)	(3)	(4)	(5)	(6)	(7)
		Refinanced				Duration	
	New County	Before reset	>One year after reset	<=One year after reset	When rates were low	Overall	After reset
Deregulation Index	0.0017***						
	(0.0006)						
HHI	0.6184***						
	(0.0376)						
New County		-0.0664***	0.0368***	-0.0178*	-0.0523***	-1.3089	3.0493***
		(0.0134)	(0.0125)	(0.0098)	(0.0143)	(1.0910)	(0.8075)
Implied Effect of Full Deregulation	0.007	-0.27	0.15	-0.07	-0.21		12.20
Observations	1,511,832	1,511,832	1,511,832	1,511,832	1,511,832	1,511,832	1,511,832
Adjusted R-squared	0.532	0.093	0.029	0.013	0.385	0.074	0.031
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y	Y

Notes: The results presented in this table are obtained using data from 1994 to 2005. For Columns (1), the dependent variable takes the value one if borrowers are from new counties, where banks do not have previous mortgage business, and zero otherwise. For Column (2), the dependent variable takes the value one if the period of the prepayment is before the fixed term and zero otherwise. For Column (3), the dependent variable takes the value one if the period of prepayment is one year after the fixed term and zero otherwise. For Column (4), the dependent variable takes the value one if the period of prepayment is within one year of the fixed term and zero otherwise. For Column (5), the dependent variable is the number of months between the prepayment time and the origination time. For Column (6), the dependent variable is the number of months between the prepayment time and the end of the fixed term. For Column (7), the dependent variable takes the value one if the average mortgage rate in the economy in the prepayment month is at least 50 bps below the actual interest rate for the loan and zero otherwise. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.

TABLE VI Shift in Borrower Profile

	(1) Age	(2) Male	(3) Years of Education	(4) Married	(5) Income	(6) FICO
Deregulation Index	-0.0443	0.0023	-0.0763	0.0024	0.0016	0.0993
	(0.0537)	(0.0030)	(0.0465)	(0.0035)	(0.0022)	(0.2267)
Implied Effect of Full Deregulation	-0.177	0.009	-0.305	0.010	0.006	0.397
Observations	1387940	601363	513698	694017	1511832	1511837
Adjusted R-squared	0.049	0.016	0.062	0.041	0.071	0.025
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y

Notes: The results presented in this table are obtained using data from 1994 to 2005. The dependent variables are borrowers' characteristics, such as age, gender, education, marriage, income and FICO score. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.

TABLE VII Expected Rising Interest Rate

	(1)	(2)	(3)	(4)	(5)	(6)
	ARM Spread	Margin	Fixed Term	ARM Spread	Margin	Fixed Term
Panel A: Decision rule from Koijen et al (2009)						
	Positive long-term bond risk premium			Negative long-term bond risk premium		
Deregulation Index	-0.0220***	0.0202***	-1.9251***	-0.0078**	0.0327***	-2.0610***
	(0.0038)	(0.0018)	(0.1298)	(0.0035)	(0.0020)	(0.1465)
Implied Effect of Full Deregulation	-0.088	0.081	-7.7	-0.031	0.131	-8.24
Observations	701,088	701,088	701,088	810,423	810,423	810,423
R-Squared	0.422	0.316	0.079	0.332	0.253	0.084
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y
Panel B: Interest rate down move vs up move						
	Down move			Up move		
Deregulation Index	-0.0186***	0.0263***	-1.1404***	-0.0310***	0.0268***	-2.9923***
	(0.0045)	(0.0023)	(0.1472)	(0.0057)	(0.0028)	(0.2039)
Implied Effect of Full Deregulation	-0.074	0.105	-4.56	-0.124	0.107	-11.97
Observations	551,183	551,183	551,183	413,072	413,072	413,072
R-Squared	0.295	0.268	0.06	0.389	0.274	0.082
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y

Notes: The results presented in this table are obtained using data from 1994 to 2005. Panel A reports the results based on the household decision rule of Koijen, van Hemert, and van Nieuwerburgh (2009). In Columns (1) to (3), the sample includes loans originated in months with a positive long-term bond risk premium. In Columns (4) to (6), the sample includes loans originated in months with a negative long-term bond risk premium. Panel B reports the results by the different trends of average mortgage rates at origination. The variable *up move* is defined as a dummy variable that takes the value one if and only if the market mortgage rate is at least 50 bps more than it was at its minimum in the prior six months; *down move* takes the value one if and only if the market mortgage is at least 50 bps less than it was at its maximum in the prior six months. In Columns (1) to (3), the sample includes loans originated in months with a *down-move* trend. In Columns (4) to (6), the sample includes loans originated in months with an *up-move* trend. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.

TABLE VIII Loan Performance

	Default			Gross Loan Payment		
	(1) Before reset	(2) >one year after reset	(3) <=one year after reset	(4) Total	(5) Before reset	(6) After reset
Deregulation Index	-0.0028***	-0.0019***	-0.0010***	-90.6404	-330.413***	239.7726**
	(0.0004)	(0.0004)	(0.0002)	(178.1103)	(106.2530)	(104.9301)
Implied Effect of Full Deregulation	-0.011	-0.008	-0.004	-363	-1322	959
Observations	1,490,025	1,490,025	1,490,025	1,490,025	1,490,025	1,490,025
Mean of Dep Var	0.02	0.025	0.0048	43162	34067	9095
Adjusted R-squared	0.039	0.030	0.007	0.250	0.326	0.083
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y

Notes: The results presented in this table are obtained using data from 1994 to 2005. For Column (1), the dependent variable takes the value one if the period of default is before the fixed term and zero otherwise. For Column (2), the dependent variable takes the value one if the period of default is one year after the fixed term and zero otherwise. For Column (3), the dependent variable takes the value one if the time period of default is within one year of the fixed term and zero otherwise. For Column (4), the dependent variable is the gross loan payment for each loan from loan origination to June 2015. For Column (5), the dependent variable is the loan payment for each loan before the fixed term. For Column (6), the dependent variable is the loan payment for each loan after the fixed term. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.

On-Line Appendix

FIGURE A.1 Distribution by Deregulation Over Time

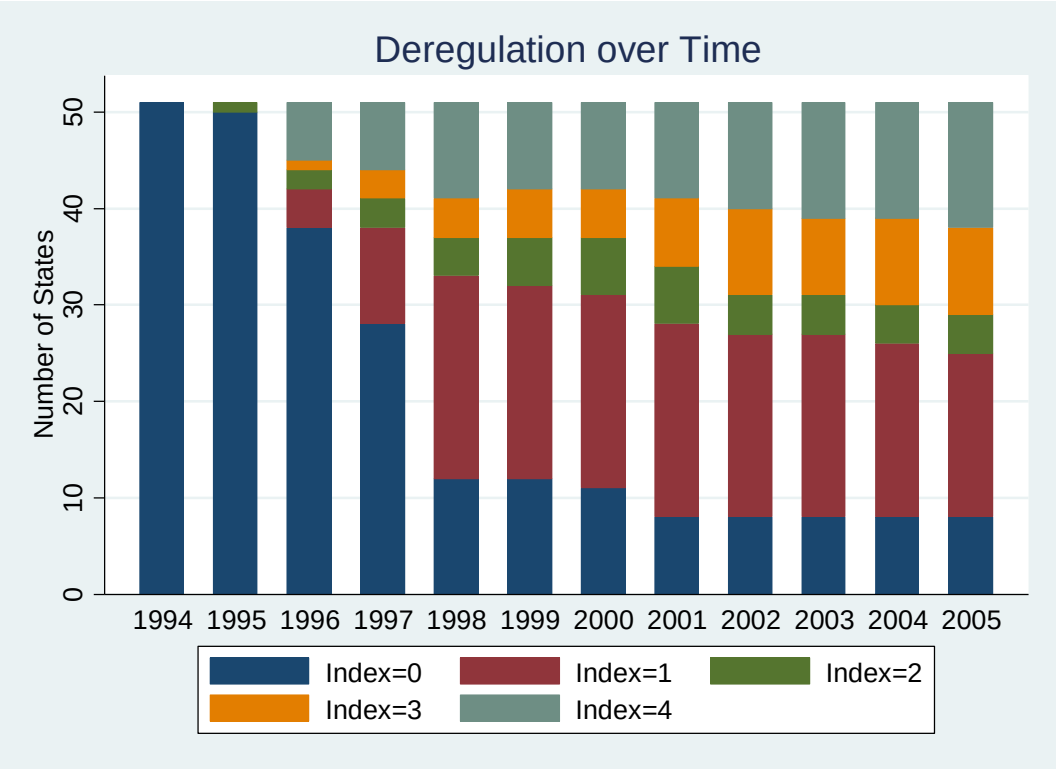
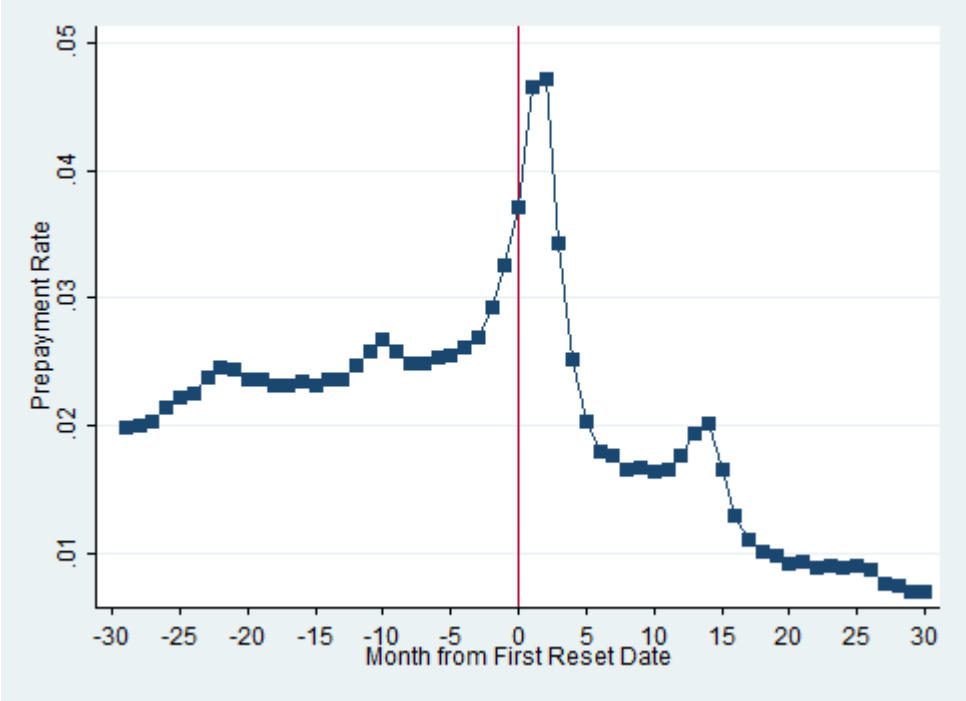


FIGURE A.2 Prepayment Speed



Note: This chart plots the prepayment speed as a function of month since first reset date. Prepayment Rate is defined as percentage of balance of loans that are prepaid in a particular month to the total loan balance as of previous month.

TABLE A.1 Summary Statistics of Deregulated and Regulated States

variables	Regulated States		Partially ior Fully Reregulated States	
	mean	**sd**	**mean**	**sd**
Origination amount	165,596	67,788	186,441	76,233
Origination rate	5.18	0.97	5.27	0.98
Rate Spread	-1.02	0.68	-0.95	0.68
Margin	2.56	0.35	2.55	0.35
Fixed term	57.77	18.03	60.19	18.46
Initial Interest Cap	3.18	1.48	3.37	1.50
Period Cap	1.98	0.12	1.98	0.15
Life Cap	5.58	0.73	5.55	0.82
LIBOR	0.48	0.50	0.50	0.50
Constant Maturity Treasure	0.51	0.50	0.48	0.50
FICO	724.10	52.01	721.02	53.41
Loan To Value	74.93	14.82	72.83	16.25
Combine Loan To Value	76.44	15.39	76.71	2541.17
Second Lien	0.13	0.34	0.14	0.35
Backend	33.09	13.95	33.73	13.83
Refinance	0.63	0.48	0.58	0.49
First Time Home Buyers	0.11	0.31	0.14	0.35
Income	6620.02	4682.32	7228.53	5126.91
Broker	0.57	0.49	0.46	0.50
Incumbent vs Entrance in state	1.00	0.00	0.76	0.43
Incumbent vs entrance in County	1.00	0.00	0.45	0.50
Number of banks in state	29.87	7.69	35.66	11.09
Number of banks in County	17.57	6.98	20.90	8.82
Year of Entry	-8.37	1.74	-0.78	2.08
Default	0.04	0.20	0.05	0.22
Default before reset	0.02	0.14	0.02	0.14
Default after reset	0.01	0.12	0.02	0.12
Default one year after reset	0.01	0.10	0.01	0.10
Default within one year of reset	0.00	0.07	0.00	0.07
Prepay	0.88	0.32	0.86	0.35
Prepay before reset	0.70	0.46	0.70	0.46
Prepay after reset	0.18	0.39	0.16	0.37
Prepay one year after reset	0.10	0.29	0.08	0.28
Prepay within one year of reset	0.09	0.28	0.08	0.26
Number of months from origination to prepay	32.54	28.43	31.24	28.73
Number of months from reset to prepay	3.85	12.86	3.48	12.35
Loan Counts	145,054		1,393,707	

TABLE A.2 Summary Statistics of FRM Sample

variables	count	mean	sd	min	max
Origination amount	1514015	161,910	74,376	7,994	800,000
Origination rate	1514015	6.38	0.96	1.875	50.25
FICO	1514015	712.13	58.42	300	899
Loan To Value	1514015	74.43	16.43	1	149
Combine Loan To Value	1514015	75.56	16.61	1	1000
Second Lien	1498642	0.10	0.30	0	1
Backend	1514015	35.42	13.79	.394	99.992
Refinance	1514015	0.57	0.50	0	1
First Time Home Buyers	1514015	0.13	0.34	0	1
Income	1514015	6,186	4,425	190	367666
Broker	1514015	0.54	0.50	0	1
Incumbent vs Entrance in stat	1514015	0.86	0.34	0	1
Incumbent vs entrance in Cou	1514015	0.62	0.49	0	1
Number of banks in state	1514015	56.70	17.65	1	90
Number of banks in County	1514015	25.70	12.26	1	62
Year of Entry	1514015	-2.48	2.97	-12	10
Default	1514015	0.07	0.25	0	1
Prepay	1514015	0.88	0.33	0	1

TABLE A.3 Impact of Deregulation on FRMs

	FRM Contract and Performance						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	FRM Rate	Default within 24 months	Default within 36 months	Default	Refinance within 24 months	Refinance within 36 months	Refinance
Deregulation Index	0.0181***	0.0003	-0.0001	-0.0043***	-0.0022	-0.0054***	-0.0017**
	(10.56)	(1.49)	(-0.35)	(-6.33)	(-1.41)	(-3.62)	(-2.03)
Observations	1490705	1490705	1490705	1490705	1490705	1490705	1490705
Adjusted R-squared	0.709	0.020	0.043	0.085	0.177	0.217	0.104

Note: The results presented in this table are obtained using data from 1994 to 2005. The deregulation index takes the values zero to four, depending on four important provisions: (1) the minimum age of the target institution, (2) de novo interstate branching, (3) the acquisition of individual branches, and (4) a statewide deposit cap. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.

TABLE A.4 Heterogeneity by Different Borrowers

	Loan Characteristics					
	(1) ARM Spread	(2) Margin	(3) Fixed Term	(4) ARM Spread	(5) Margin	(6) Fixed Term
Panel A: Financial constrained or not borrowers						
	CLTV>= 80			CLTV<80		
Deregulation Index	-0.0124***	0.0274***	-1.8755***	-0.0181***	0.0232***	-1.8742***
	(0.0034)	(0.0018)	(0.1263)	(0.0034)	(0.0018)	(0.1438)
Implied Effect of Full Deregulation	-0.050	0.110	-7.5	-0.072	0.093	-7.5
Observations	767,770	767,770	767,770	743,728	743,728	743,728
R-Squared	0.353	0.255	0.093	0.425	0.301	0.072
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y
Panel B: New purchase or refinance						
	New Purchase			Refinance		
Deregulation Index	-0.0136***	0.0302***	-1.9606***	-0.0168***	0.0174***	-1.5227***
	(0.0036)	(0.0018)	(0.1211)	(0.0035)	(0.0018)	(0.1421)
Implied Effect of Full Deregulation	-0.054	0.121	-7.84	-0.067	0.07	-6.09
Observations	624,621	624,621	624,621	886,889	886,889	886,889
R-Squared	0.355	0.278	0.088	0.397	0.261	0.07
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y
Panel C: First time home buyers						
	First Time Home Buyers			Existing Home Buyers		
Deregulation Index	-0.0217***	0.0283***	-2.4410***	-0.0124***	0.0265***	-1.8179***
	(0.0061)	(0.0035)	(0.2463)	(0.0029)	(0.0014)	(0.1051)
Implied Effect of Full Deregulation	-0.087	0.113	-9.76	-0.05	0.106	-7.27
Observations	206,349	206,349	206,349	1,305,088	1,305,088	1,305,088
R-Squared	0.350	0.272	0.089	0.380	0.272	0.074
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y
Panel D: PMI vs piggyback loan						
	PMI Loan			Piggyback Loan		
Deregulation Index	-0.0182***	0.0256***	-1.6498***	-0.0007	0.0028	-1.0805**
	(0.0051)	(0.0027)	(0.1643)	(0.0092)	(0.0040)	(0.4853)
Implied Effect of Full Deregulation	-0.073	0.102	-6.5	-0.003	0.011	-4.32
Observations	260,389	260,389	260,389	147,202	147,202	147,202
R-Squared	0.357	0.292	0.136	0.458	0.315	0.075
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y

Notes: The results presented in this table are obtained using loan-level data from 1994 to 2005. The dependent variables are similar to those in Table III. Panels A to D show the heterogeneous effects with respect to financially constrained borrowers or not, whether the mortgage is a refinancing loan, whether the buyer is a first time home buyer, and whether the mortgage is a piggyback loan. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.

TABLE A.5 Heterogeneous Effects by FICO Score

	FICO Score		
	(1)	(2)	(3)
	ARM Spread	Margin	Fixed Term
Panel A: FICO score less than 620			
Deregulation Index	-0.0019	0.0436***	-3.0308***
	(0.0122)	(0.0066)	(0.3470)
Observations	51396	51396	51396
R-Squared	0.337	0.291	0.114
Panel B: Fico score including 620 to less than 660			
Deregulation Index	-0.0123	0.0230***	-2.0815***
	(0.0078)	(0.0037)	(0.2741)
Observations	153,474	153,474	153,474
R-Squared	0.35	0.229	0.1
Panel C: Fico score including 660 to less than 720			
Deregulation Index	-0.0108***	0.0298***	-2.0673***
	(0.0041)	(0.0023)	(0.1579)
Observations	474,775	474,775	474,775
R-Squared	0.364	0.293	0.088
Panel D: Fico score including 720 to less than 780			
Deregulation Index	-0.0143***	0.0212***	-1.6750***
	(0.0033)	(0.0016)	(0.1412)
Observations	622,195	622,195	622,195
R-Squared	0.425	0.297	0.077
Panel E: Fico score more than and including 780			
Deregulation Index	-0.0294***	0.0283***	-1.6086***
	(0.0055)	(0.0028)	(0.245)
Observations	208,377	208,377	208,377
R-Squared	0.428	0.285	0.064
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y

Notes: The results presented in this table are obtained using data from 1994 to 2005. The deregulation index takes the values zero to four, depending on four important provisions: (1) the minimum age of the target institution, (2) de novo interstate branching, (3) the acquisition of individual branches, and (4) a statewide deposit cap. The FICO scores are between 300 and 899. A higher score indicates lower credit risk. Panels A to E show the results for the different ranges of FICO scores. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.

TABLE A.6 Heterogeneity by Different Lenders

	Lender Characteristics					
	(1) ARM Spread	(2) Margin	(3) Fixed Term	(4) ARM Spread	(5) Margin	(6) Fixed Term
Panel A: Type of lender						
	Retail lenders			Brokers		
Deregulation Index	-0.0062*	0.0316***	-2.1013***	-0.0195***	0.0112***	-1.2136***
	(0.0034)	(0.0018)	(0.1257)	(0.0039)	(0.0021)	(0.1366)
Implied Effect of Full Deregulation						
Observations	796,910	796,910	796,910	714,615	714,615	714,615
R-Squared	0.352	0.283	0.077	0.443	0.277	0.071
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y
Panel B: Incumbent VS Entrants in State						
	Entrants			Incumbent		
Deregulation Index	-0.0195**	0.0305***	-0.0292	-0.0048*	0.0254***	-2.0484***
	(0.0089)	(0.0054)	(0.3075)	(0.0028)	(0.0016)	(0.1058)
Implied Effect of Full Deregulation						
Observations	321,799	321,799	321,799	1,189,771	1,189,771	1,189,771
R-Squared	0.383	0.272	0.099	0.393	0.272	0.081
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y
Panel C: Incumbent VS Entrants in County						
	Entrants			Incumbent		
Deregulation Index	0.0011	0.0105***	0.0320	-0.0066**	0.0160***	-1.8416***
	(0.0069)	(0.0040)	(0.2411)	(0.0030)	(0.0017)	(0.1115)
Implied Effect of Full Deregulation						
Observations	743,181	743,181	743,181	768,549	768,549	768,549
R-Squared	0.359	0.271	0.078	0.419	0.286	0.093
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y

Notes: The results presented in this table are obtained using data from 1994 to 2005. The dependent variables are similar to those in Table III. Panels A to D show the heterogeneous effects with respect to the lender type, whether the mortgage is a refinance loan, whether the buyer is a first time home buyer, and whether the mortgage is a piggyback loan. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.

TABLE A.7 Heterogeneity by Markets with Different Proportion of Naïve Borrowers

	(1) ARM Spread	(2) Margin	(3) Fixed Term	(4) Deception 10|90	(5) ARM Spread	(6) Margin	(7) Fixed Term	(8) Deception 10|90
Panel A: Proportion of borrowers who have not refinanced before the first reset								
	MSAs Above Median				MSAs Below Median			
Deregulation Index	-0.0199***	0.0413***	-2.1994***	0.0170***	-0.0028	0.0194***	-1.7921***	0.0020*
	(0.0069)	(0.0033)	(0.1830)	(0.0020)	(0.0037)	(0.0019)	(0.1700)	(0.0011)
Implied Effect of Full Deregulation	-0.080	0.17	-8.800	0.068	-0.011	0.078	-7.168	0.008
Observations	693195	693195	693195	693195	695638	695638	695638	695638
Adjusted R-squared	0.355	0.221	0.068	0.072	0.429	0.294	0.099	0.063
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y	Y	Y
Panel B: Proportion of borrowers who have refinanced when rates were high								
	MSAs Above Median				MSAs Below Median			
Deregulation Index	-0.0482***	0.0533***	-2.7050***	0.0177***	-0.0118***	0.0249***	-2.2523***	0.0086***
	(0.0179)	(0.0114)	(0.4969)	(0.0063)	(0.0032)	(0.0016)	(0.1176)	(0.0008)
Implied Effect of Full Deregulation	-0.191	0.213	-10.820	0.071	-0.047	0.100	-9.010	0.034
Observations	695041	695041	695041	695041	689974	689974	689974	689974
Adjusted R-squared	0.249	0.206	0.055	0.069	0.462	0.302	0.107	0.077
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y	Y	Y

Notes: The results presented in this table are obtained using data from 1994 to 2005. The dependent variables are similar to those in Table III. Panel A and B use two measures of the fraction of naïve borrowers for each region that are defined based on ex post prepayment behavior of the borrowers. In Panel A, borrowers who have not refinanced before the first reset to avoid higher fully-indexed rate are considered naïve compared to those who have refinanced in time. In Panel B, borrowers who have refinanced with inadequate rate savings are considered naïve compared to those who have done so with at least 50 bps rate savings. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.

TABLE A.8 Heterogeneity in Refinance Inattentiveness

	Prepay					
	(1)	(2)	(3)	(4)	(5)	(6)
	Before fixed term	One year after fixed term	Within one year after fixed term	Before fixed term	One year after fixed term	Within one year after fixed term
Panel A: Type of lender						
	Retail lenders			Brokers		
Deregulation Index	-0.0091***	0.0098***	0.0038***	0.0134***	0.0018	-0.0004
	(0.0022)	(0.0017)	(0.0013)	(0.0035)	(0.0024)	(0.0018)
Implied Effect of Full Deregulation	-0.036	0.039	0.015	0.053	0.007	-0.002
Observations	796,910	796,910	796,910	714,615	714,615	714,615
Adjusted R-squared	0.084	0.035	0.015	0.110	0.027	0.014
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y
Panel B: New purchase or refinance						
	New Purchase			Refinance		
Deregulation Index	-0.0084***	0.0083***	0.0047***	0.0065**	0.0047**	-0.0021
	(0.0024)	(0.0017)	(0.0013)	(0.0029)	(0.0020)	(0.0017)
Implied Effect of Full Deregulation	-0.034	0.033	0.019	0.026	0.019	-0.008
Observations	624,621	624,621	624,621	886,889	886,889	886,889
Adjusted R-squared	0.106	0.036	0.016	0.089	0.029	0.013
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y
Panel C: First time home buyers						
	First Time Home Buyers			Existing Home Buyers		
Deregulation Index	-0.0094*	0.0116***	0.0091***	-0.0023	0.0071***	0.0011
	(0.0049)	(0.0035)	(0.0029)	(0.0020)	(0.0014)	(0.0011)
Implied Effect of Full Deregulation	-0.038	0.046	0.036	-0.01	0.028	0.004
Observations	206,349	206,349	206,349	1,305,088	1,305,088	1,305,088
Adjusted R-squared	0.106	0.034	0.019	0.092	0.030	0.013
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y
Panel D: PMI vs piggyback loan						
	PMI Loan			Piggyback Loan		
Deregulation Index	-0.0059*	0.0092***	0.0059***	-0.0049	0.0049	0.0149***
	(0.0031)	(0.0024)	(0.0020)	(0.0083)	(0.0052)	(0.0045)
Implied Effect of Full Deregulation	-0.024	0.037	0.024	-0.02	0.02	0.06
Observations	260,389	260,389	260,389	147,202	147,202	147,202
Adjusted R-squared	0.128	0.047	0.021	0.083	0.018	0.014
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y

Notes: The results presented in this table are obtained using data from 1994 to 2005. The dependent variables are similar to those in Table V. Panels A to D show the heterogeneous effects with respect to the lender type, whether the mortgage is a refinance loan, whether the buyer is a first time home buyer, and whether the mortgage is a piggyback loan. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.

TABLE A.9 Heterogeneity Above and below Median Age and Income

	(1) ARM Spread	(2) Margin	(3) Fixed Term	(4) ARM Spread	(5) Margin	(6) Fixed Term
Panel A: Heterogeneous effects by median age						
	Below median age			Above median age		
Deregulation Index	-0.0190***	0.0224***	-1.9398***	-0.0202***	0.0242***	-2.1700***
	(0.0038)	(0.0017)	(0.1335)	(0.0032)	(0.0017)	(0.1284)
Implied Effect of Full Deregulation	-0.076	0.09	-7.76	-0.081	0.097	-8.68
Observations	695,161	695,161	695,161	692,433	692,433	692,433
R-Squared	0.408	0.243	0.093	0.397	0.258	0.07
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y
Panel B: Heterogeneous effects by median income						
	Below median income			Above median income		
Deregulation Index	-0.0191***	0.0269***	-2.1561***	-0.0080***	0.0255***	-1.6389***
	(0.0036)	(0.0017)	(0.1272)	(0.0034)	(0.0020)	(0.1374)
Implied Effect of Full Deregulation	-0.076	0.108	-8.62	-0.032	0.102	-6.56
Observations	758,227	758,227	758,227	753,265	753,265	753,265
R-Squared	0.374	0.26	0.089	0.403	0.262	0.074
Month FE/ Zip Code FE/ Borrower Controls	Y	Y	Y	Y	Y	Y

Notes: The results presented in this table are obtained using data from 1994 to 2005. Panel A reports the heterogeneous effects by median age. In Columns (1) to (3), the sample includes borrowers below the median age. In Columns (4) to (6), the sample includes borrowers above the median age. Panel B reports the heterogeneous effects by median income. In Columns (1) to (3), the sample includes borrowers below the median income. In Columns (4) to (6), the sample includes borrowers above the median age. Robust clustered errors are reported in parentheses. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. All columns include month and zip code fixed effects and borrower controls.