

Failure to Refinance[†]

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Abstract

Households that fail to refinance their mortgage when interest rates decline can lose out on substantial savings. Based on a large random sample of outstanding U.S. mortgages in December of 2010, we estimate that approximately 20% of households for whom refinancing was optimal and who appeared unconstrained to do so had not taken advantage of the lower rates. We estimate the present-discounted cost to the median household who failed to refinance to be approximately \$11,500, making this a particularly large consumer financial mistake. To shed light on possible mechanisms and corroborate our main findings, we also provide results from a mail campaign targeted at a sample of homeowners that could benefit from refinancing.

Keywords: Refinancing; Mortgage Market; Household Finance, Behavioral Economics

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1. Introduction

Buying and financing a house is one of the most important financial decisions a household makes. Housing decisions can have substantial long-term consequences for household wealth accumulation in the U.S., where housing wealth makes up almost two thirds of the median household's total wealth (Iacoviello 2011). Given the importance of housing wealth, public policies have been crafted to encourage home ownership and help households finance and refinance home mortgages. However, the effectiveness of these policies hinges on the ability of households to make wise housing decisions.

One housing decision in particular that can have large financial implications is the choice to refinance a home mortgage. Households that fail to refinance when interest rates decline can lose out on tens of thousands of dollars in savings. For example, a household with a 30-year fixed-rate mortgage of \$200,000 at an interest rate of 6.0% who refinances when rates fall to 4.5% (approximately the average rate decrease between 2008 and 2010 in the U.S.) will save over \$60,000 in interest payments over the life of the loan, even after accounting for refinance transaction costs. Further, when mortgage rates reached all-time lows in late 2012, with rates of roughly 3.35% prevailing for three straight months (Freddie Mac PMMS), this household with a contract rate of 6.5% would save roughly \$130,000 over the life of the loan by refinancing.

Despite the large stakes, anecdotal evidence suggests that many households may fail to refinance when they otherwise should. Failing to refinance is puzzling due to the large financial incentives involved. However, certain features of the refinance decision make failing to refinance consistent with recent work in behavioral economics. For example, calculating the financial benefit to refinancing is complex and households have very limited experience with transactions of this type. Furthermore, the benefits of refinancing are not immediate, but rather accrue over time. Finally, there are a number of up-front costs, both financial and non-financial, that households must pay in order to complete a refinance, including a re-evaluation of their financial position and the value of their home. All of these features provide a psychological basis in

addition to the opportunity cost of time for why some households may fail to take up large savings.

In this paper, we provide empirical evidence regarding how many households in the U.S. appear to be suffering from a failure to refinance and approximate the magnitude of their mistakes. Our analysis utilizes a unique, nationally-representative sample of approximately one million single-family residential mortgages that were active in December 2010. These data include information about the origination characteristics of each loan, the current balance, second liens, the payment history, and the interest rate being paid. Given these data, we can calculate how many households would save money over the life of the loan if they were to refinance their mortgages at the prevailing interest rate.

Of course, there are many reasons why a household may very sensibly not refinance their house, even when it appears they could save money by doing so. Perhaps the most obvious reason – and one that is especially important after the recent housing bust – is that they are unable to qualify for a new loan due to bad credit or because of decreasing housing values (leading to high loan-to-value ratios). Another example of a reason why a household may choose not to refinance is if they plan to move in the near future. For these reasons, it would be naïve to argue that any household who appears as if they could save money by refinancing is acting sub-optimally when they fail to do so.

The dataset that we use contains information that allows us to reasonably identify homeowners who may be unable to refinance from those who sub-optimally fail to do so. For example, we can restrict the sample to homeowners who have not missed any previous loan payments and whose current combined loan-to-value (CLTV) ratio is below a certain threshold (including information on second liens). Additionally, we can take into account reasonable assumptions about the probability of moving and the present-discounted, tax-adjusted benefits of refinancing relative to up-front costs.

Based on a conservative set of assumptions, we estimate that approximately 20% of households in December 2010 had not refinanced their mortgage when it appeared profitable to do so given the interest rate environment at the time. We calculate that the median household that is holding on to a mortgage with too high an interest rate would have saved approximately \$160 per month, or \$45,000 (unadjusted) over the remaining life of the loan by refinancing, or approximately \$11,500 when adjusting for the probability of moving, tax incentives, up-front costs, and discounting over time. In addition, our data allow us to see whether these loans continue to be active in December 2012 when interest rates reached historic lows. We find that approximately 40% of the households that we identified as those who could have benefited from refinancing in December 2010 had not moved from their homes and still had not refinanced their mortgage – despite interest rates dropping even further between 2010 and 2012.

To be clear, refinancing behavior requires a lender willing to take on the risk of a new mortgage. Over the period 2010-2012, lenders were especially reluctant to lend to borrowers whose credit, income, or home values deteriorated substantially following the financial crisis. Although we use updated CLTV measures at the time of refinancing and restrict the sample to households who never missed a housing payment, we do not observe updated credit scores or income for mortgage-holding households in our data. We provide a series of heterogeneity analyses to explore whether factors such as becoming unemployed may be a primary driver of the failure to refinance that we document.

As a complement to our results using a nationally-representative sample, we also analyze microdata from a nonprofit lender in one major city. In an attempt to help households refinance, this nonprofit lender participated in several waves of mail offers to their clients that would allow them to refinance. By working directly with the lender, we were able to identify in the data which households were eligible (preapproved) to refinance. Consistent with the results from the nationally-representative data, we find that a large fraction of the households who received an offer to refinance did not take up this offer despite large savings, no out-of-pocket costs, and

being eligible to do so with certainty. We estimate factors that correlate with failure to take up and provide survey evidence from households who chose not to refinance in order to better understand the behavioral mechanisms at play.

Overall, these results suggest that the size and scope of the problem of failing to refinance is large. While much of the savings a household can receive by refinancing represents a transfer of wealth from investors to households (as opposed to a welfare loss), the foregone savings is clearly significant for each individual household. Failing to refinance may also have important macroeconomic implications for which policy options are available. We find that during the aftermath of the Great Recession, the Federal Reserve's efforts to reduce households' debt servicing costs by lowering interest rates were constrained by the extent to which homeowners failed to take advantage of their option to refinance. In the conclusion section, we discuss reasons why failing to refinance might be important from a total-welfare perspective and policies such as automatically-refinancing mortgages that may combat this failure.

Our paper contributes to a growing body of literature that documents important financial household mistakes, including mistakes associated with savings and investments (Madrian and Shea 2001; Thaler and Bernartzi 2004; Choi, Madrian, and Laibson 2011), failure to smooth consumption (Stephens Jr. 2003; Shapiro 2005), failure to accurately respond to taxation (Chetty, Looney, and Kroft 2009; Finkelstein 2009), mistakes associated with the purchase of durable goods (Conlin, O'Donoghue, and Vogelsang 2007; Busse et al. forthcoming), and mistakes with credit cards and payday lending (Argarwal et al. 2008; Bertrand and Morse 2011; Agarwal, Chomsisengphet, Liu, and Souleles 2014). DellaVigna (2009) provides a thorough review of the empirical literature at the intersection of psychology and economics. Relative to the settings explored in this literature, the financial magnitude of failing to refinance is especially large.

Prior research in real estate and finance has documented the existence of a subset of households who fail to refinance despite the benefits from refinancing being large. The most closely related papers are those by Green and LaCour-Little (1999), Campbell (2006), Schwartz

(2006), and Deng and Quigley (2013). Each of these papers provides varying degrees of evidence on anomalous behavior on the part of homeowners with regards to optimal refinancing decisions during earlier time periods. Key contributions of our paper relative to these include the representativeness, accuracy, and immediacy of our loan-level data to better estimate the current magnitude of the failure to refinance in the U.S. and, importantly, our ability to restrict our focus to households whose payment histories and loan-to-value ratios (across all liens) are such that we can reasonably assume their ability to refinance. Our paper is also related to other evidence in the real estate market demonstrating that a lack of financial savvy may be costly to homeowners (see Bucks and Pence 2008). For example, Woodward and Hall (2012) argue that borrowers on average lose out on \$1,000 for failing to effectively shop for mortgage brokers and that the loss is heterogeneous across consumer types.

Our work builds on two recent papers that explore households' refinancing choices. Agarwal, Rosen, and Yao (2012) empirically investigate the time-varying option value of refinancing and find that over half of borrowers who refinance do so at a sub-optimal time, though more experienced refinancers make smaller mistakes. Agarwal, Driscoll, and Laibson (2013) provide the first optimal closed-form solution to the household's refinancing problem under a plausible set of parameters. In our paper we use this closed-form solution to calculate the fraction of households who suboptimally fail to refinance in our data, but whereas Agarwal, Rosen, and Yao (2012) examine the optimal timing for those who choose to refinance, we focus solely on the failure to refinance.

Finally, our paper is also related to the literature that provides evidence of less than 100% take-up of social services (for a review, see Currie 2004). These papers – such as recent work on EITC take-up by Bhargava and Manoli (2013) – provide evidence that individual biases (inattention, status quo bias, self-control issues, etc.) can play an important role in the failure to take-up, along with lack of information, complexity, and potential stigma. Since there is not generally a stigma associated with refinancing a mortgage, our results complement the evidence

in this literature on the importance of individual biases and lack of simple information as factors that can lead to surprisingly low take-up rates.

The paper proceeds as follows. In section 2 we provide background on the mortgage market and refinancing in the United States. In section 3 we describe the unique loan-level dataset we use and document the size and magnitude of the failure to refinance in the U.S. during the recent decline in interest rates. In section 4 we analyze the efforts of a nonprofit to help their clients refinance. Finally, we provide a discussion of policy implications and conclude in section 5.

2. Background on Mortgage Markets and Refinancing

There are two primary mortgage loan instruments that are used in the U.S.: an adjustable-rate mortgage (ARM) and a fixed-rate mortgage (FRM). A standard ARM has a floating nominal interest rate that is indexed to the general level of short-term interest rates. A standard FRM has a fixed interest rate over the life of the mortgage loan and thus eliminates any uncertainty about the required stream of payments even if interest rates increase substantially. If, however, interest rates move significantly downward, a household in the U.S. with a FRM may benefit by refinancing: paying off the old mortgage (known as a prepayment) and taking out a new fixed-rate loan at the lower prevailing rate.

According to Campbell (2013), approximately 90% of the mortgages in the U.S. are 30-year nominal FRMs, with the remainder of mortgages either ARMs or shorter-duration FRMs. This dominance of 30-year FRMs in the U.S. is quite different than most other countries in the world and is likely an artifact of a relatively stable inflation history and a variety of public policies that promote this mortgage design (Green and Wachter, 2005). More importantly in the context of our paper, since most borrowers have FRMs, there are serious consequences for homeowners if they fail to take advantage of refinancing options when interest rates decline.

The decision to refinance is typically complicated and involves a large number of factors. These factors include the up-front costs associated with refinancing, the probability of moving within a short period of time, a discount factor on future savings, expectations about future interest rate changes, current mortgage balance, risk preferences, and current and future marginal tax rates.

Agarwal, Driscoll, and Laibson (2013) recently derived a closed-form optimal refinancing rule based on the difference between a household's contract rate and the current mortgage interest rate. Their solution requires the consideration of a large number of parameter values (a marginal tax rate, discount factor, probability of moving, etc.), as well as other more general assumptions (e.g. they assume that the nominal mortgage interest rate follows a continuous-time random walk). For a reasonable set of parameter values, they find that interest rates must fall by 100 to 200 basis points to make refinancing optimal. The optimal rate is particularly sensitive to up-front points and closing costs for the mortgage, as these costs are immediate and not discounted like the longer-term benefits of refinancing. When these costs fall, the refinancing threshold rate rises sharply, with \$1,000 in up-front costs associated with roughly 25 basis points movement in the threshold. As discussed below, we apply this closed-form optimal solution, using a conservative set of parameter values, to a sample of recent mortgage loans active during a period of historically low interest rates.

3. Size and Magnitude of the Failure to Refinance

3.1 Description of Loan-Level Dataset

Our analysis is based on approximately one million observations of a nationally-representative sample of mortgage loans that were active in December 2010. The data comes from CoreLogic Solutions (henceforth "CoreLogic"), and is provided through a CoreLogic

Academic Research Council (CLARC) data grant.¹ Mortgage-level data is provided by most of the top 20 mortgage servicers in the nation, and the sample is drawn from mortgage records covering both the agency and non-agency segments of the mortgage market. In total, the CoreLogic database covers roughly 85% of the mortgage market.

To make our calculations of the financial benefit of refinancing as consistent across mortgage-holders as possible, the sample provided to us was randomly drawn from the overall sample of fixed-rate mortgages of single-family, owner-occupied homes that are not overseen by the FHA/VA program, are not manufactured or mobile homes, and are not in foreclosure proceedings as of December 2010. The sample was also restricted to loans with an outstanding balance of at least \$75,000 as of December 2010.

The data contain information about each mortgage including date of origination, credit score of borrower at origination, loan-to-value ratio at origination, unpaid balance (in December 2010), interest rate, time remaining on the loan, the zip code of the house location, and a full payment history (late payments, missed payments, etc.). In addition to these variables, we also have access to any additional mortgage liens for which the household is responsible. We also merge 2010 Census information that includes zip-code level variables such as median average income and education levels. Local unemployment rates at the county level are from BLS. We also merge zip-code level housing price data from Zillow. Using the loan-to-value ratio for each mortgage at origination and the date of origination, we are able to compute the loan-to-value ratio for each mortgage (including all mortgage liens) at subsequent dates.²

¹ More information on accessing the data can be found on the CLARC website at <http://www.corelogic.com/about-us/research-trends/academic-research-council.aspx>.

² Due to the Zillow coverage, we are unable to compute December 2010 loan-to-value ratios for approximately 15% of the sample. Also, we have Zillow housing price data starting in 1997. For homes that had an origination date prior to 1997 (0.4% of our total sample), the loan-to-value ratios that we compute do not take into consideration any price movements that occurred prior to 1997. Since house prices were generally increasing through the 1990s, this is likely to result in loan-to-value ratios that are biased upward for these households. For robustness, we have also applied the CoreLogic proprietary valuation model to calculate updated LTV and CLTV values, and the results are similar (and available upon request).

The CoreLogic data are unique for the amount of detail that is available for each mortgage. Although these data are likely the best available large-scale data source on refinancing, a number of limitations remain. First, we do not observe refinancing directly in the CoreLogic data, only the prepayment of a mortgage, which could be due to either refinancing or moving to a new home. Second, although we observe measures of borrower creditworthiness at the time the loan was originated, this information is not updated in the panel data. We do, however, have the full payment history for each loan. Lastly, we do not have any direct information regarding how long homeowners intend to remain in their home.³

Table 1 provides summary statistics for our sample. The first column in Table 1 indicates that a typical active loan in December of 2010 was paying an interest rate of 5.52%, had 23 years remaining and an unpaid balance of just over \$200,000. The average loan-to-value ratio at origination was approximately 70% and in 2010 was 74%. The small increase in LTV is due to the fact that many loans were originated early in the housing boom and experienced only a small relative decline in value on net in the boom and bust. The additional columns in Table 1 provide the same summary statistics when we restrict our sample to loans with certain characteristics that we discuss in detail below.

Of particular importance for our research is the distribution of interest rates being paid across homeowners. Panel A of Figure 1 illustrates the distribution of interest rates for our full sample. While the average interest rate being paid is 5.52%, there is substantial variation with many households paying interest rates near the market rate in December 2010 (~4.3%) and other households paying interest rates well over 6%. The second panel in Figure 1 shows the distribution of interest rates being paid by households when we restrict the sample to households that appear as if they should be eligible to refinance (more discussion of these restrictions below). As expected, the distribution of interest rates for this latter sample is narrower, but there

³ An additional limitation is lack of information on the presence, duration, or size of prepayment penalties. These are unlikely to be an issue in 2010, as nearly all fixed-rate agency loans (Fannie Mae, Freddie Mac, and the FHA) do not carry prepayment penalties, while non-agency prepayment penalty periods (traditionally two or three years) had likely expired by this time.

remains substantial heterogeneity in mortgage rates, with many homeowners continuing to make mortgage payments on rates well above the market rate of 4.3%, indicated by the solid black line.

3.2 Estimating the scope of the failure to refinance

Using our loan-level dataset, Table 2 provides the main results regarding the failure to refinance. The first row results are based on the full sample, and thus the naïve assumption that all households could refinance in December 2010 at the prevailing rate of 4.3% if they chose to do so. For this full sample of mortgages, we first estimate the share of households that would experience positive savings if they were to refinance in December of 2010. The savings from refinancing are calculated by taking the difference between the total interest payments on the remaining term of the mortgage at the contract rate and the total interest payments on the remaining term at a counterfactual refinanced interest rate.⁴ These savings are then reduced by the upfront costs that are typically associated with refinancing a home (1% in points and \$2,000, see Agarwal, Driscoll, and Laibson 2013). Using this measure of savings, we estimate that 91.4% of households in our full sample could save money over the life of the loan by refinancing.

This simple measure of savings, however, does not include several obviously important factors. For example, it does not take into consideration the tax incentives associated with paying mortgage interest rates, the probability of moving, and the discounting of money over time. Thus, the 91.4% estimate is likely to dramatically overstate the percentage of households who would actually benefit from refinancing.

In order to obtain a more accurate measure of how many people should refinance (still assuming at this point that everyone is eligible to do so), we apply the optimal refinancing

⁴Using data from Freddie Mac PMMS series, the average interest rate for a 30-year, fixed-rate mortgage in November 2010 (immediately prior to our sample window) was 4.3%, so we use 4.3% as the baseline prevailing interest rate.

formula found in Agarwal, Driscoll, and Laibson (2013) to our nationally representative mortgage data. We also use the parameter values that they suggest in their baseline illustrative calibration. These parameter values include a discount rate of 5% per year, a 28% marginal tax rate, and a probability of moving each year of 10%. We consider these parameter values to be quite conservative, in that they suggest that people should only refinance when it is unambiguously in their best interest to do so. With these parameter values, we use Agarwal, Driscoll, and Laibson's "square-root rule" and compute the change in interest rates required for a household to optimally decide to refinance their house.⁵ Based on this calculation, we report in the third column of Table 2 that 41.2% of households in our full sample were in a position where they should optimally refinance.

Table 2 also gives a sense of the magnitude of the foregone savings. Conditional on refinancing being optimal for a household, we estimate that the median household would benefit from refinancing by \$184 per month, or approximately \$54,313 of unadjusted savings over the life of the loan. Using the same parameter values above (discount rate of 5% per year, 28% marginal tax rate, and a 10% probability of moving each year), we calculate the median present-discounted value of refinancing once all considerations have been made to be approximately \$13,000.

The main factor that the calculation in the first row of Table 2 neglects is that many households in December 2010 may have wanted to refinance, but were unable to do so because of credit problems or because their loan-to-value ratio was too high. The subsequent rows in Table 2 impose increasingly restrictive requirements on mortgages in our sample in an attempt to limit the sample to households who likely would have been eligible in December 2010 to refinance their house had they chosen to do so. While these sample restrictions are not perfect, they allow us to better estimate how many households are actually failing to refinance due to

⁵ The square root rule is straightforward to calculate on any calculator, and is a second-order Taylor series approximation to the authors' closed-form exact solution, which requires the use of Lambert's W-function. For details, see Agarwal, et al. (2013), page 601.

non-optimal decision making as opposed to institutional features that cause them to be ineligible.⁶

The second row in Table 2 restricts the sample to households with good credit scores at the time of origination (FICO > 680) and whose initial loan-to-value ratio was less than 90%.⁷ Imposing this sample restriction slightly reduces the percentage of households who we estimate would see positive savings over the life of the loan from 91.4% to 89.0%, and the percentage of people who should optimally refinance according to the Agarwal, Driscoll, and Laibson (2013) formula declines from 41.2% to 31.1%. The reduction in the percentage of people who should optimally refinance that we observe when we restrict the sample to more creditworthy households with lower loan-to-value ratios could be a result of selecting households who were more likely to be eligible to refinance (and thus more of them do so) or a result of selecting on the types of households who are savvier and more likely to refinance when rates go down. We are unable to distinguish between these two explanations for the percentage decline that we observe and assume it is likely to be a combination of both factors.

While having good credit and a low loan-to-value ratio at origination helps us to restrict the sample to households who are more likely to be eligible to refinance in December 2010, many households may have had good initial credit, but then saw their credit score drop below usual mortgage underwriting standards during the recession. To help eliminate households whose credit rating declined after securing their initial loan, we further restrict the sample to households who have not missed a mortgage payment or even had one late payment (one of the clear signs of credit trouble). This sample restriction has only a small effect on the percentage of people who should have optimally refinanced (now down to 27.5%).

⁶ Our sample restrictions may be imperfect in several different ways. For example, having good initial FICO scores and never missing a payment does not mean with certainty that the household has a high enough credit score to qualify for a refinance. Thus, this restriction may not be restrictive enough. At the same time, it may be too restrictive; a household that had good initial FICO scores and simply was late on one house payment may have a credit score that is high enough to refinance even though we categorize them as ineligible.

⁷ These restrictions are intended to capture the stringent underwriting standards that prevailed in the aftermath of the housing crisis relative to the housing boom period. Sensitivity of our results to different sample restrictions are available upon request.

Along with the possibility that households saw their credit scores decline after securing a loan, a household's loan-to-value ratio may have increased due to declining home prices between origination and December 2010. We, therefore limit the sample to households whose *current* LTV is less than 90% based on our zip-code adjusted LTV ratios described in the data section. This restriction reduces the sample by approximately 25% and is driven by the elimination of mortgages for homes that experienced a large amount of depreciation during the Great Recession. The percentage of people who should optimally refinance in this more restricted sample is 23.4%.

One reason why some households are unable to refinance is the existence of second liens that were taken out on the home. Our final sample restriction focuses on households whose current loan-to-value ratio on their *cumulative* loans (CLTV) for the house is less than 90%. In total, the sample restrictions that we impose in an attempt to focus on homeowners who are likely eligible for a refinance reduces our sample from roughly 995,000 to 376,000 households.⁸ After imposing these restrictions, our final estimate is that approximately 20% of households in December of 2010 had not refinanced their mortgage when it appears to have been both optimal and feasible to do so.

The average unadjusted savings available to the median household in this 20% of households was \$160 per month, or \$45,473 over the remaining life of the loan. When adjusting this using the parameter values discussed above, we find that the median present-discounted value of forgone savings was equal to approximately \$11,500. However, this estimate masks a large degree of heterogeneity in the amount of potential savings. Figure 2 provides a simple histogram of the unadjusted savings for the 20% of households who we argue were failing to refinance, revealing that 25% of households would save more than \$68,000 in unadjusted reduced mortgage interest payments over the life of the loan, and 11% of households would save more than \$100,000.

⁸ These creditworthy households are also least likely to face loan-level risk-based pricing adjustments, and thus the prevailing PMMS rate may be most reflective of their likely price of mortgage credit.

If interest rates had increased sharply starting in December 2010, our estimates suggest that approximately 20% of households would have lost their chance to refinance even though it would have been optimal for them to do so. Interest rates, however, continued to decline through the end of 2012 and reached record lows of 3.35% for 30-year fixed-rate mortgages. This continued interest rate drop provided an opportunity for the 20% of households we estimate as failing to refinance in December 2010 to finally decide to refinance and to realize even greater savings because of the ever lower rates.

We obtained from CoreLogic an update for all loans in our December 2010 sample. Specifically, we know what fraction of these loans prepaid at some point between December 2010 and December 2012. Given that the even greater savings (due to historically low rates) and additional time, many of the 20% of households that had failed to refinance by December 2010 prepaid their mortgage in the subsequent two-year period.⁹ However, 40% of the households who we estimate should have refinanced in December 2010 were still living in their house by December 2012, continued to make full and on-time monthly payments, yet had not refinanced their mortgage despite the further decline in interest rates.

3.3 Heterogeneity analysis

An important assumption that we make in this study is that we can reasonably identify households who would qualify for refinancing. This is a difficult task given that we are studying a period of financial contraction and tightening underwriting standards among lenders. As noted above, by focusing on households with certain FICO scores at origination, certain CLTV ratios, and households who never missed a payment, we are able to reasonably restrict the sample to people who would likely qualify for a refinance. However, exploring differences in the failure to refinance within this already-restricted sample can shed further light on which households are failing to refinance and provide possible explanations for this failure.

⁹ Again, our measure is a mortgage prepayment, so we cannot distinguish between refinances and moves.

We do not have microdata on households' employment status either at origination or at later dates, however, we can explore this dimension by stratifying our results based on county-level unemployment rates. The first set of results in Table 3 uses the 376,036 loans from our most restricted sample (homeowners with FICO > 680, current CLTV < 90, and never missed a payment) and breaks down the failure to refinance of these individuals into quartiles based on county-level unemployment rates in 2010. Comparing the top and bottom quartiles of counties in the unemployment distribution, we find similar proportions of households who failed to refinance. Specifically, among homeowners living in the quartile of counties with the lowest unemployment rates in 2010 (less than 7.7%), 19% should have optimally refinanced but did not do so. Similarly, for homeowners in the top unemployment rate quartile (greater than 10.9% in 2010), 20.2% should have optimally refinanced but did not do so. The lack of a steep gradient in unemployment rates is suggestive evidence that among creditworthy households, there is consistent and widespread failure to refinance when it is optimal to do so.

The next two sets of results in Table 3 decomposes the failure to refinance by quartiles of FICO score at origination and current CLTV. Even among households in the highest FICO credit score quartile (FICO > 793) and in the lowest CLTV quartile (Current CLTV < 54%), we find non-trivial rates of failing to refinance (12.3% and 17.5% respectively). The percentage of households who are failing to refinance, however, is quite different across quartiles with the lower FICO score and higher CLTV households showing much higher rates of non-refinancing than their counterparts. The gradient in failure to refinance across these quartiles could be a result of selecting on households who were more likely to be eligible to refinance (and thus more of them do so) or a result of selecting on the types of households who are savvier and more likely to refinance when rates go down.

The fourth set of results in Table 3 stratifies the failure to refinance by quartiles of the loan amount (remaining unpaid principal balance) for each household. Given the fixed cost involved with refinancing, households with a much higher loan amount stand to gain

significantly more from refinancing than households with a smaller loan amount. Surprisingly, we find very little difference in the failure to refinance (21.2% vs. 19.1%) for households in the bottom quartile of loan amount (loan amount < \$140k) and households in the top quartile of loan amount (loan amount > \$288k).

The final two sets of results in Table 3 stratifies the failure to refinance by income and education status of homeowners. The Corelogic data does not provide information about income or education for individual loans. We therefore use zip-code level census data for both median income and percent of individual with a bachelor's degree in order to stratify the sample. We find small, but limited, evidence of differences that exist in the failure to refinance across these zip-level quartiles (possibly due to the large geographic units used to measure education and income levels). For example, 19.0% of households residing in zip codes with above median education are suboptimally not refinancing, while 20.9% of households with below median education are suboptimally not refinancing.

4. Micro-Level Evidence

By using a large, random sample of households in the previous section, we were able to provide broad representative evidence regarding the failure to refinance in the U.S. While these data were ideal for producing an estimate of the scope of the problem, a more micro-level dataset could potentially provide even cleaner evidence of individual financial mistakes with regards to refinancing and on the behavioral mechanisms at play.

To this end, we partnered with a non-profit organization called Neighborhood Housing Services of Chicago, Inc. (NHS). Founded in 1975, NHS's stated mission is to create opportunities for individuals to live in affordable homes. Their efforts are primarily concentrated in lower-income communities in Chicago to provide services including, among others, education programs for new homeowners, foreclosure prevention services, reclaiming vacant properties, and preserving and rehabilitating older homes. In addition to these various services, NHS's

nonprofit lending affiliate, Neighborhood Lending Services (NLS) acts as a mortgage lender and servicer to homeowners in the Chicago area. Because they are a non-profit organization interested in helping homeowners – including those that they lend to – NHS and NLS educate their clients on the pros and cons of refinancing, and emphasize the importance of considering long-term savings, short-term costs, and other factors. In some cases, NLS actively encourages their clients to refinance their mortgages when interest rates decrease to a level that is advantageous to their clients.

In July of 2011, NHS sent a letter to 446 households whose mortgages NLS services. The letter (see Appendix Figure 1) provided the details of an offer to refinance their current mortgage loan at a 4.7% interest rate. No money up front was required to refinance, as the appraisal fee and a loan origination fee of 1% of the loan amount could be rolled into the new loan. The letters were only sent to households who NHS had already determined were eligible to refinance their mortgages (screening included thresholds for current loan-to-value ratios and also required that the homeowners be current on their payments) and who would benefit from doing so (based on unadjusted savings calculated using the unpaid balance and interest rate). The letter encouraged homeowners to call an NLS loan officer.

The data associated with this letter campaign that took place in the summer of 2011 is ideal for the purposes of this paper. The letter campaign isolated homeowners who were eligible and would benefit financially (according to NHS) from refinancing, and allows us to measure exactly how many of them chose to take up the offer. Furthermore, these homeowners had a pre-existing relationship with NHS and NLS and had attended homeownership counseling in one of their local offices, so this refinance offer was from a trusted source in the community. Additionally, because NLS is the servicer of these loans, we are able to calculate exactly how much savings each household would have received if they refinanced at a 4.7% interest rate.

The summary statistics from the letter campaign described above (which we refer to as “Wave 1”) are presented in the top panel of Table 4. 84% (375 of the 446) of the households who

received the refinance offer did not respond to the pre-approved, no up-front-cost offer to refinance their mortgage. This is consistent with our findings in the previous section that a large portion of the population chooses not to refinance even when they are eligible to do so and substantial savings are available.¹⁰ Using the same strategy discussed in the previous section, we calculate the forgone unadjusted savings over the life of the loan for each homeowner who received a letter in Wave 1 from NLS. We estimate that the 16% of homeowners that took up NLS's first refinance offer would go on to pay \$85 less per month, or \$24,500 less in total interest payments over the life of the loan by lowering their rate.¹¹ The median household of the 84% that did not respond to the offer to refinance saw forgone savings of \$17,700 over the life of the loan by failing to respond to the refinance offer. Thus, those households who took up the offer had a slightly larger financial benefit to do so, but the difference is not statistically significant.

Because rates continued to decrease, NLS decided to send a similar letter in July of 2012 with an offer to refinance their clients' mortgages at a 3.99% interest rate (Wave 2). This letter was sent to 140 households (nearly all of whom had been non-responders in Wave 1) who continued to have loan-to-value ratios that NLS deemed low enough and whose loans were current.¹² The results from this second wave of refinance offers are presented in the second panel of Table 4. Still, over 75% of households did not respond, resulting in a take-up rate of 24.3%. The median household that took up the refinance offer had a large savings opportunity of \$100 per month reduction in mortgage outlays (\$29,900 unadjusted savings over the life of the loan),

¹⁰ The NHS sample is not intended to serve as a nationally representative sample, as they typically lend in disproportionately low-income and minority communities. However, to generalize slightly, we interpret this finding as suggesting that sending a pre-approved offer letter to the 20% of households we found in the previous section could and should refinance would result in only a small fraction responding to the mail offer.

¹¹ The savings available to NHS borrowers is smaller relative to the estimated savings for the national average household because the rate reductions were not as dramatic and mortgage balances were smaller relative to the mortgage holders in the CoreLogic data.

¹² The large reduction in the number of households receiving a letter in Wave 2 relative to Wave 1 was a direct result of declining home values (and therefore increasing loan-to-value ratios) over this time period in the relevant neighborhoods of the Chicago area.

but once again households that chose not to respond to the offer letter also saw a large (and not statistically distinguishable) forgone unadjusted savings opportunity (\$24,700).

In May of 2013, NLS once again decided to conduct a mail campaign to encourage their clients to refinance their mortgages (Wave 3). 193 households were deemed eligible and preapproved by NLS to refinance. Each of these households again received an offer to refinance their house at a 4% interest rate. During this third mail campaign, we worked with NLS to divide letter recipients into three treatment groups. Each group received a different letter with a different treatment. For example, one letter provided more direct information about the amount of savings that homeowners could receive both over the life of the loan and on a month-to-month basis if they were to refinance. The results from this third wave of refinance offers are presented in the final panel of Table 4. Only 13.0% of households took up the offer to refinance. As in the previous two waves, we find that higher potential savings significantly predicts a higher take up of the refinance offer. However, once again, those that did not take up passed on substantial reductions in debt service costs (in this case, an savings opportunity of \$94 per month, or \$26,400 on average over the life of the loan). We found no differences in take-up across the treatment groups, but due to the very small sample sizes (fewer than 10 households refinanced in each group), we are unable to reject economically meaningful differences across the randomized groups.

In an attempt to shed light on why households chose not to refinance, we (in conjunction with NHS and NLS) designed and conducted a short survey after the expiration of the 3rd mail offer. Eligible households that did not refinance were contacted by phone and asked to answer a few simple questions about the refinance process. Of the non-refinancing households, 32 were reached by phone and were willing to answer the survey questions. The survey results suggest that up to 1/4th of the households did not open the letter that they received from NLS. Of those that did open the letter, just over 1/3rd indicated that they planned to call the loan officer, but did not get around to it or were simply too busy to make the phone call. Another 1/3rd indicated that

they did not call the loan officer because they didn't think the savings were significant enough. At the end of the survey, 12 out of the 32 households said they would be happy to have a loan officer call them to discuss the possibility of refinancing their home. These survey results are consistent with both behavioral explanations such as procrastination and inattention, as well as lack of information as possible reasons why households fail to respond to offers that appear to be in their financial best interest.

To further explore the determinants of take-up of refinancing offers, we estimated regressions (combining across mail campaigns) to predict take-up based on observable characteristics of borrowers' mortgage contracts. The available measures of mortgage characteristics are the remaining length of the loan term, the unpaid balance, and the initial interest rate. In results not shown, we find that the size of the loan is the only statistically significant predictor of take-up in these reduced-form specifications, with an increase in loan amount of \$10,000 associated with a 1.2 percentage point increase in the likelihood of refinancing (on a baseline refinancing rate of 16.7 percent, this is an increase of 7%).

Notably, conditional on loan amount, we find no relationship between the interest rate at origination and the likelihood of refinancing among NHS households. We interpret this lack of a relationship with caution, as both larger loan amounts and lower interest rates may be associated with the ability to qualify for a larger and less expensive loan and perhaps greater financial savvy. Nonetheless, based on our data, it appears that households were not responsive to the relative savings induced from variation in the price of their outstanding debt. Instead, households were more responsive when total lifetime savings through refinancing is driven by a larger unpaid mortgage balance. In sum, the results from three letter campaigns of a non-profit mortgage lender further establish that many households in the U.S. choose not to refinance despite being eligible to do so and despite a large amount of savings potential.

5. Discussion and Conclusion

This paper analyzes an important anomaly—the failure of households to refinance their mortgage when interest rates decline, despite substantial monetary benefits from doing so. We analyze a detailed loan-level dataset containing a large random sample of U.S. mortgages and demonstrate that approximately 20% of households who appeared unconstrained to refinance failed to do so at a point during the recent decline in interest rates. The median household would have saved \$160 per month over the remaining life of the loan, and the total present-discounted value of the forgone savings for these 20% of households was approximately \$11,500. Given that this 20% of households represents roughly 400,000 mortgages from the full sample in the CoreLogic database, which represents 85% of the mortgages in the U.S., our estimates conservatively suggest that the total forgone savings of U.S. households over this period was approximately 5.4 billion dollars. Thus it appears that the size and scope of the failure to refinance is substantial and that this is a particularly large household financial mistake.

Clearly, failing to refinance can have important implications for a household's financial well being. However, failing to refinance may have broader macroeconomic repercussions as well. While the failure to refinance primarily represents a simple transfer from homeowners to investors in mortgage-backed securities, there are several reasons why this transfer may not be simply a zero-sum game. Specifically, in the situation where low interest rates are a result of a financial crisis, refinancing can have a stimulating effect by placing money in the hands of homeowners who a) might have a higher marginal propensity to consume than investors and b) who are located in the country where the financial crisis occurred (and where stimulus is likely to be the most welcome).¹³ In addition, transfers to homeowners by way of refinancing in the aftermath of a financial crisis may significantly lower the probability of default. Agarwal, Amromin, Ben-David, Chomsisengphet, Piskorski, and Seru (2012) find that a one percentage point decline in mortgage interest rates through loan modifications is associated with

¹³ Foreign entities hold a substantial share of mortgage-backed bonds (Tracy and Wright 2012).

approximately a four percentage point decline in the probability of default. Overall, Eberly and Krishnamurthy (2014) argue that lowering interest rates can be one of the most efficient policies that the government might undertake following a housing crash (even more useful than alternative modifications involving principal reductions).

What policies might be effective at helping homeowners to refinance? The magnitude of the financial mistakes that households make suggest that psychological factors such as procrastination, trust, and the inability to understand complex decisions are likely barriers to refinancing. One policy that has been suggested to overcome the need for active household participation would require mortgages to have fixed interest rates that adjust downward automatically when rates decline (Campbell 2013). To the extent that it is undesirable to reward only those households that are able to overcome the computational and behavioral barriers of the refinance process, policies such as an automatically-refinancing mortgage may be beneficial. Although an automatically-refinancing mortgage contract would be more expensive up-front for all borrowers in equilibrium, it would remove the cross-subsidization in the current mortgage finance system, where savvier homeowners who use their refinancing option when rates decline are subsidized by those households who fail to do so. Automatically-refinancing mortgages may also be an effective policy intervention that is designed with debt crises in mind (see the previous paragraph). An alternative policy approach is to streamline the refinance process in important ways. For example, in the wake of the recent financial crisis, Boyce, Hubbard, Mayer, and Witkin (2012) proposed that refinancing be streamlined (e.g. by removing re-appraisal or income verification requirements) in order to provide rapid economic stimulus.

Notably, the U.S. federal government has sought to encourage refinancing after the recent financial crisis. In March of 2009, the Federal Housing Finance Agency (FHFA) and the Treasury announced a large-scale refinance program entitled “Home Affordable Refinance Program” (HARP). This program was designed to help borrowers with federally guaranteed loans to refinance even if they had little or no equity in their homes. Homeowners that were

current on their mortgage payments and met the other conditions of the loan (including having less than 125% loan-to-value on their mortgage) could refinance to a lower interest rate. When HARP was announced, FHFA and the Treasury estimated that 4 to 5 million borrowers whose mortgages were backed by Fannie Mae and Freddie Mac could take advantage of the refinancing program. By September 2011, however, less than one million borrowers had actually refinanced their mortgages under HARP, remarkably similar in scope to the failure to refinance we find in our loan-level analysis. Although amendments to the program have resulted in more households taking up refinance offers, the overall take-up rate remains low.

Consistent with the findings in our paper, the experience of HARP suggests that eliminating the failure to refinance by homeowners is not straightforward. During a period of aggressive monetary policy to reduce interest rates faced by consumers, many homeowners did not benefit from lower costs of servicing mortgage debt. Future research should continue to explore products, such as automatically-refinancing mortgages, and policies to reduce barriers to refinancing through both informational and behavioral channels to encourage homeowners to take advantage of mortgage-related savings when interest rates decline.

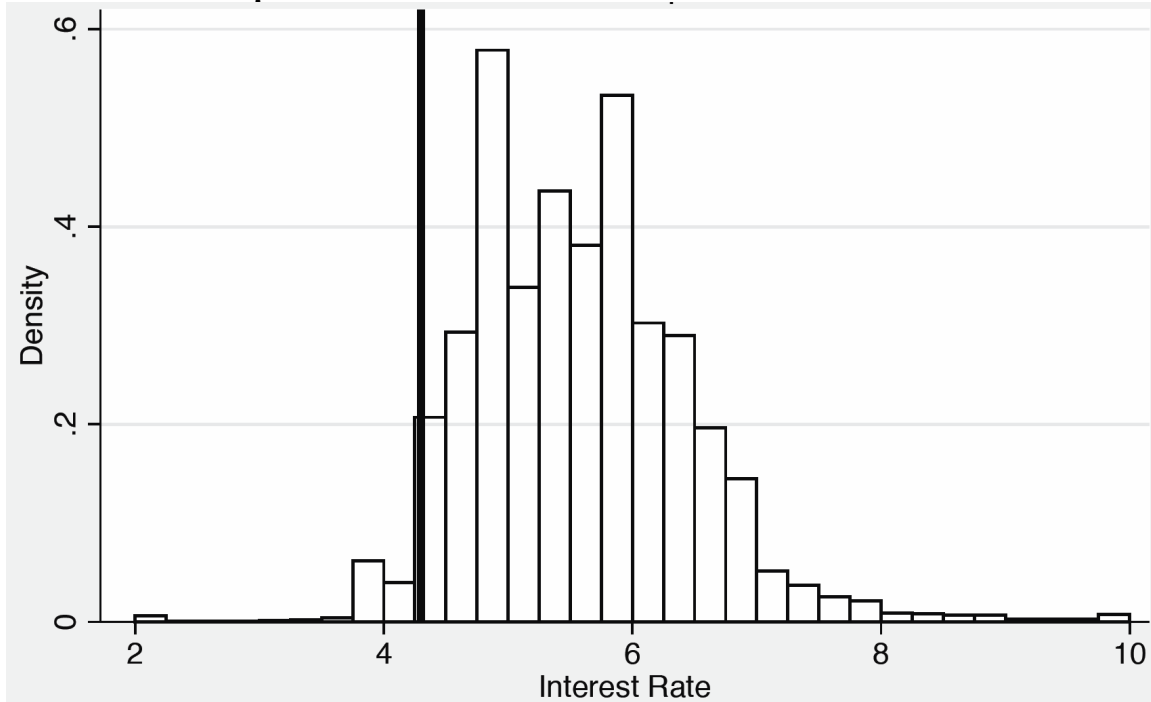
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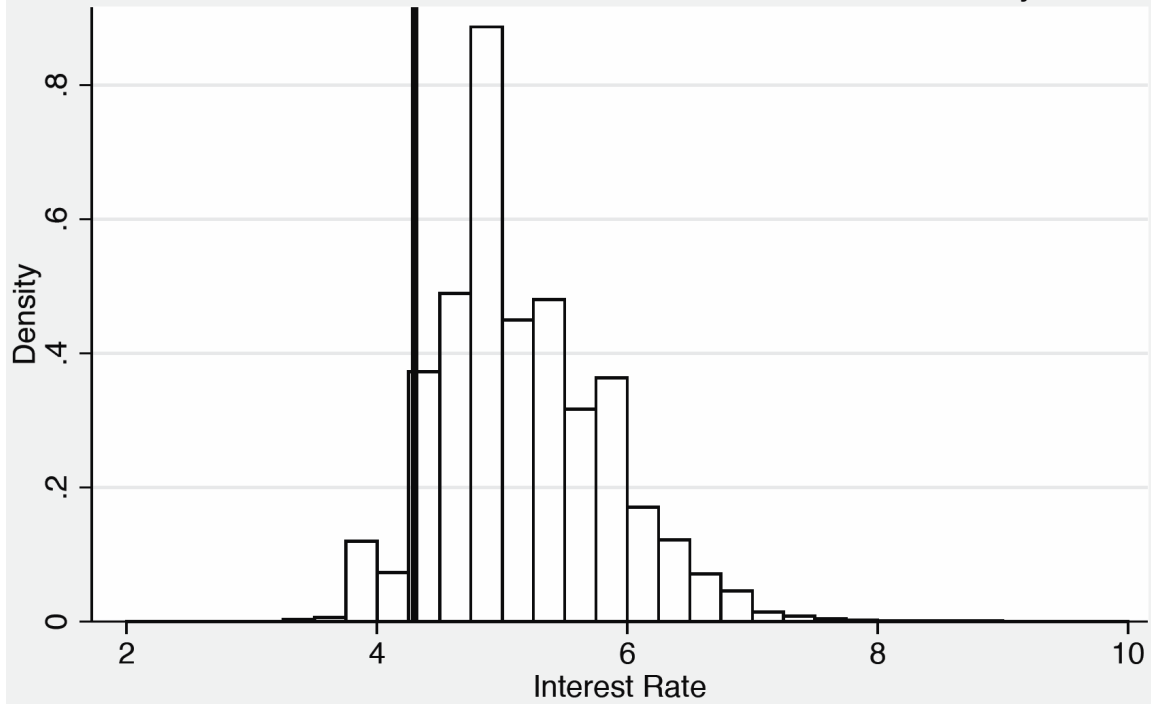
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Figure 1. Distribution of Interest Rates in December 2010

Panel A. Full Sample

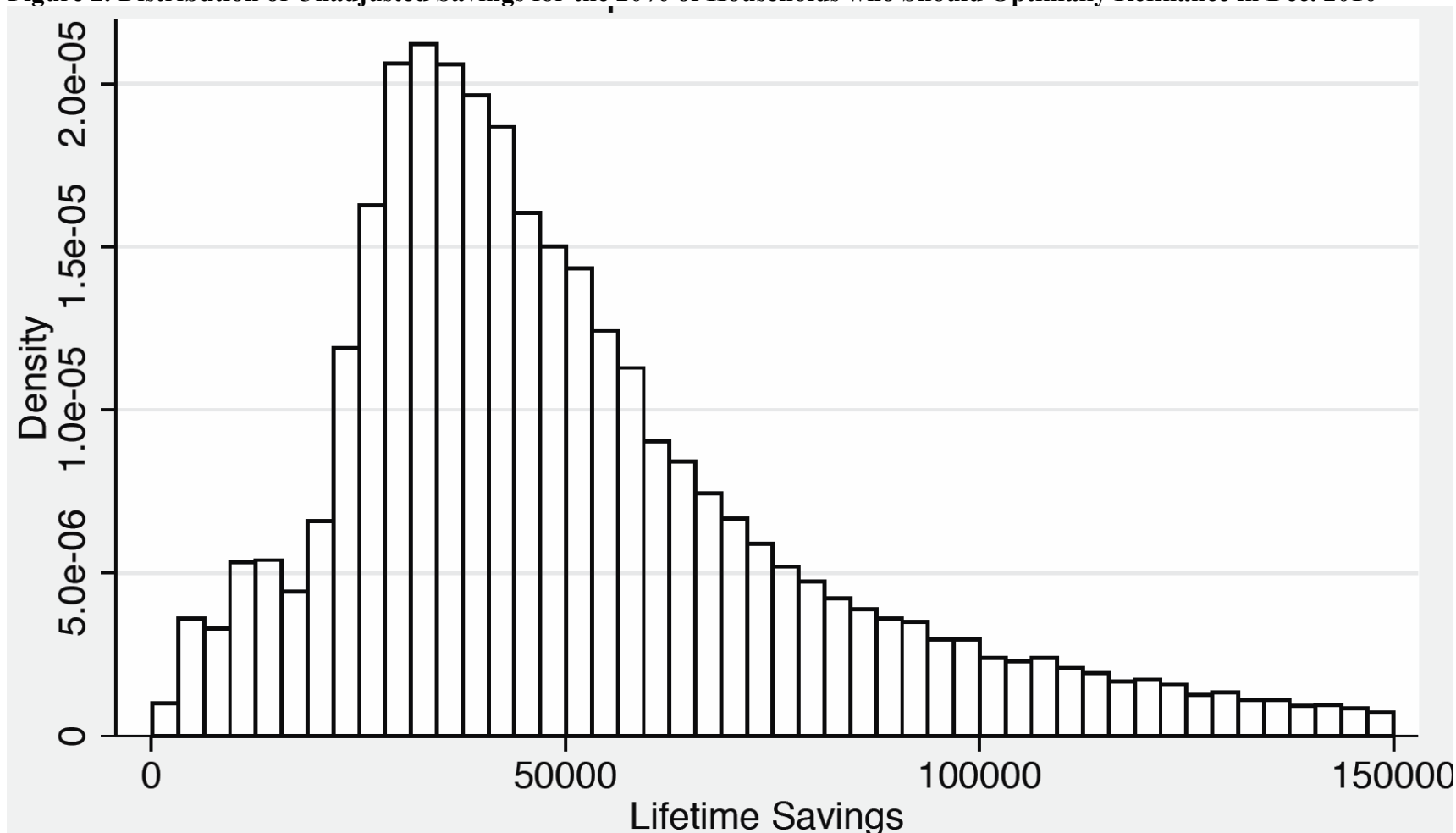


Panel B. Loans with Initial FICO >680, Current CLTV < 90, and Never Missed a Payment



Source: Calculations from CoreLogic Data. Sample of loans originated prior to November 2010 and active in December 2010. See text for detailed description of sample selection criteria.

Figure 2. Distribution of Unadjusted Savings for the 20% of Households who Should Optimally Refinance in Dec. 2010



Source: Calculations from CoreLogic Data. Savings calculated based on the remaining unpaid balance, the remaining loan term, and the difference between the market interest rate and the interest rate at origination. Sample of loans originated prior to November 2010 and active in December 2010. See text for detailed description of sample selection criteria.

Table 1. CoreLogic Data Summary Statistics

Variables of Interest						
Interest Rate		5.52	5.29	5.22	5.22	5.1
Years Remaining		23.4	23.3	23.3	22.9	22.9
Unpaid Balance		\$205,218	\$215,481	\$215,248	\$216,296	\$212,102
Monthly Payment		\$1,370	\$1,421	\$1,414	\$1,420	\$1,395
FICO Score at Origination		737	758	761	761	765
LTV at Origination		70.7	66.4	65.9	64.6	62.7
Computed LTV in December 2010		74.2	68.5	67.1	62.4	60.2
Sample Restrictions						
FICO>680 & LTV < 90			X	X	X	X
Never missed a payment				X	X	X
Current LTV < 90					X	X
Current CLTV < 90						X
Observations		994,188	650,490	573,973	477,601	376,036
Source: Calculations from CoreLogic Data. Sample of loans originated prior to November 2010 and active in December 2010. See text for detailed description of sample selection criteria.						

Table 2. Percentage Failing to Refinance

Sample	Observations	% with positive unadjusted savings	% optimal in Dec. 2010	Median unadjusted savings if optimal	Median adjusted savings if optimal
Full Sample	994,188	91.4%	41.2%	\$54,313	\$13,260
Initial FICO > 680 and initial LTV < 90	650,490	89.0%	31.1%	\$53,831	\$13,218
Initial FICO > 680 and initial LTV < 90, never missed a payment	573,973	88.2%	27.5%	\$52,075	\$12,815
Initial FICO > 680 and <i>current</i> LTV < 90, never missed a payment	477,601	87.2%	23.4%	\$48,344	\$12,174
Initial FICO>680 and <i>current</i> CLTV <90, never missed a payment	376,036	85.7%	20.0%	\$45,473	\$11,568

Source: Calculations from CoreLogic Data. Sample of loans originated prior to November 2010 and active in December 2010. See text for detailed description of sample selection criteria and savings calculation. All savings calculations include transaction costs of point point (one percent of the unpaid balance) plus \$2000. Optimal threshold calculated using Agarwal et al. (2013) formula. See text for details.

Table 3. Heterogeneity of Failure to Refinance

	% with positive unadjusted savings	% optimal in Dec. 2010	Median unadjusted savings if optimal	Quartile Range
By Unempl. Rate quartile:				
least unemployment	84.5%	19.0%	\$47,667	<7.7%
2nd quartile	85.3%	20.6%	\$44,432	7.7%<x<9.2%
3rd quartile	86.3%	20.0%	\$44,561	9.2%<x<10.9%
most unemployment	86.8%	20.2%	\$45,520	>10.9%
By FICO Score quartile:				
lowest FICO	90.0%	29.1%	\$46,150	<741 (but > 680)
2nd quartile	87.3%	21.3%	\$45,651	741<x<773
3rd quartile	84.3%	16.4%	\$45,307	773<x<793
highest FICO	81.1%	12.3%	\$43,670	x>793
By Current CLTV quartile:				
lowest CLTV	79.1%	17.5%	\$37,285	<54%
2nd quartile	83.9%	18.9%	\$42,518	54%<x<69%
3rd quartile	87.7%	19.6%	\$47,429	69%<x<80%
highest CLTV	91.4%	23.4%	\$52,437	>80% (but <90%)
By Loan Amount quartile:				
smallest loan amount	85.4%	21.2%	\$30,324	<\$140k
2nd quartile	83.0%	20.6%	\$39,496	140k<x<196k
3rd quartile	85.0%	19.0%	\$53,248	196k<x<288k
largest loan amount	89.5%	19.1%	\$94,599	>\$288k
By %BA quartile:				
least educated county	85.4%	19.6%	\$39,846	<28.7%
2nd quartile	86.4%	22.1%	\$45,488	28.7%<x<33.8%
3rd quartile	85.4%	18.8%	\$46,033	33.8%<x<41.1%
most educated county	85.6%	19.1%	\$53,292	>41.1%
By Income quartile:				
least income county	85.4%	20.7%	\$40,467	<\$53418
2nd quartile	85.8%	19.8%	\$43,840	\$53418<x<\$61555
3rd quartile	85.6%	18.8%	\$46,618	\$61555<x<\$75566
most income county	86.0%	20.4%	\$52,663	>\$75566

Source: Calculations from CoreLogic Data. Sample of loans originated prior to November 2010 and active in December 2010. See text for detailed description of sample selection criteria and savings calculations. All savings calculations include transaction costs of one point (one percent of the unpaid balance) plus \$2000. Optimal refinancing threshold calculated using Agarwal et al. (2013) formula. See text for details.

Table 4. NLS Mail Campaign Summary Statistics

Wave		
1		
Number of letters sent		446
% who refinanced		15.9%
Median original interest rate		6.2%
Median unadjusted savings for those that refinanced		\$24,500
Median unadjusted savings for those that did not refinance		\$17,700
Wave		
2		
Number of letters sent		140
% who refinanced		24.3%
Median original interest rate		6.1%
Median unadjusted savings for those that refinanced		\$29,900
Median unadjusted savings for those that did not refinance		\$24,700
Wave		
3		
Number of letters sent		193
% who refinanced		13.0%
Median original interest rate		6.1%
Median unadjusted savings for those that refinanced		\$48,200
Median unadjusted savings for those that did not refinance		\$26,400

Note: This table summarizes the three waves of NLS refinancing mail campaigns, undertaken in May 2011, July 2012, and May 2013, respectively. The first two waves included outgoing calls from loan officers, whereas the third wave was exclusively conducted by mail.

Appendix Figure 1. Example of NLS Letter

Name
Address
City, State Zip
Loan #

Date

Your mortgage company, Neighborhood Lending Services (NLS), has a one-time offer to reduce your mortgage interest rate. You have been selected because you have shown that you are able to make your mortgage payments on time, so we would like to give you the opportunity to take advantage of today's lower interest rates.

This is an offer to **refinance** your primary mortgage you have NLS.

For a limited time, we are offering you a **fixed-rate of X.XX%** to refinance your NLS loan. In addition to this lower fixed-rate, we are offering the following incentives:

- **No application fee**
- **Streamlined processing**
- **Appraisal fee can be included in the loan**
- **Reduced loan origination fee of 1% of your loan amount**
- **Loan terms up to 30 years (or less if you desire)**
- **Possible closing cost assistance and other assistance for income-eligible borrowers**

This allows you to take advantage of this lower rate with no out of pocket costs. You could be enjoying your new, lower fixed –rate loan before the summer is over.

To take advantage of this offer, certain conditions apply:

- **You must apply for this refinance loan by July 12, 2013**
- **Loans are subject to an appraisal of your home**
- **You must be current on your NLS loan(s) payments**
- **No cash out is allowed - this loan is solely to refinance your existing NLS loan**
- **New co-borrowers cannot be added to the loan**

If you would like to apply immediately, contact one of our Loan Officers below to start your application for this lower-rate refinance loan.