Online Appendix—The Effects of Mortgage Credit Availability: Evidence from Minimum Credit Score Lending Rules

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Appendix A Supplementary Material

A.1 The FHA's Streamline Refinance Program

One additional complication in studying mortgage underwriting decisions during this period is lenders' participation in the FHA's streamline refinance program, which allows borrowers to refinance FHA-guaranteed mortgages into new FHA mortgages without going through the full underwriting process.[1] For example, it may be that there are actually many low-credit score borrowers getting mortgages through this program who appear in the data with missing FICO® Scores. While we can't observe in the data which mortgages are originated through the streamline refinance program, we can study the pool of mortgages with characteristics that would make them likely to part of this program: refinance mortgages guaranteed by the FHA that do not involve any equity extraction.

Reassuringly, the fraction of mortgages in this category with missing FICO® Scores is only slightly higher than the overall fraction of mortgages in the data with missing scores (14 percent compared to 12 percent overall), making it unlikely that there are a large number of low-score borrowers obtaining mortgages through the program and appearing in the data with missing scores. In contrast, FHA refinances just below the 620 threshold do exhibit other risky characteristics that suggest they were underwritten less stringently, likely because they were disproportionately originated through the streamline program. In particular, FHA refinances with credit scores just below the threshold have higher DTIs and are more likely to lack full documentation of the borrower's income. Again, however, these are supply-driven differences that do not invalidate our identification strategy.

A.2 Additional Results on Mortgage Originations

We can get a good sense of the connection between our credit availability measure and mortgage attainment by examining plots of the relationship between credit score and the probability of taking out a mortgage. Figure A.1 shows the contemporaneous probability of mortgage attainment by credit score, across the three stable periods of availability in our data. The plot shows that the probability of taking out a new mortgage declined most sharply for those at the bottom of the credit distribution between the 2008 (the black line) and 2009:Q2-2010:Q2 periods (the red line). After lenders began using the 640 threshold, we see that the 2012 probabilities (the blue line) show evidence of a further decline in mortgage

[1] In theory, the program allowed FHA mortgages to be refinanced with no underwriting at all, though in practice, many lenders did impose restrictions on which loans they would refinance.

originations in the middle of our sample. These patterns mirror the evolution of our credit availability measure, as shown in figure 4 of the main text.

A.2.1 Mortgage Balance

In table A.1, we consider an alternative measure of new mortgage borrowing, namely the change in the total mortgage balance on an individual's credit record, relative to the quarter prior to that in which we estimate credit availability. Qualitatively, the results are similar to those in table 1. In panel A of table A.1, credit availability increased an individual's mortgage balance by about $3,000 over four quarters and $6,600 over 16 quarters, where the average increases in mortgage debt over the entire sample are close to zero. The effects are noticeably smaller for those who did not have mortgages previously (panel B) and larger for those who did (panel C).

Interestingly, those who did have mortgages previously had $56,000 less in mortgage debt after 16 quarters, on average, a strikingly high figure. Roughly one quarter of this sample had a zero balance after four years, and a partially overlapping quarter of the sample experienced 60-day delinquency, suggesting that most of the decline in mortgage debt reflects foreclosure or other forms of debt discharge. Conditional on starting with a positive balance and still having a positive balance after four years, the average individual pays down only $10,000. All told, even if we halve the coefficient on credit availability, to match the actual change in our credit availability measure for low-score borrowers, this result suggests that credit availability materially attenuated the (largely undesired) decline in mortgage balances that households experienced during this period.

A.3 Mortgage Interest Rates

In the main text, we suggest that some of our findings may be attributable to current homeowners being able to refinance into lower-rate mortgages if they have access to mortgage credit. Ideally, we would test this suggestion by looking explicitly at changes in borrowers' mortgage rates, but we are limited by the fact that these rates are not observed in our credit data. Instead, we next show that having access to credit allows existing borrowers to take out new mortgages during periods when prevailing interest rates are lower than when they had taken out their current mortgage.

To this end, we define an individual's "inferred mortgage interest rate" as the national average fixed-rate mortgage rate in the year the individual's largest current mortgage was

originated. We show in column 1 of table A.2 that, on average, existing borrowers lower their inferred mortgage rate during this period by 8 basis points over the next four quarters and that having access to mortgage credit allowed them to lower their inferred rate by an additional 8 basis points. These averages naturally combine the outcomes for the small share of borrowers who do refinance over the four quarters with the large majority who do not (and therefore have no change in their implied mortgage interest rate), so that the reduction in implied interest rate for those who do actually refinance is much larger.[2]

Using our inferred measure of mortgage interest rates rather than actual interest rates can produce biases in both directions. On the one hand, our approach likely overstates the reduction in interest rates for some borrowers because we ignore the possibility of adjustable-rate mortgages: Borrowers refinancing from an adjustable-rate mortgage to a fixed-rate mortgage likely start with a lower rate and therefore experience a smaller reduction in their interest payments. On the other hand, our measure likely understates the reduction in interest rates from refinancing because borrowers with unobservably larger incentives to refinance are more likely to do so. As a result of these biases, we would be hesitant to draw quantitative conclusions about the importance of interest rate reductions in explaining our findings. Nevertheless, this exercise provides some evidence that credit access does allow borrowers to reduce their mortgage rates, which could help explain many of the results we observe in our data.[3]

A.4 Persistence of Credit Scores

Figure A.2A shows the average change in Risk Scores over 16 quarters in different periods of time and for individuals with different initial scores. Individuals with Risk Scores above 620 experience an average change in Risk Score of less than 10 points over the subsequent

[2]Using the fact that only 8 percent of existing borrowers take out new mortgages during any 4 month period in our sample, a back-of-the-envelope calculation implies that the average refinance in our sample involves a roughly 1 percentage point decrease in the implied mortgage rate.

[3]In unreported results, we attempt to further test the importance of rate-reducing refinances by splitting up the sample based on borrowers' refinancing incentives, which we measure as the difference between the current available mortgage interest rates and the inferred interest rate on their current mortgage. This exercise fails to produce any significant results of credit availability across the various outcomes we measure. In fact, this proxy for refinancing incentives is not predictive of refinancing activity in general, indicating that it fails to capture borrowers' interest in refinancing, at least among the lower-credit score borrowers in our sample. Thus, using our inferred interest rate measure, we can show that prior borrowers do seem to lower their rates (and those with higher credit availability do so more) but not that they respond to differential incentives.

16 quarters.[4] Meanwhile, individuals who start with lower scores tend to experience much larger increases in their scores, with an average rise of roughly 40 points over 16 quarters for those who begin with scores around 530. Such low scores are typically the result of recent derogatory credit events, and scores recover rapidly as long as there are no additional derogatory events.

Despite some rise in credit scores for these borrowers, the scores of these borrowers do not rise quickly enough over our 16-quarter horizon to reach levels that would imply a high likelihood of exceeding 620 and 640 FICO® thresholds that remained in place during our study period. As a result, our measure of mortgage credit availability changes slowly for these borrowers, reaching only about 0.4 after 16 quarters for a borrower who started with a risk score of 530 (as shown in figure A.2B). Even after four years, then, credit availability for those with initial Risk Scores in the mid-500s is still about half that of those who began with scores in the mid-600s. Expressed differently, the correlation between our measure of an individual's credit availability measure now and her credit availability 16 quarters later is 0.45 in our estimation sample and 0.63 in the full sample. These results indicate a striking degree of persistence in both credit scores and mortgage credit availability during this time period.

A.5 Robustness Checks

We next examine a series of alternative specifications to some of our main results, to ensure that they are robust. Tables A.3 and A.4 show different estimates of the effect of credit availability on the contemporaneous probability of taking out a mortgage, across all borrowers. Column 1 of table A.3 repeats our preferred estimate from column 1 of panel A in table 1. As with all of our main estimates, it shows standard errors that allow for clustering at the level of Risk Score crossed with quarter, since that is the level of variation of our credit availability measure. Column 2 shows exactly the same point estimates, but with standard errors allowing for two-way clustering within both Risk Score and quarter. While the standard error on credit availability is somewhat larger, the qualitative interpretation of the effect is unchanged.[5]

[4] The size of these changes varied somewhat with the state of the economy, with scores in this range remaining roughly flat during the Great Recession but increasing slightly once the economic recovery began.

[5] We do not apply the two-way clustering for our main estimates for two reasons: First, in some cases—as in column 2 of table A.5—the resulting standard errors are smaller, rather than larger, than with one-way clustering, so neither approach is obviously more conservative. Second, two-way clustering is much more computationally intensive because the variance-covariance matrix for each model must be estimated three times, which is costly given the size of our data set.

In the third column, we add linear and quadratic terms for the age of the individual, interacted with quarter. Age is an attractive control because it is highly correlated with credit score, as we show in figure 6. Moreover, because age evolves deterministically, it may be a more stable proxy for current and past credit scores. In any event, including age does not change the estimated effect of credit availability. In the fourth column, we add controls for lagged employment and house price growth, as well as tract-level characteristics including median household income and the fractions of residents who are black and Hispanic. Again, these extra controls do not change the estimated effect of interest.

Next we consider the possibility of changing how we control for the past evolution of credit availability and credit score, via a more direct route than controlling for age. Column 5 shows the result of including the second through fourth lags of credit availability, the second through fourth lags of the predicted threshold probabilities, as well as the second through fourth lags of credit score interacted with quarter dummies. The effects of credit availability and the first lag are nearly unchanged. Similarly, the effect of credit availability is also unchanged in column 6 when we drop all lags, including the first, from the right-hand side.

Turning to table A.4, we explore robustness to the score window we use. Column 1 repeats our baseline estimate, which includes individuals with scores between 530 and 730. We selected that window because scores above 730 or below 530 are very unlikely to be affected by changes in lenders' use of a 620 or 640 threshold. Moreover, we wanted to use a narrow enough window that the linear credit score controls could plausibly pick up variation in mortgage demand by score, since a wider window makes it more likely that the relationship between score and demand would be nonlinear.

Column 2 considerably expands the sample by including all individuals with scores between 500 and 830.[6] The estimated average marginal effect of credit availability is slightly smaller in magnitude, but the mean of the dependent variable is larger, because high-score individuals are so much more likely to take out mortgages. Column 3 does the opposite, narrowing the window to include only individuals with scores between 580 and 680. In this case the mean of the dependent variable is about the same, but the average marginal effect is about half as large as in column 1 and is no longer statistically significantly different than zero.

Intuitively, with a more narrow range of scores, nonlinearities play a smaller role and the

[6]This expanded sample still drops the roughly 5 percent of individuals who have extremely high or low scores.

linear credit score interacted with the time dummy picks up most of the variation. In other words, as the range narrows, it becomes more difficult to separate out the effect of being more likely to be above the credit score threshold from the effect of simply having a higher credit score. Indeed, for some narrow enough range of credit scores, our non-linear credit availability measure becomes sufficiently well approximated by a time-varying linear credit score (which we include as a control) that it is impossible to identify any separate effect.

To further explore this phenomenon, columns 4 through 7 include only a non-time varying linear credit score control, and then vary the risk score window again. With the original window (column 4), the estimated effect increases in magnitude, and with the wide window (column 5), it quintuples, which strongly suggests to us that those specifications fail to adequately control for credit demand. However, when we zoom in to the narrow window (column 6) or an extra-narrow window that includes only individuals with scores between 605 and 655 (column 7), we get effects quite close to our preferred estimate, likely because narrowing the window is a good substitute for controlling for credit score and a linear and time-varying way.

In tables A.5 and A.6, we apply the same alternative specifications to the longer-run probability of taking out a mortgage, specifically the model for one to 16 quarters ahead from column 5 of panel A in table 1. The results are generally similar to those for the contemporaneous effects. We find no variation in the effect of interest in table A.5. And in table A.6, we also find that we lose power when we narrow the window but leave the time-varying linear score controls (column 3), but that the effects balloon when we widen the window, especially without the time-varying linear score controls. Using a narrower window but excluding the time-varying linear score controls (column 6), gives a similar point estimate to the baseline. In contrast, one difference with the contemporaneous effects is that the "extra narrow" window in column 7 gives an effect more than twice as large in magnitude. In any case, we take comfort from the fact that the effect only becomes statistically insignificant in column 3, the one case where we think we are clearly tossing out too much identifying variation.

A.6 Heterogeneity by State

Credit scores, and thus mortgage credit availability, also exhibit interesting geographic variation. Figure A.4 contains maps illustrating heterogeneity by state, with panel A.4A showing average credit scores in 2008. There is a substantial range, with the highest-score states–concentrated in the upper Midwest, Great Plains, and Northeast—averaging around 710. In

contrast, the lowest-score states—mostly in the deep South—average 670 or so. Panel A.4B shows that average scores in each state changed very little between 2008 and 2011, consistent with the small changes in average scores at the national level, as we discussed above.

The variation in scores across states shown in panel A.4A translates directly into variation in credit availability, which is mapped in panel A.4C. This figure shows that in 2008, the variation in credit availability was fairly small, because there were minimal restrictions on credit around the 620 and 640 thresholds. However, the variation in scores translated into a wide range of *changes* in availability as banks began enforcing these thresholds in subsequent years. Panel A.4D shows that credit availability fell by substantially more in the South—the lighter shading—than in the Midwest, Great Plains, or Northeast—the darker shading.[7]

A.7 Details of Counterfactual Exercise

This section provides additional details of the calculations reported in section 5 of the main text, where we attempt to compute the aggregate direct impact of the 620 and 640 FICO® Score thresholds on the total number of mortgages originated in the years following the financial crisis. To perform these calculations, we use counts of mortgages taken out by each individual, over various horizons, and estimate negative binomial models to relate these counts to the credit availability measure and our controls. Because many mortgages are taken out jointly by couples, we estimate separate models for joint and individual mortgages, so that we can properly aggregate and avoid double-counting.

Table A.7 shows the effects of credit availability on joint mortgages, while table A.8 shows them for individual mortgages. We see large positive effects throughout both tables, with uniformly larger effects for joint mortgages, which have larger unconditional probabilities as well. Comparing panel C from each table to the other makes clear that individuals who already have a mortgage balance on their credit record are much more likely to take out joint mortgages than individual mortgages, and that the effects of credit availability scale up with the unconditional probabilities.

Next we use these models to predict the number of mortgages that would have been originated if the credit availability measure had remained at its level in the first quarter of 2008. Specifically, we take every individual in our sample and recalculate our credit availability measure using her actual Risk Score at each point in time and the 620 and 640

[7] We find no meaningful cross-state variation in the estimated marginal effects of credit availability on mortgage attainment. Thus, unlike with age, race, or income, the effects of changes in availability across states are directly proportional to the changes in availability themselves.

threshold ratios from 2008:Q1, holding all else constant. Then, using the specifications in column 2, panel A, of tables A.7 and A.8, we predict the number of each type of mortgage that would have been originated zero to three quarters ahead. We divide the number of joint mortgages by two, and then add the two predictions together.

For the results on mortgage originations over a longer, four-year period, we use the specifications in column 5, panel A, predicting the number of joint and individual first mortgages that would have been originated zero to 15 quarters ahead.

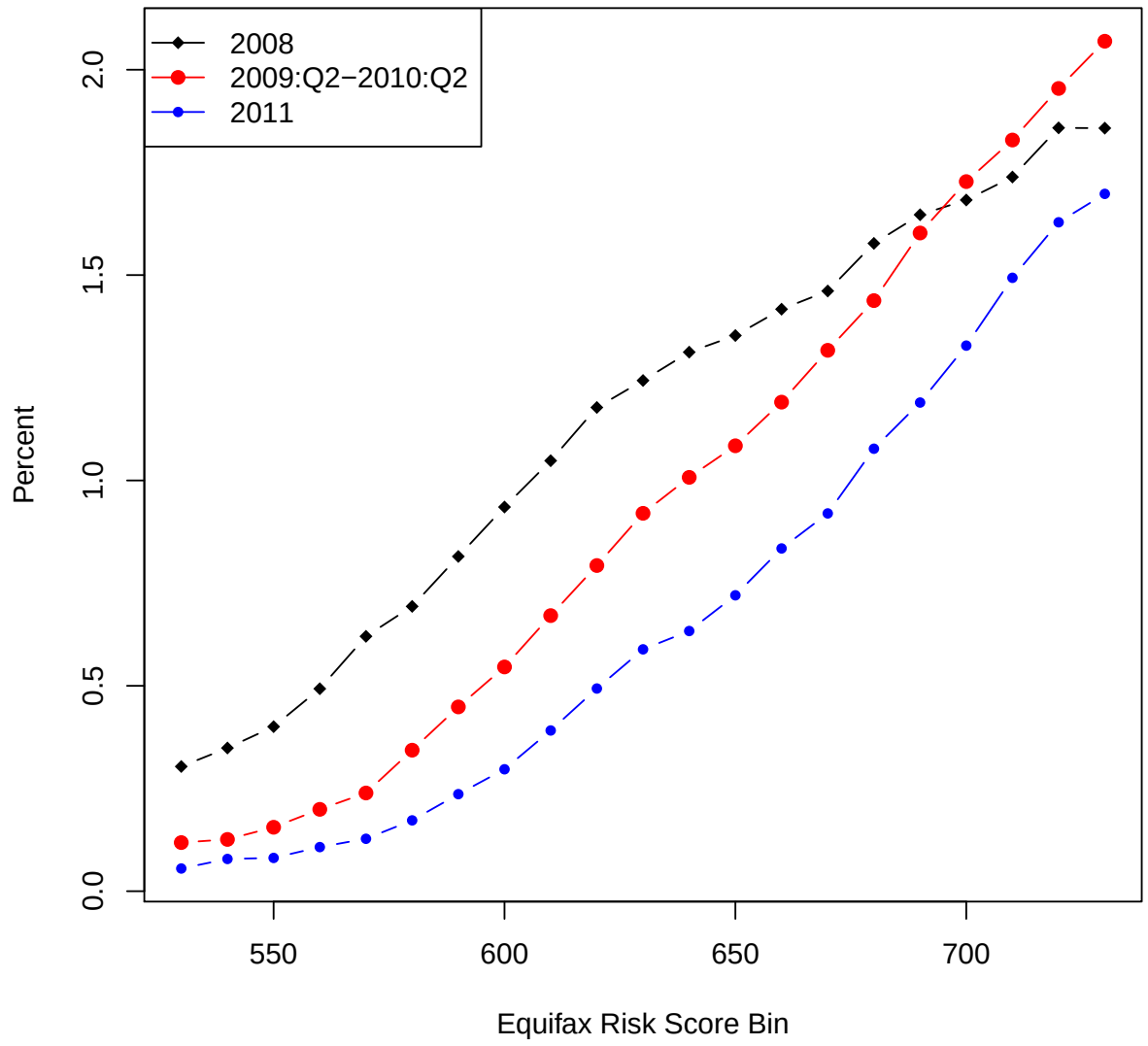
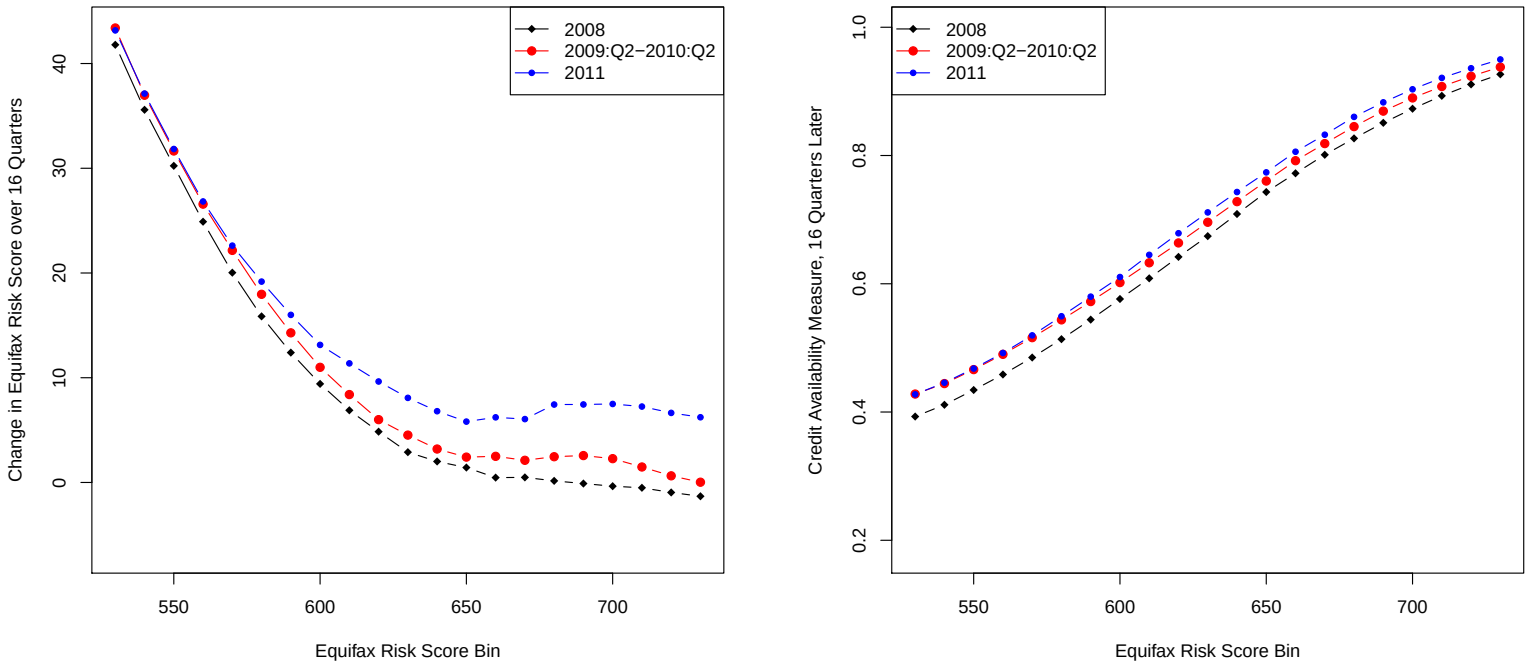
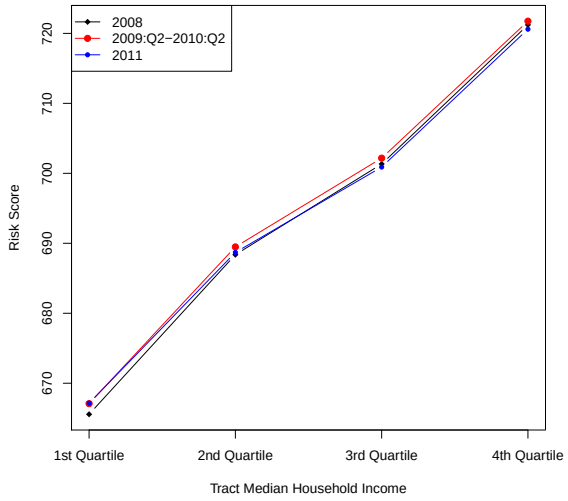


FIG. A.1.—Contemporaneous Mortgage Origination Probability. This figure compares the probability of taking out at least one mortgage in the contemporaneous quarter, by 10-point Equifax Risk Score bin, across the three stable periods of credit availability.

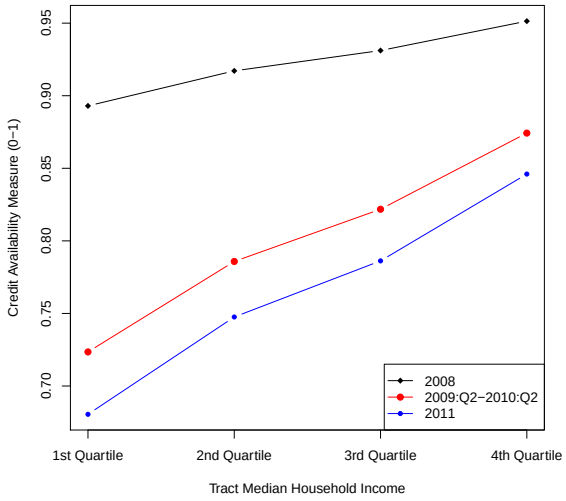


Panel A. Score Evolution *Panel B. Availability Evolution*

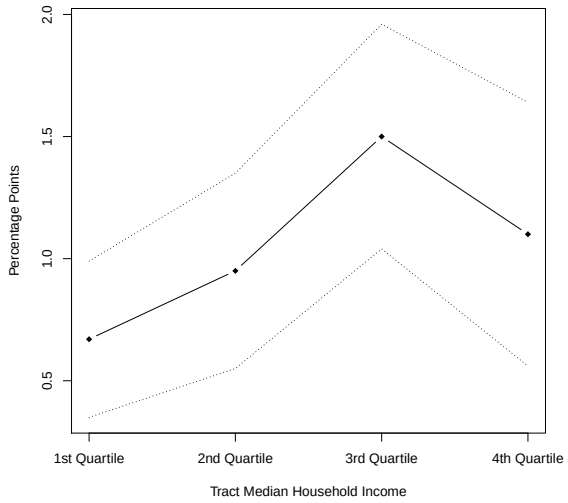
FIG. A.2.—Evolution of Credit Score and Credit Availability. This figure shows the average change in Risk Score (left panel) and the average level of our credit availability measure (right panel), after 16 quarters, conditional on initial Risk Score. The lines in each panel represent averages within the three stable periods of credit availability.



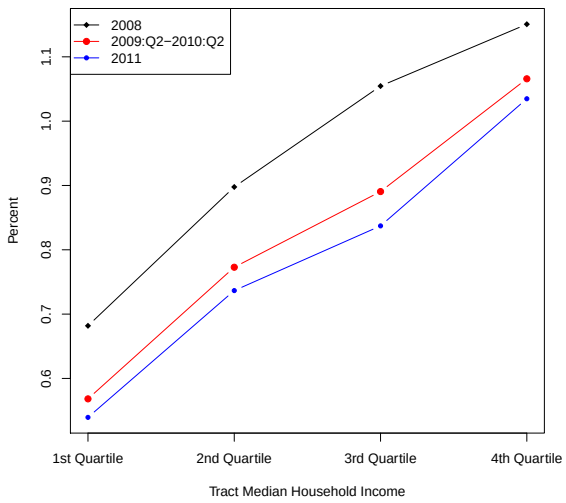
Panel A. Credit Score



Panel B. Credit Availability

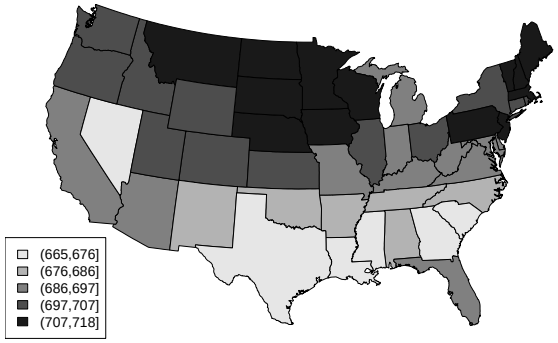


Panel C. Marginal Effects

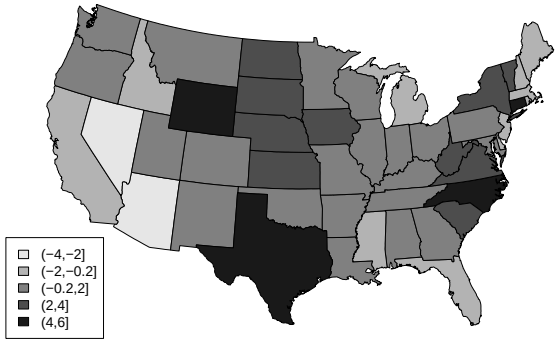


Panel D. Implied Effects

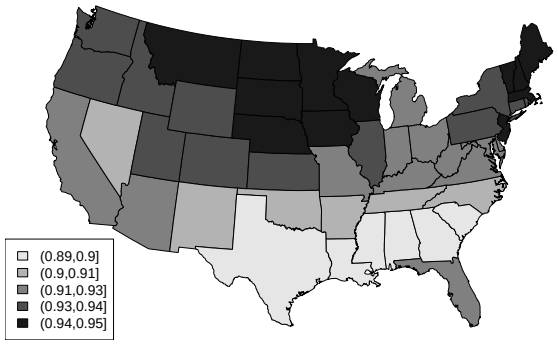
FIG. A.3.—Income Heterogeneity. This figure traces out the effects of credit availability by tract median household income quartiles, for individuals with no initial mortgage balance. Panel A shows the average Equifax Risk Score in each quartile, across the three stable periods of credit availability. Panel B shows average credit availability in each quartile, across periods. Panel C shows the estimated marginal effects of credit availability on the contemporaneous probability of mortgage attainment for each quartile (which are assumed to be constant across periods), plus or minus two standard errors. Panel D shows the model-derived contemporaneous probability of mortgage attainment for each quartile, allowing credit availability to change over time but holding all else constant at 2008:Q1 levels. See text for details.



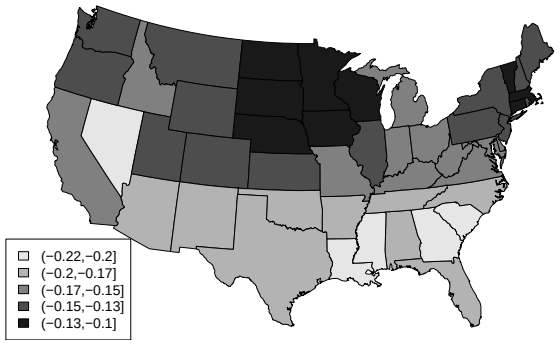
Panel A. Credit Score, 2008



Panel B. Change in Credit Score, 2008-2011



Panel C. Credit Availability, 2008



Panel D. Change in Credit Availability, 2008-2011

FIG. A.4.—Heterogeneity by State. This figure examines credit scores and credit availability by state. Panel A shows the average Equifax Risk Score in each state, in 2008. Panel B shows the change in the average Equifax Risk Score in each state, from 2008 to 2011. Panel C shows the average of our credit availability measure in each state, in 2008. Panel D shows the change in the average of our credit availability measure in each state, from 2008 to 2011.

TABLE A.1
EFFECTS ON CHANGE IN FIRST MORTGAGE BALANCE

Horizon in Quarters:	(1) 4	(2) 8	(3) 12	(4) 16
	Panel A: Entire Sample			
Credit Availability	3340	5293	6809	6623
	(765)	(1100)	(1318)	(1473)
Lagged Availability	-589	239	1353	0
	(898)	(1366)	(1676)	(1908)
Dep. Var. Mean	-31	-564	-737	-522
Observations	32,037,646	31,612,415	31,292,893	31,002,021
	Panel B: No Initial Mortgage Balance			
Credit Availability	1235	1298	2359	1460
	(432)	(527)	(635)	(733)
Lagged Availability	-2762	-2428	-2697	-3554
	(533)	(620)	(743)	(858)
Dep. Var. Mean	3208	5364	7405	9472
Observations	27,252,549	26,858,940	26,558,765	26,282,176
	Panel C: Positive Initial Mortgage Balance			
Credit Availability	16973	31038	35237	35188
	(2762)	(3834)	(4364)	(4730)
Lagged Availability	16506	24956	28714	26019
	(3052)	(4510)	(5311)	(5959)
Dep. Var. Mean	-18478	-34057	-46415	-56173
Observations	4,785,097	4,753,475	4,734,128	4,719,845

NOTE.—Linear regression estimates of effect of credit availability on the change in an individual's mortgage balance, over various horizons. Standard errors clustered at quarter-riskscore level in parentheses. Models are estimated separately on the whole sample (panel A) and on samples split by whether the individual has a positive mortgage balance at t=-1 (panels B and C). All models include predicted probablities of having a score over 620 and 640, lagged predicted probability of having a score over 620 and 640, quarter fixed effects, quarter fixed effects interacted with linear riskscore term, and quarter fixed effects interacted with lagged linear riskscore term.

TABLE A.2
EFFECTS ON CHANGE IN INFERRED MORTGAGE INTEREST RATE

	(1)	(2)	(3)	(4)
Horizon in Quarters:	4	8	12	16
	Panel C: Positive Initial Mortgage Balance			
Credit Availability	-0.078	-0.110	-0.110	-0.120
	(0.009)	(0.016)	(0.021)	(0.026)
Lagged Availability	0.066	0.091	0.130	0.059
	(0.010)	(0.016)	(0.022)	(0.027)
Dep. Var. Mean	-0.078	-0.220	-0.390	-0.580
Observations	4,105,807	3,802,600	3,552,429	3,346,508

NOTE.—Linear regression estimates of effect of credit availability on the change in an individual's inferred mortgage interest rate, over various horizons. The inferred mortgage interest rate is calculated as the national average fixed-rate mortgage rate in the year the individual's largest current mortgage was originated. Standard errors clustered at quarter-riskscore level in parentheses. Models are estimated only on the population with a positive mortgage balance at t=-1. All models include predicted probablities of having a score over 620 and 640, lagged predicted probability of having a score over 620 and 640, quarter fixed effects, quarter fixed effects interacted with linear riskscore term, and quarter fixed effects interacted with lagged linear riskscore term.

TABLE A.3

ROBUSTNESS CHECKS: EFFECTS ON CONTEMPORANEOUS QUARTER PROBABILITY OF TAKING OUT A MORTGAGE, PART 1

Specification:	(1) Baseline	(2) Alt. Clust.	(3) Age Controls	(4) Extra Controls	(5) More Lags	(6) No Lags
Credit Availability	0.010	0.010	0.010	0.010	0.009	0.010
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
1Q Lagged Availability	0.001	0.001	0.001	0.001	0.001	
	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)	
Dep. Var. Mean	0.009	0.009	0.009	0.009	0.009	0.009
Observations	32,523,707	32,523,707	32,523,707	29,895,045	28,888,334	32,523,707

NOTE.—Robustness checks for the logit estimate of the effect of credit availability on the probability of taking out a first mortgage in the contemporaneous quarter. Average marginal effects, with standard errors clustered at quarter-riskscore level in parentheses (except for column 2). Except as specified, all models include predicted probablities of having a score over 620 and 640, lagged predicted probability of having a score over 620 and 640, quarter fixed effects, quarter fixed effects interacted with linear riskscore term, and quarter fixed effects interacted with lagged linear riskscore term. Column 1 ("Baseline") is the estimate from Panel A of column 5 of table 1. Column 2 ("Alt. Clust.") shows the same point estimates but standard errors clustered by time and riskscore separately. Column 3 ("Age Controls") includes linear and quadratic age terms interacted with quarter. Column 4 ("Extra Controls") includes the 8- and 20-quarter growth rates of MSA employment, the 8- and 20-quarter growth rates of median MSA home prices, tract median household income, tract fraction of black residents, and tract fraction of Hispanic residents. Column 5 ("More Lags") includes the second through fourth lags of credit availability, the second through fourth lags of probabability of having a score over 620 and 640, as well as the second through fourth lags of the riskscore interacted with quarter. Column 6 ("No Lags") includes no lags.

TABLE A.4

ROBUSTNESS CHECKS: EFFECTS ON CONTEMPORANEOUS QUARTER PROBABILITY OF TAKING OUT A MORTGAGE, PART 2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	With Time-Varying Linear Score			Without Time-Varying Linear Score			
Score Range:	530-730	500-830	580-680	530-730	500-830	580-680	605-655
Credit Availability	0.010	0.008	0.004	0.017	0.050	0.013	0.013
	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.002)
1Q Lagged Availability	0.001	0.006	-0.001	0.006	0.002	0.003	0.002
	(0.001)	(0.001)	(0.004)	(0.000)	(0.001)	(0.001)	(0.002)
Dep. Var. Mean	0.009	0.015	0.008	0.009	0.015	0.008	0.008
Observations	32,523,707	72,854,430	15,108,690	32,523,707	72,854,430	15,108,690	6,336,600

NOTE.—Robustness checks for the logit estimate of the effect of credit availability on the probability of taking out a first mortgage in the contemporaneous quarter. Average marginal effects, with standard errors clustered at quarter-riskscore level in parentheses. All models include predicted probablities of having a score over 620 and 640, lagged predicted probability of having a score over 620 and 640, and quarter fixed effects. Column 1 is the baseline estimate from Panel A of column 5 of table 1. Columns 1-3 include quarter fixed effects interacted with linear riskscore term and lagged linear risk score term. Columns 4-7 include linear riskscore term and lagged linear risk score term (without time interactions). Otherwise, columns differ only by the included score range, as labeled.

TABLE A.5

ROBUSTNESS CHECKS: EFFECTS ON 0-15 QUARTER PROBABILITY OF TAKING OUT A MORTGAGE, PART 1

Specification:	(1) Baseline	(2) Alt. Clust.	(3) Age Controls	(4) Extra Controls	(5) More Lags	(6) No Lags
Credit Availability	0.028	0.028	0.030	0.027	0.029	0.031
	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)	(0.005)
1Q Lagged Availability	0.006	0.006	0.012	0.006	-0.011	
	(0.009)	(0.007)	(0.008)	(0.008)	(0.008)	
Dep. Var. Mean	0.131	0.131	0.131	0.132	0.133	0.131
Observations	30,393,949	30,393,949	30,393,949	28,007,114	27,138,172	30,393,949

NOTE.—Robustness checks for the logit estimate of the effect of credit availability on the cumulative probability of taking out a first mortgage within the contemporaneous and 15 subsequent quarters. Average marginal effects, with standard errors clustered at quarter-riskscore level in parentheses (except for column 2). Except as specified, all models include predicted probablities of having a score over 620 and 640, lagged predicted probability of having a score over 620 and 640, quarter fixed effects, quarter fixed effects interacted with linear riskscore term, and quarter fixed effects interacted with lagged linear riskscore term. Column 1 ("Baseline") is the estimate from Panel A of column 5 of table 1. Column 2 ("Alt. Clust.") shows the same point estimates but standard errors clustered by time and riskscore separately. Column 3 ("Age Controls") includes linear and quadratic age terms interacted with quarter. Column 4 ("Extra Controls") includes the 8- and 20-quarter growth rates of MSA employment, the 8- and 20-quarter growth rates of median MSA home prices, tract median household income, tract fraction of black residents, and tract fraction of Hispanic residents. Column 5 ("More Lags") includes the second through fourth lags of credit availability, the second through fourth lags of probabability of having a score over 620 and 640, as well as the second through fourth lags of the riskscore interacted with quarter. Column 6 ("No Lags") includes no lags.

TABLE A.6

ROBUSTNESS CHECKS: EFFECTS ON 0-15 QUARTER PROBABILITY OF TAKING OUT A MORTGAGE, PART 2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	With Time-Varying Linear Score			Without Time-Varying Linear Score			
Score Range:	530-730	500-830	580-680	530-730	500-830	580-680	605-655
Credit Availability	0.028	0.052	0.018	0.037	0.075	0.034	0.069
	(0.007)	(0.011)	(0.020)	(0.003)	(0.007)	(0.004)	(0.010)
1Q Lagged Availability	0.006	0.026	-0.027	0.025	0.016	0.017	-0.001
	(0.009)	(0.011)	(0.031)	(0.003)	(0.006)	(0.005)	(0.016)
Dep. Var. Mean	0.131	0.196	0.117	0.131	0.196	0.117	0.113
Observations	30,393,949	68,823,342	14,093,644	30,393,949	68,823,342	14,093,644	5,914,185

NOTE.—Robustness checks for the logit estimate of the effect of credit availability on the cumulative probability of taking out a first mortgage within the contemporaneous and 15 subsequent quarters. Average marginal effects, with standard errors clustered at quarter-riskscore level in parentheses. All models include predicted probablities of having a score over 620 and 640, lagged predicted probability of having a score over 620 and 640, and quarter fixed effects. Column 1 is the baseline estimate from Panel A of column 5 of table 1. Columns 1-3 include quarter fixed effects interacted with linear riskscore term and lagged linear risk score term. Columns 4-7 include linear riskscore term and lagged linear risk score term (without time interactions). Otherwise, columns differ only by the included score range, as labeled.

TABLE A.7
EFFECTS ON TOTAL NUMBER OF NEW JOINT FIRST MORTGAGES

Horizon in Quarters:	(1) 0	(2) 0-3	(3) 0-7	(4) 0-11	(5) 0-15
	Panel A: Entire Sample				
Credit Availability	0.006	0.020	0.028	0.030	0.027
	(0.001)	(0.002)	(0.003)	(0.005)	(0.006)
Lagged Availability	0.002	0.004	0.007	0.005	0.006
	(0.001)	(0.002)	(0.004)	(0.006)	(0.008)
Dep. Var. Mean	0.006	0.023	0.046	0.071	0.097
Observations	32,521,878	31,978,664	31,397,303	30,895,003	30,392,255
	Panel B: No Initial Mortgage Balance				
Credit Availability	0.006	0.017	0.025	0.030	0.033
	(0.001)	(0.002)	(0.003)	(0.004)	(0.004)
Lagged Availability	0.000	0.003	0.006	0.006	0.005
	(0.001)	(0.002)	(0.003)	(0.004)	(0.005)
Dep. Var. Mean	0.004	0.014	0.028	0.043	0.060
Observations	27,692,800	27,203,296	26,676,170	26,217,051	25,754,177
	Panel C: Positive Initial Mortgage Balance				
Credit Availability	0.016	0.078	0.120	0.130	0.120
	(0.004)	(0.008)	(0.012)	(0.015)	(0.017)
Lagged Availability	0.018	0.045	0.067	0.069	0.086
	(0.004)	(0.008)	(0.011)	(0.014)	(0.017)
Dep. Var. Mean	0.019	0.074	0.150	0.230	0.300
Observations	4,829,078	4,775,368	4,721,133	4,677,952	4,638,078

NOTE.—Negative binomial estimates of effect of credit availability on the number of new joint first mortgages taken out, over various horizons. Average marginal effects, with standard errors clustered at quarter-risk score level in parentheses. Models are estimated separately on the whole sample (panel A) and on samples split by whether the individual has a positive mortgage balance at t=-1 (panels B and C). All models include predicted probablities of having a score over 620 and 640, lagged predicted probability of having a score over 620 and 640, quarter fixed effects, quarter fixed effects interacted with linear risk score term, and quarter fixed effects interacted with lagged linear risk score term.

TABLE A.8
EFFECTS ON TOTAL NUMBER OF NEW INDIVIDUAL FIRST MORTGAGES

Horizon in Quarters:	(1) 0	(2) 0-3	(3) 0-7	(4) 0-11	(5) 0-15
	Panel A: Entire Sample				
Credit Availability	0.005	0.014	0.019	0.020	0.019
	(0.001)	(0.002)	(0.003)	(0.004)	(0.005)
Lagged Availability	0.000	0.003	0.008	0.012	0.015
	(0.001)	(0.002)	(0.003)	(0.004)	(0.006)
Dep. Var. Mean	0.004	0.015	0.030	0.045	0.062
Observations	32,521,878	31,978,664	31,397,303	30,895,003	30,392,255
	Panel B: No Initial Mortgage Balance				
Credit Availability	0.005	0.013	0.017	0.018	0.017
	(0.001)	(0.002)	(0.003)	(0.004)	(0.005)
Lagged Availability	0.000	0.002	0.006	0.010	0.012
	(0.001)	(0.002)	(0.004)	(0.005)	(0.007)
Dep. Var. Mean	0.004	0.015	0.031	0.047	0.065
Observations	27,692,800	27,203,296	26,676,170	26,217,051	25,754,177
	Panel C: Positive Initial Mortgage Balance				
Credit Availability	0.006	0.016	0.025	0.020	0.019
	(0.002)	(0.003)	(0.004)	(0.006)	(0.007)
Lagged Availability	0.001	0.011	0.016	0.019	0.025
	(0.001)	(0.003)	(0.004)	(0.006)	(0.007)
Dep. Var. Mean	0.003	0.011	0.022	0.035	0.049
Observations	4,829,078	4,775,368	4,721,133	4,677,952	4,638,078

NOTE.—Negative binomial estimates of effect of credit availability on the number of new individual (i.e., non-joint) first mortgages taken out, over various horizons. Average marginal effects, with standard errors clustered at quarter-risk score level in parentheses. Models are estimated separately on the whole sample (panel A) and on samples split by whether the individual has a positive mortgage balance at t=-1 (panels B and C). All models include predicted probablities of having a score over 620 and 640, lagged predicted probability of having a score over 620 and 640, quarter fixed effects, quarter fixed effects interacted with linear risk score term, and quarter fixed effects interacted with lagged linear risk score term.