RESEARCH REPORT

THE REFINANCING TRANSITION:

Equity Extraction, Income Constraints, and Subprime Refinancing Among CRA Mortgage Borrowers

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Abstract

The rise of risk-based pricing altered the context surrounding targeted lending programs. The growth of the subprime industry not only created competition for purchase mortgage originations, but also introduced refinancing options available to existing borrowers. This article focuses on the refinancing decision, following a sample of community reinvestment borrowers through the first years following home purchase. While the majority of refinancing borrowers secured lower-cost prime loans, a minority refinanced into adjustable-rate mortgages and into products with above-prime interest rates.

The analysis examines these latter transitions, exploring the extent to which the desire to tap accumulated equity explains the observed refinancing behaviors. The empirical evidence supports the distinction between rate and cash-out refinancing, suggesting that the desire to extract equity offers an economic rationale for transitions into subprime products through refinancing.

Introduction

The rise of risk-based pricing raises questions about the relative place of targeted lending programs within the broader mortgage market. Where underserved borrowers previously had limited access to mortgage credit, the growing subprime industry expanded both access to credit and the scope of available product options. In doing so, the widespread presence of subprime lenders also altered the context surrounding targeted lending programs. Subprime lenders not only competed directly for purchase mortgage originations, but also offered refinancing options available to existing borrowers. In this way, the subprime market overlapped and interacted with the targeted lending activities of prime lenders.

This article examines one specific type of interaction, namely the transition of borrowers from community reinvestment mortgages to subprime loans through refinancing. The empirical analysis follows a sample of community reinvestment mortgage borrowers through the first years following home purchase, documenting transitions from the initial community reinvestment mortgage into higher-cost and adjustable-rate (ARM) refinancing products. The analysis is conducted with respect to a sample of mortgages purchased through the Community Advantage Program (CAP), a secondary-market demonstration program that purchases mortgages originated through the CRA-related lending activities of participating lenders. As such, all of the purchased mortgages are 30-year fixed-rate purchase mortgages with near-prime interest rates. In contrast to the prime market, however, many of these mortgages contain flexible underwriting

characteristics such as high debt-to-income ratios, limited down payments, and/or non-traditional credit history.

The empirical analysis examines refinancing behavior within this sample, focusing on the transition of some borrowers into adjustable-rate and higher-cost refinancing products. While the majority of refinancing borrowers secured lower-cost prime loans, a minority refinanced into adjustable-rate mortgages and into products with above-prime interest rates. Within the CAP sample, 15 percent of borrowers who refinanced received higher-cost mortgage products, defined by an interest rate that exceeds the prime rate by 150 basis points or more.[1] This measure of higher-cost refinancing also overlaps strongly with the use of ARM products, suggesting that both mortgage characteristics are indicative of subprime refinancing within the CAP sample.

The analysis focuses on these transitions out of community reinvestment mortgages, exploring the extent to which the desire to tap accumulated equity explains the observed refinancing behaviors. Refinancing motivated by a desire to secure a lower interest rate ('rate refinancing') is hypothesized to be substantively distinct from refinancing motivated by the desire to extract equity ('cash-out refinancing'). The empirical analysis first separates rate and cash-out refinancing, showing differences in the determinants of each. Second, the impact of equity extraction on borrowers' refinancing behavior is shown to also influence the choice of refinancing product, as equity extraction alters borrowers' product options. Specifically, rate refinancers can be expected to select the

[1] Ideally, this measure would be calculated on the basis of annual percentage rates (APR), rather than the nominal interest rate. Unfortunately, the fees and points paid at origination are not fully observed, preventing calculation of the APR on refinanced mortgages.

product with the lowest cost, whereas cash-out refinancers face tradeoffs between the long-term cost of the refinancing product, the monthly payment obligation, and the ability to extract equity in the short-term.

Because the portfolio is collected through purchase into the CAP program, it is not designed to be representative of the affordable mortgage market. Nonetheless, the CAP dataset offers rich data on the community reinvestment lending activities of 15 participating lenders in 22 states. The implication is that this dataset creates a unique opportunity to study refinancing transitions, but must be considered within the context of the CAP demonstration program. With this caveat in mind, analysis of the refinancing behavior of CAP borrowers clarifies the changing nature of the market surrounding community reinvestment lending programs. In particular, it highlights the need to evaluate targeted lending activities with respect to the full homeownership tenure. Where community reinvestment mortgage borrowers previously faced few higher-cost refinancing options, the advent of risk-based pricing dramatically expanded the set of available alternatives. As a result, observing homeownership entry (and mitigating default) is no longer sufficient to ensure low long-term costs of homeownership. A direct implication is that the achievement of policy goals requires understanding the nature of mortgage transitions and their implications for the long-term costs of homeownership.

The Refinancing Decision

Existing research relies primarily on option theory in explaining borrowers' refinancing decisions. This approach treats the refinancing decision similar to the decision of

investors to exercise the call option on other financial products (Deng, Quigley, and Van Order 2000; Foster and Van Order 1984). The financial incentive to prepay is measured in monetary terms, with the value of the call (refinancing) option defined as the difference between the market value of a mortgage at the available interest rate M() and the unpaid balance of the mortgage F(t). With respect to refinancing, this option can be represented as follows:

Refinance if: $M(H(t),G(t),r(t),t) - F(t) \geq T_{r(t)}$ (1)

where M() is the value of the current mortgage given the current house value H(t), the current available interest rate r(t), the number of monthly payments remaining t, and the difference between the housing services provided by the current home and the borrower's current housing demand G(t) (Clapp et. al. 2001; Deng, Pavlov, and Yang 2005). $T_{r(t)}$ reflects the transactions costs associated with the refinancing process.

In empirical studies, this incentive to refinance has been defined to be explicitly financial. Borrowers are expected to refinance when the expected financial value of this option is greatest. Deng, Quigley, and Van Order (2000) define the value of the prepayment option as the difference between the financial costs associated with the present mortgage and those of a mortgage at the currently available interest rate:

$$Call\,Option_{i,t} = 1 - \frac{V_{i,m(t)}}{V_{i,r_i}} \quad (2)$$

where

$$V_{i,m(t)} = \sum_{j=1}^{TMi-ki} \frac{3 * P_i}{(1 + m(t)/400)^t}$$

$$V_{i,r_i} = \sum_{j=1}^{TMi-ki} \frac{3 * P_i}{(1 + r_i / 400)^t}$$

The value of each component is summed over the remaining term of the mortgage, where TM_i denotes the number of quarters in the term and k_i denotes the number of elapsed quarters. The value of the call option thus depends both on the difference between the market rate at time t, m(t), and the contract rate r_i and on the number of quarters remaining in the loan term.[2] This empirical measure has been found to powerfully predict borrower refinancing behavior, as borrowers seek to secure a lower interest rate (Deng, Quigley, and Van Order 2000; Quercia and Spader 2008).

The inequality defined in equation (1) also offers two additional insights with respect to borrower refinancing behavior. First, the incentive to secure a lower rate will be moderated by any factor that affects the pricing of the mortgages offered to the borrower. Any changes in borrowers' credit histories and/or loan-to-value ratios will alter refinancing behavior to the extent that they alter the mortgage options available to the borrower. Second, the influence of transactions costs increases as the outstanding balance of the mortgage decreases. Because transactions costs are weighed relative to the benefit of a reduced interest rate, the influence of these costs is greatest for small mortgage amounts.

<u>The Cash-Out Motivation:</u>

[2] The market rate m(t) is defined using the monthly average for 30-year fixed rate mortgages reported by Freddie Mac's Primary Mortgage Market Survey [http://www.freddiemac.com/dlink/html/PMMS/display/PMMSOutputYr.jsp?year=2006]

In contrast to the option theory framework defined by equation (1), Hurst and Stafford (2004) suggest that the desire to extract equity to smooth consumption constitutes a second motivation for refinancing. Noting the persistence of some refinancing behavior during periods of high and increasing interest rates, the authors define a 'consumption-smoothing motivation' for refinancing, whereby the desire to access home equity leads some households to refinance when it is not financially advantageous. This cash-out motivation for refinancing directly explains the presence of refinancing activity during periods when interest rates are high. It also suggests that, in other periods, credit-constrained households may refinance into higher-cost products.

Using a permanent income model with uncertain income, Hurst and Stafford (2004) show that home equity provides an important source of wealth during periods of low realized income, particularly for households with limited other assets. If the realized income value in a period is sufficiently low, the utility gained from refinancing and using extracted equity to smooth consumption may outweigh the costs incurred from refinancing into a higher-cost mortgage. While previous authors have alluded to the cash-out motivation for refinancing, Hurst and Stafford (2004) formalize the economic motive for such behavior.

This consumption-smoothing motivation for refinancing is distinct from the underlying motivation for rate refinancing. Nonetheless, the factors driving each behavior are not unrelated. Borrowers facing unemployment or other types of income loss can be expected to weigh the relative costs of cash-out refinancing and alternative sources of

funds. Cash-out refinancing should therefore be responsive to any factors that determine the interest rate offered to the borrower. For instance, the amount of equity in the home is likely to determine cash-out refinancing behavior not only because it reflects wealth that can be tapped, but also because it directly influences the loan-to-value ratio on the refinanced loan. Similarly, borrowers' liquid assets both provide alternative sources of available wealth and offer assets that may be used to meet reserve requirements on a refinanced mortgage.

The implication is that the set of factors determining rate and cash-out refinancing may be similar, while the underlying relationships are substantively different. For this reason, the determinants of rate and cash-out refinancing are likely to differ in empirical analyses.

The Cash-Out Motivation and Product Choice:

This basic difference in the motivation for refinancing also carries clear implications for product choice. Among households without a need for extracted equity, the refinancing decision is driven by the financial incentive defined in equation (1), and the product with the lowest cost is chosen. In contrast, equity extraction directly increases the loan-to-value ratio on the new mortgage, forcing borrowers with a cash-out motivation to weigh the cost of the new mortgage product against their consumption needs in the present. As a result, the borrower must make simultaneous decisions of whether to refinance and how much equity to extract. This decision confronts the borrower with a tradeoff between the long-term cost of the mortgage and the amount of equity available for current

consumption. Particularly for households with few other sources of wealth, higher-cost refinancing terms may be acceptable in order to access home equity during times of need.

The cash-out motivation additionally implies that the payment-to-income ratio may act as a binding constraint, creating a third dimension along which refinancing products are selected. Borrowers with a cash-out motivation typically face three options: extract equity through refinancing; take out a second mortgage or home equity line of credit (HELOC); or reduce consumption. While the decision between these choices is likely to be driven by the relative costs of extracting equity through each option, income constraints may also play a role for lower-income households. For borrowers who are able to secure a lower interest rate through refinancing, the cash-out option is likely to be the preferred option. Conversely, borrowers without lower-cost alternatives may prefer to leave the first mortgage intact and extract equity through a second mortgage or HELOC. The drawback to the second mortgage/HELOC option is that these products often carry higher interest rates and require borrowers to make payments on both mortgages, which often implies a higher monthly payment obligation.

For borrowers in the affordable mortgage market, the higher monthly payment burden may play a central role in the choice of refinancing products. Households experiencing a cash-out motivation, in particular, are likely to desire to both extract equity and minimize monthly payment obligations in the short-term. To the extent that borrowers face cash-out motivations and income constraints, subprime ARMs offer reduced monthly payments in the short-term while compensating lenders for the higher loan-to-value ratio

following equity extraction. Particularly among borrowers who perceive their current income shock to be temporary, higher-cost ARMs may be preferred.

Despite the growing literature examining the relationship between home equity and consumption, little attention has been given to the choice of refinancing products in the context of equity extraction. Yamashita (2007) examines the decision to extract equity through a second mortgage, finding that households with relatively fewer alternative assets are more responsive to gains in home appreciation. Hurst and Stafford (2004) document a similar phenomenon with respect to refinancing, but focus on the macroeconomic implications of equity extraction for monetary policy. The literature on mortgage product choice also offers only indirect evidence.[3] For instance, recent studies offer substantial evidence that credit risk and financial characteristics drive product choice with respect to purchase mortgages (LaCour-Little 2007; Pennington-Cross, Yezer, and Nichols 2000). This previous work guides the specification of the empirical models in this article, but offers little evidence with respect to cash-out refinancing specifically.

Methodology

The analysis in this article examines the refinancing behavior and product choice of community reinvestment borrowers. Specifically, it documents the presence and influence of cash-out refinancing among this set of homeowners, examining the implications for product choice.

[3] Because of the fundamental nature of the recent changes to the mortgage market, the discussion here focuses on studies that include the subprime or nonprime market.

Refinancing: Empirical Model and Measures

Researchers have traditionally analyzed the refinancing decision using the Cox proportional hazards framework. The option framework defined in equation (1) lends itself to hazard analysis, as borrowers are faced in each month with a decision of whether to make a payment, to exercise the put (default) option, or to exercise the call (prepayment) option. The Cox model reflects this structure, directly addressing duration dependence and handling censoring well.[4] The limitation of the Cox model is the proportional hazards assumption. For a single hazard, estimation of a logit model on a transformed dataset offers one means of circumventing the limitations of the Cox model (Jenkins 1995; Narendranathan and Stewart 1993). The likelihood function for this logit approach can be represented as:

$$L = \prod_{i=1}^{N} \prod_{t=1}^{T_i} \left(\frac{1}{1+\exp(X_i\beta)} \right)^{Y_i} \left(1 - \frac{1}{1+\exp(X_i\beta)} \right)^{1-Y_i} \quad (3)$$

Where i indexes individual borrowers and t indexes monthly payment periods.

Clapp and colleagues (2001, 2006) show that the logic underlying the logit-based hazard framework directly extends to modeling competing risks using the multinomial logit (MNL) framework. This approach directly structures competing risks by defining the probability of observing the base outcome as the difference between the sum of the other probabilities and one. The cost of the MNL estimation strategy is the IIA assumption,

[4] Left censoring occurs as loans are originated and enter the observed loan portfolio. Right censoring occurs through default and prepayment.

which requires that the relative probability of observing any outcome is independent of the alternative outcomes (Small and Hsiao 1985).

The IIA assumption is partially relaxed by the mixed multinomial logit (MMNL) model, which allows for dependent competing risks by addressing unobserved heterogeneity (Skrondal and Rabe-Hesketh 2003a, 2003b). Applying the MMNL framework, the empirical analysis identifies separate equations for default, home sale, rate and cash-out refinancing. Default is defined to occur at 90 day delinquency. Home sale reflects residential mobility concurrent with prepayment of the mortgage. Cash-out refinancing is defined as refinancing that includes equity extraction. Conversely, rate refinancing is defined as refinancing that does not include equity extraction. The omitted category includes borrowers whose mortgages remained active and current through the end of the observation period.

The likelihood function for the resulting model is defined by:

$$L = \prod_{i=1}^{N} \int \prod_{t=1}^{T_i} \prod_{j=1}^{J} \left(\frac{\exp(X_{it}\beta_j + \alpha_j)}{\sum_{k=1}^{J} \exp(X_{it}\beta_k + \alpha_k)} \right)^{d_{ijt}} f(\alpha)\, d\alpha \qquad (4)$$

where J indexes the alternative and d_{ijt} =1 if the individual chooses alternative j at time t (d_{ijt} =0 otherwise). In this specification, α_j reflects unobserved heterogeneity, which may lead to violation of the IIA assumption in the standard specification without random effects. Maximization of the random effects model shown in equation (4) partially relaxes this requirement, but requires integrating over the distribution of α. With large

datasets, this process requires substantial computation time. Estimation of equation (4) is therefore achieved using maximum simulated likelihood based on Halton sequences, which offers a marked reduction in computational time relative to adaptive quadrature (Haan and Uhlendorff 2006; Hole 2007).

The estimation models defined by equations (3) and (4) define refinancing with respect to the determinants implied by the previous discussions of option theory and the cash-out motivation. First, the potential gain from securing a lower rate is defined by the spread between the interest rate on the initial mortgage and the available interest rate on a refinanced mortgage. Because the latter measure cannot be directly observed in all periods, it is approximated using the mean interest rate on 30-year, fixed-rate prime mortgages reported each month by Freddie Mac's Primary Mortgage Market Survey (PMMS). The resulting variable reflects the spread between the interest rate on the initial purchase mortgage and the interest rate on prime mortgage products. In the empirical analysis, this measure is virtually collinear with the measure of the refinance option defined by equation (2), as the observed set of mortgages have similar terms.[5]

The measure of the interest rate spread is expected to capture the financial incentive to refinance, but must also be complemented with several additional financial measures. First, the average number of points paid by borrowers in each month is included to adjust for differences in the PMMS rate attributable to the payment of points. Second, the transactions costs of refinancing influence borrowers' decisions to the extent that they

[5] The correlation coefficient comparing the rate spread measure with the measure of the call option defined by equation (2) exceeds .95. Because these variables are virtually collinear, the rate spread measure is used in the empirical analyses for its ease of interpretation.

offset the benefits of a reduced interest rate. The unpaid balance of the initial mortgage is therefore included to control for the relative size of the transactions costs. Third, borrower wealth may act to constrain refinancing if borrowers with few liquid assets have difficulty paying the transactions costs associated with refinancing. The analysis therefore includes two additional measures of housing and non-housing wealth. The amount of equity in the home is calculated for each month as the difference between the estimated home value and the unpaid balance of the mortgage.[6] A measure of liquid assets, defined as whether the household has liquid assets amounting to more than two monthly payments, is also included to capture borrowers' alternative sources of wealth. Lastly, borrowers' credit histories directly determine the type and cost of available refinancing options. The analysis includes the borrower's origination credit score and an indicator for a previous 30 day delinquency as measures of borrower credit history.

In addition to these financial variables, the empirical analysis also includes several demographic variables that control for differences in household makeup and economic stability. Previous studies suggest that low-income and minority borrowers prepay at lower rates than other borrowers (Firestone, Van Order, and Zorn 2007; Deng and Gabriel 2006), and that changes in marital status, household size, and other demographic triggers induce mobility and home sale (Boehm and Schlottman 2004). As a result, demographic triggers are included to adjust for changes in the household's economic and household position. The presence of an unemployment shock is defined as whether the household head lost at least one week of work due to unemployment following home

[6] Home value estimates are derived at multiple time points using Fannie Mae's automated valuation model. See footnote 9.

purchase. The analysis also includes indicator variables to reflect the presence of a divorce/separation, income change, and the addition of a child following home purchase. Lastly, a set of period of origination indicator variables is included to adjust for unobserved factors related to cyclical economic changes and/or duration of the mortgage.

Product Choice: Empirical Model and Measures

The second objective of this article is to document the consequences of cash-out refinancing for borrowers' product choices. The analysis first examines the decision between fixed-rate (FRM) and adjustable-rate (ARM) mortgage products, examining the association between equity extraction and ARM choice. Second, the high degree of overlap between ARM choice and the use of higher-cost mortgage products leads us to repeat the analyses using a measure of wither the mortgage is high-cost—defined as whether the interest rate on the refinanced product exceeds the prime rate by 150 basis points or more.[7] This measure roughly reflects the definition of high-cost defined by the Federal Reserve Board's recent changes to Regulation Z, which adhere to a similar definition but base the comparison on the APR rather than the nominal interest rate. Because the closing costs and fees on the refinanced mortgage are not reported, this comparison must be approximated on the basis of the originated interest rate.

Ideally, the product choice decision might be modeled simultaneously with the refinancing decision, as homeowners face both decisions together. Unfortunately, the relatively small number of observed refinances—and the even smaller number of

[7] The prime rate is defined as the mean interest rate on originated prime mortgages during the month of origination, as reported by Freddie Mac's Primary Mortgage Market Survey (PMMS).

refinances into ARM and high-cost products—makes reliable convergence of even a simple probit selection model difficult to obtain. Given the computational complexity of the refinancing model defined by equation (4), analysis of the product choice decision is modeled in the probit selection model framework, using a simplified first stage model of whether the homeowner refinances.

This model—a variation of Heckman's (1979) selection model—specifies the outcomes of both the selection equation and the main equation as dichotomous variables. The estimated equations can be represented as:

$$R_i=X_i\beta+ \Theta(t) + \varepsilon_{i1} \quad (5)$$

$$Y_i=X_i\beta+ C_i\gamma+ \rho\lambda + \varepsilon_{i2} \quad (6)$$

where R_i is an indicator for whether the CAP mortgage refinanced and Y_i indicates whether the refinanced product is an ARM. X_i includes the full set of covariates, C_i is the indicator for equity extraction, $\Theta(t)$ are period of origination indicator variables and λ is the inverse Mill's ratio,[8] which adjusts for the probability of refinancing. This specification identifies the selection equation using three period of origination indicator variables $\Theta(t)$, which both strongly predict refinancing and pass the necessary exclusion restrictions.

To simplify notation, denote the right hand side of equation (5) as $Z_{i1}\omega_1$ and the right hand side of equation (6) as $Z_{i2}\omega_2$. Further, let $Y_{i1}=1$ if the CAP borrower refinances and $Y_{i2}=1$ if an ARM refinancing product is chosen. Using maximum likelihood estimation,

[8] The inverse Mill's ratio is defined as the ratio of the probability density function to the cumulative density distribution with respect to the predicted refinancing values from the first stage equation.

equations (5) and (6) can be simultaneously estimated by maximizing the corresponding likelihood function:

$$L = \prod_{i=1}^{N} [\Phi(Z_{i1}\omega_1, Z_{i2}\omega_2, \eta)]^{Y_{i1}Y_{i2}} [\Phi(Z_{i1}\omega_1) - \Phi(Z_{i1}\omega_1, Z_{i2}\omega_2, \eta)]^{Y_{i1}(1-Y_{i2})} [1 - \Phi(Z_{i1}\omega_1)]^{(1-Y_{i1})} \quad (7)$$

where Φ is the cumulative normal function and η is the correlation coefficient for the joint normal distribution.

Specification of equations (5) and (6) is guided both by previous analyses of the ARM/FRM decision and by the determinants of loan pricing. First, the PMMS rate for 30-year FRMs provides a measure of the nominal cost of an FRM product relative to the CAP mortgage. This measure also captures any qualification effect, as borrowers must meet the payment-to-income requirements on the refinanced product (Brueckner and Follain 1988; Brueckner and Follain 1989). Second, the relative cost of FRM and ARM products is captured by the difference between the 10-year and 1-year Treasury rates. This measure of the relative spread between long-term and short-term rates approximates the relationship between the yield curve environment and preference for ARM mortgages. Ideally, differences in the margin offered on ARM products would be included as a third measure of the relative cost of ARM products. However, very little variation exists in the margins reported by the PMMS during the period observed, and the margins on refinanced ARMs are not directly observed.

These measures of the relative cost of ARM and FRM mortgages are supplemented with measures of underwriting and demographic characteristics. Campbell and Cocco (2003) show that households with larger mortgages, variable income, and/or little expectation of

future mobility are theoretically less likely to prefer ARM mortgages. Using empirical data, Dhillon, Shilling, and Sirmans (1987) show that households with dual incomes and/or expectations of future mobility are more likely to select ARM products. The prevalence of ARM products in the subprime market also suggests that traditional underwriting characteristics belong in the specification of the product choice model. The borrower's loan-to-value ratio at the time of refinance is calculated as the difference between the home's appreciated value—as estimated by Fannie Mae's automated valuation model—and the amount of the refinanced mortgage. Additionally, the measures of borrower reserves, 30-day delinquency, and origination credit scores from the refinancing model are also included, as are the set of demographic characteristics and trigger events. This set of covariates includes measures of marital status and income change. However, expected mobility is not directly observed in the CAP dataset.

Analysis of the ARM/FRM decision is performed first using the theoretical predictors of product preference described above. This analysis identifies the association between equity extraction and product choice if equations (5) and (6) are correctly specified. However, the high incidence of high-cost mortgages among observed ARMs raises concerns about the context within which CAP refinancing occurs. To this end, the product choice analyses are repeated with the origination of a high-cost refinancing product as the outcome of interest. The analysis also examines the robustness of the estimation results to origination through a mortgage broker or retail lender. While empirical evidence on the practices of mortgage brokers is still emerging (Jackson and Burlingame 2007; Woodward 2003), brokers have received substantial attention in recent

months from Congress and others critical of their role in the growth of the subprime market. The analyses are therefore repeated after controlling for origination through a mortgage broker. The findings and implications of both of these specification issues are discussed at greater length with the estimation results.

The empirical analyses apply this methodology to the refinancing behavior of a sample of community reinvestment mortgage borrowers. The effect of the cash-out motivation on refinancing behavior and product choice is likely to be particularly influential in the affordable market, as many of the households targeted by homeownership initiatives have few other assets and rely on the home as a primary source of wealth. Because many CRA lending programs offer relaxed underwriting requirements, community reinvestment borrowers may also exhibit an increased risk of transitioning into higher-cost mortgages. This article examines these issues within the context of the Community Advantage Program (CAP), a secondary market purchasing program for community reinvestment mortgages. While the empirical analyses must be interpreted within the context of the CAP program, the rich dataset nonetheless offers a unique opportunity to study borrowers' transitions out of community reinvestment mortgage products.

The Community Advantage Home Loan Secondary Market Program (CAP)

CAP was initiated as a partnership between the Ford Foundation, Fannie Mae, and Self-Help, a leading community development financial institution (CDFI) located in Durham, North Carolina. Under CAP, Self-Help purchases 30-year, fixed-rate, home purchase mortgages with loan features that prevent them from being readily sold in the secondary

market. Many of the loans allow high debt-to-income levels, limited down payments, lack of private mortgage insurance, and/or non-traditional credit history. Additionally, where affordable mortgage products generally allow the relaxation of only one qualifying requirement, loans in the CAP portfolio are allowed to deviate from multiple underwriting standards.

To qualify for purchase under CAP, the borrower must meet one of three criteria: (1) have income under 80 percent of the area median income (AMI) for the metropolitan area; (2) be a minority with income below 115 percent of AMI; or (3) purchase a home in a high-minority (>30%) or low-income (<80% AMI) census tract and have an income below 115 percent AMI. This mix of income- and location-based requirements gives the participating lenders some flexibility in developing programs to meet the needs of their markets. However, it also implies that the set of CAP loans is not specific to an individual lending program or set of underwriting criteria. Instead, the CAP portfolio reflects the CRA lending activities of a variety of lenders across the United States.

For many borrowers, equity held in the CAP home represents the primary source of wealth. Stegman, Freeman, and Paik (2007) show that home equity accounts for 60 percent of the median CAP household's net worth. Similarly, Stegman, Quercia, and Davis (2007) follow CAP households during the run-up in housing prices between 2001 and 2005, finding that these households captured substantial home equity gains during this period. Taken together, these findings create conditions under which many households may seek to extract equity, particularly if unexpected income losses or

expenses are realized. However, many CAP borrowers may not have access to similarly-priced options for refinancing credit, particularly if substantial equity is extracted during the transaction.

The analysis in this article relies on extensive data on CAP borrowers, including three waves of annual survey data. The third wave, collected in 2005, includes detailed information on borrowers' refinancing products and experiences. This information is merged with information from the origination loan file, as well as monthly loan performance data. Lastly, home appreciation data is provided for the original CAP homes by Fannie Mae, using its automated valuation model.[9]

The resulting dataset follows 1,163 borrowers who purchased homes between 1999 and 2003. Of this sample, 342 borrowers refinanced their original CAP loan prior to the 2005 wave of interviews, which surveyed borrowers in detail regarding their refinancing products and experiences. Figure 1 shows the origination and refinancing activity of the CAP portfolio prior to the end of 2005. The percent of the full portfolio of 1,163 CAP loans that were refinanced increased through 2003 as loan origination and seasoning leads to higher nominal rates of refinancing. Refinancing activity then decreases through the end of 2005 as refinancing activity occurs with respect to the decreasing number of loans that remain in the sample. The cumulative measures then document the

[9] Fannie Mae estimated appreciated values for each home in the 4th quarter of 2005. Appreciated values in interim periods are interpolated using the home purchase price and the Fannie Mae appreciated value, assuming a constant rate of appreciation. Fannie Mae's proprietary automated valuation model (AVM) produces four different estimates of each home's appreciated value based on repeat sales information, public tax records, and property characteristics. When discrepancies arise between the estimates, a reconciliation model generates the final estimate. Because of its proprietary nature, we do not directly observe the estimation procedure used by the AVM. We base our trust in the model's reliability on OFHEO's consistent approval in regulatory audits.

aggregation of the origination (refinancing) activity into the cumulative percent of loans that were originated (refinanced) prior to the end of each quarter. Figure 1 shows that the final origination into the analysis sample occurred in June 2003, and that nearly 30 percent of originated CAP loans refinanced during the observation period.

[INSERT FIGURE 1 ROUGHLY HERE]

Figure 2 displays the mean interest rate on CAP mortgages originated in each quarter, comparing these rates to the mean interest rates on fixed-rate (FRM) and adjustable-rate (ARM) mortgages reported by Freddie Mac's Primary Mortgage Market Survey (PMMS).[10] In each quarter, the mean interest rate for CAP mortgages hovers roughly 50 to 100 basis points above the average rate reported by PMMS for the prime market. This difference reflects the 75 basis point credit enhancement applied to CAP interest rates, which is offset by a lack of private mortgage insurance.[11] As a result, the rates shown in Figure 2 imply that the pricing of CAP mortgages roughly corresponds to that for prime loans. The implication is that CAP borrowers hold relatively low-cost purchase mortgages, but potentially lack access to low-cost refinancing products.

[INSERT FIGURE 2 ROUGHLY HERE]

Empirical Analysis

[10] See Freddie Mac's Primary Mortgage Market Survey [http://www.freddiemac.com/dlink/html/PMMS/display/PMMSOutputYr.jsp?year=2008]

[11] The interest rates reported for the prime market by PMMS exclude borrowers' mortgage insurance payments.

The analysis file of CAP loans consists of 1,163 borrowers with loans originated between November 1999 and July 2003. Of this sample, 342 borrowers (29%) refinanced prior to the 2005 survey wave. The remaining borrowers are observed monthly through the end of 2005, with observations being censored either through termination or through the loan reaching the end of the sampling period without refinancing. The mean origination month is February 2002, with loans observed for an average of 33 months prior to censoring. The observation period therefore reflects the seasoning of CAP loans in the first years following home purchase. Despite the relatively short period of observation, decreasing interest rates and strong home price appreciation created substantial incentives for many households to refinance.

Table 1 describes the characteristics of CAP borrowers. For variables that change through time, the mean value shown corresponds to the mean value across borrowers in the last period that they are observed. The unpaid balance and home equity variables therefore reflect the cumulative result of equity accumulation during the observation period. The characteristics shown in Table 1 reflect the population of lower-income borrowers targeted by affordable mortgage products. The mean household income for the sample is $42,452, with borrowers purchasing homes worth, on average, $83,835 at origination. By the end of the observation period, borrowers owed an average of $77,701 in principal, a figure that reflects the low down payment requirements of CAP mortgages. Strong home price appreciation following origination—along with monthly principal payments—created an average of $12,377 in home equity.

[INSERT TABLE 1 ROUGHLY HERE]

The credit history and demographic variables further reflect the economic positions of CAP borrowers. Over 70 percent of borrowers had credit scores below 720 at origination, with 37 percent having a score below 660. Following origination, 26 percent of borrowers experienced at least one delinquency of 30 days or more. This economic insecurity is also reflected in borrowers' wealth and employment characteristics. Fifty-three percent of borrowers reported holding liquid assets amounting to more than 2 monthly mortgage payments, and 14 percent lost at least one week of work to unemployment. Fifty seven percent of respondents reported being married or partnered at origination, and 4 percent became divorced, separated, or widowed following home purchase. Eighteen percent of borrowers added a child to their household during this period.

A substantial proportion of borrowers reported income changes between the first and third waves of survey data collection. The income increase and income decrease measures are derived from an income variable that segments borrowers into $5,000 income categories. The income increase and decrease variables reflect whether the borrower's income increased into a higher category or decreased into a lower category between the first and third waves of data collection. Lastly, the demographic variables offer a broad image of the population served by CAP mortgages. The race/ethnicity variables show that 37 percent of CAP borrowers belong to at least one minority racial or

ethnic group. 28 percent of borrowers hold a 4-year college degree, and an additional 44 percent completed some post-secondary education.

The Refinancing Decision:

The analyses of the refinancing decision examine the competing risks of rate refinancing, cash-out refinancing, default, and home sale. Through the end of 2005, 342 borrowers (29%) had refinanced, with 115 of the refinances (34%) including equity extraction. Beyond this set of refinances, 54 borrowers (5%) reached 90 day delinquency and 66 borrowers (6%) sold the home and prepaid the CAP mortgage. The remaining set of 701 mortgages (60%) remained active and current through the end of the observation period. In the MMNL analyses, this latter group is used as the base category.

Table 2 presents the estimation results for the competing risks model defined in equation (4). This model identifies the predictors of refinancing when rate and cash-out refinancing are combined into a single outcome variable.[12] The results largely reinforce the theoretical predictions of option theory, showing the influence of financial factors. First, the rate spread strongly predicts whether a mortgage refinances, with borrowers reacting to decreases in the available mortgage rate. Second, a larger unpaid balance is associated with a higher likelihood of refinancing, as these borrowers are likely to benefit more from securing a lower interest rate. Third, borrowers with higher credit scores are

[12] Interpretation of the estimated coefficients must be performed with care, as the sign of a coefficient may differ from the sign of the underlying marginal effect under certain conditions in MNL models. Derivation of the marginal effects confirms the sign of the estimated coefficient (and the substantive interpretation) for all of the variables that reach significance in the results presented. The coefficients are presented rather than the marginal effects as the hazard structure of the underlying dataset makes direct interpretation of the marginal effects difficult.

significantly more likely to refinance, suggesting that refinancing is sensitive to the potential cost of the refinanced mortgage. This effect reflects the unique nature of the CAP program, as borrowers at all credit score levels received 30-year, fixed-rate mortgages with interest rates that averaged 50 to 100 basis points above the prime rate. Where borrowers with high credit scores may have access to low-cost refinancing options, many of the borrowers with low credit scores may not have been able to secure lower interest rates.

[INSERT TABLE 2 ROUGHLY HERE]

Several of the results in Table 2 cannot be explained by option theory. First and foremost, households with a larger amount of accumulated equity are more likely to refinance, suggesting that households react to home price appreciation. This finding is consistent with cash-out refinancing, as some households refinance to tap available equity reserves. Second, the variables measuring asset reserves and unemployment shocks suggest that wealth constraints may prevent some households from refinancing. Taken together, the asset reserves and unemployment variables suggest that transactions costs may create an obstacle to refinancing for low-wealth households. Lastly, black households are significantly less likely to refinance, a finding that is consistent with previous analyses of refinancing and prepayment (Firestone, Van Order and Zorn 2007; Deng and Gabriel 2006).

Table 2 also presents the predictors of default and home sale, which are consistent with previous analyses of these outcomes. The borrower's origination credit score is the strongest predictor of default. Black homeowners and homeowners experiencing divorce, separation, or widowhood also show elevated levels of default. The home sale equation confirms that homeowners' mobility is responsive to the financial incentives to prepay that influence refinancing behavior. Homeowners' mobility decisions are shown to respond positively both to the rate spread and to the accumulation of equity. Lastly, adding a child to the household also increases the likelihood of home sale.

Table 3 repeats this model, separating rate and cash-out refinancing. Among observed refinances (n=342), 227 borrowers (66%) refinanced solely to secure a lower interest rate, while 115 borrowers (34%) extracted equity during the refinance.[13] The estimates in the default and home sale equations appear nearly identical to those presented in Table 2. However, the separate identification of each type of refinancing behavior confirms that the substantive predictors of rate and cash-out refinancing differ. In particular, cash-out refinances are shown to be less sensitive to the financial cost of the refinanced product. Where the likelihood of rate refinancing decreases marginally for each of the lower credit score buckets, the highest rates of cash-out refinancing are observed among borrowers in the middle two score buckets. In this way, borrowers who extract equity appear to be less sensitive to the cost of the refinancing product.

[13] This definition of cash-out refinancing includes 82 refinances in which the borrower both extracted equity and secured a lower interest rate. As a result, this measure may overstate the presence of cash-out refinancing to the extent that some borrowers who extracted equity refinanced primarily to secure a lower interest rate.

[INSERT TABLE 3 ROUGHLY HERE]

Several of the results shown in Table 3 also suggest substantive differences between rate and cash-out refinancing. The availability of equity is shown to play a stronger role in determining cash-out refinancing than rate refinancing. Additionally, the unemployment and asset reserves variables both differentially impact rate and cash-out refinancing. Interestingly, unemployment does not increase the likelihood of cash-out refinancing, but rather decreases the likelihood of rate refinancing. Similarly, the presence of asset reserves do not appear to buffer against cash-out refinancing, and instead increase the likelihood of rate refinancing. While these findings show substantive differences between rate and cash-out refinancing, they are only weakly consistent with the hypothesis that the motivation for cash-out refinancing derives from a short-term loss of income.

Instead, borrowers' stated uses of the extracted equity reveal a more complicated picture. Of the 115 borrowers who extracted equity, 70 borrowers (61%) indicated that the primary use of the equity was to 'Pay off credit card balance or other debts' and 31 borrowers (27%) indicated that the primary use was for 'Home improvement or home repair.' The remaining 14 borrowers (12%) reported using the extracted equity for educational expenses, medical debts, vehicle down payments, or other uses. While credit card debts and unexpected home repairs may both reflect unanticipated expenses, these categories are defined broadly. As a result, both categories may equally reflect consumption in response to home equity gains.

A final finding from Table 3 is that education moderates borrowers' willingness to extract equity from the home. Borrowers with a college degree are less likely to cash-out refinance than borrowers with less formal education. One potential explanation for this effect is that a college degree provides these borrowers with more stable employment, creating a more stable income stream. However, the model directly controls for both unemployment. A second potential explanation is that borrowers with less education may be less able to manage consumer credit and/or evaluate the long-term costs of alternative mortgage products, and thus more willing to extract equity. The positive relationship between age and rate refinancing is also suggestive of an educational effect, as older homeowners may have more knowledge and experience with respect to the refinancing process.

Product Choice:

The second objective of this article is to document the consequences of cash-out refinancing for borrowers' product choices. Table 4 presents the characteristics of the refinancing products used by CAP borrowers, separating the products into fixed rate (FRM) and adjustable-rate (ARM) mortgages. Of the 342 borrowers who refinanced, 274 borrowers (80%) chose FRM refinancing products and 68 borrowers (20%) chose ARM products. Both sets of borrowers held CAP mortgages with interest rates near 7.6 percent, and both sets of borrowers refinanced into products with nominal interest rates that averaged just below 6.0 percent. Among ARM borrowers, this refinanced rate reflects the current interest rate of the mortgage at the time of the 2005 interview.

Because only 19 percent of the refinanced ARMs had reset from the introductory rate at that time, the refinanced rate primarily reflects the introductory rate received by ARM borrowers.[14]

[INSERT TABLE 4 ROUGHLY HERE]

The similarity of the refinanced rates received by FRM and ARM borrowers conceals the differential pricing of these products. Because ARM borrowers accept the interest rate risk associated with the mortgage, ARM pricing generally offers a discounted interest rate relative to FRM mortgages. Figure 2 confirms that the interest rates offered by lenders in the primary market on 30-year FRMs remained substantially above the commitment rate on 1-year ARMs. The pricing variable in Table 4 measures the difference between the rate of the refinanced FRM (ARM) mortgage and the mean interest rates reported for prime mortgages by Freddie Mac's Primary Mortgage Market Survey (PMMS). This variable shows that the refinanced rates on FRM mortgages near the prime rate, whereas the refinanced rates secured by CAP borrowers on ARM mortgages averaged nearly 200 basis points above those on prime ARMs.

To formalize this difference in cost, the second measure of pricing defines high-cost loans, identifying any loan whose interest rate is 150 basis points or more above the prevailing rate on prime products. This definition is roughly consistent with the recent Federal Reserve Board definitions, which use a 150 point spread in the annual percentage

[14] Among borrowers whose rates had reset prior to the 2005 interview, the current interest rates averaged 5.96 percent, compared to introductory rates that averaged 5.82 percent.

rate (APR) to delineate higher-cost mortgages from prime mortgages.[15] Unfortunately, the APR cannot be calculated for CAP loans, as the full set of closing costs and fees is not observed. As a result, the measure of high-cost loans relies on the interest rate spread.

The resulting measure of high-cost refinancing products is closely associated with ARM choice in the CAP dataset. More than 65 percent of the identified higher-cost products were ARMs. Conversely, Table 4 shows that 50 percent of the refinanced ARM mortgages carried interest rates greater than 150 basis points above the prime rate, compared to only 7 percent of the refinanced FRM products. This concentration of higher-cost mortgages among ARM products likely reflects the prevalent use of ARM and hybrid ARM products in the subprime market. This interpretation is reinforced by the low reset rates among recently refinanced mortgages. The interest rates on 81 percent of observed ARMs had not yet reset from their initial rate, suggesting that many of the observed ARMs reflect the hybrid products commonly originated by subprime lenders during this period (Ambrose, LaCour-Little, and Huszar 2005).

Table 4 lastly shows that ARM borrowers refinanced a larger amount than FRM borrowers, and that a substantially higher proportion of ARM borrowers extracted equity. The higher rate of equity extraction among ARM borrowers contrasts with previous analyses of the decision between FRM and ARM mortgages, which suggest little

[15] The Federal Reserve Board's recent revisions to Regulation Z define first lien mortgages to be 'higher-cost' when the associated annual percentage rate exceeds 150 basis points above the average prime offer rate. This rule is approximated among CAP mortgages using the spread associated with the nominal interest rate.

theoretical role for equity extraction. Instead, this relationship likely indicates households' use of non-prime ARMs to extract equity. This proposition is tested directly by examining the effect of equity extraction on the choice of ARM/FRM products.

Table 5 presents the results of the estimated product choice models, which predict the likelihood of choosing an adjustable-rate mortgage.[16] The immediate finding from Table 5 is that equity extraction is strongly associated with the choice of an ARM mortgage, and that this effect is robust to the origination of the mortgage through a broker or lender. Cash-out refinancing is strongly associated with choice of an ARM refinancing product in both specifications. Given the previous discussion of the refinanced interest rates shown in Table 4, this finding is consistent with the expectation that the cash-out motivation induces many borrowers to choose subprime ARMs.

[INSERT TABLE 5 ROUGHLY HERE]

An additional finding from the second model in Table 5 is that borrowers who refinanced through a mortgage broker were also significantly more likely to choose an ARM product. This effect is consistent with the central role of mortgage brokers in the origination of subprime ARM and hybrid mortgages. However, it should be interpreted merely as an association, as this analysis is not designed to isolate the impact of origination through a mortgage broker. Instead, the second model clarifies that the role

[16] Diagnostic tests suggest that the period of origination indicator variables perform satisfactorily in identifying the selection equation. These variables significantly predict whether a loan refinances, while passing the exclusion restrictions for the main equation. Furthermore, the need for the selection model structure is confirmed by the results shown in Table 5 for Rho.

of equity extraction in product choice is robust to origination through a mortgage broker. In fact, this effect strengthens when origination channel is controlled for. While the coefficients reported in Table 5 cannot be directly interpreted, the associated marginal effect of a cash-out refinance suggests that equity extraction increases the predicted probability of ARM choice by roughly 15 percentage points.[17]

The findings shown in Table 5 also support the influence of income constraints in the choice of refinancing products. Among the full set of demographic variables included in Table 5, only the variable reflecting whether the household's income increased is significant.[18] An increase in household income following origination is associated with a reduced likelihood that the borrower chooses an adjustable-rate refinancing product. This result is consistent with the hypothesis that households may choose ARM mortgages to extract equity while maintaining a manageable monthly payment obligation in the short-term. To further explore this effect, the second model in Table 5 also adds an interaction effect between the cash-out refinance and income increase indicators. This interaction effect further supports the above interpretation, showing that the effect of an income increase on product choice is specific to cash-out refinances.[19]

[17] The marginal effect in non-linear models is a function of the value of the covariates. In this paper, marginal effects are computed with respect to the average of the probabilities (e.g. predicted probabilities are calculated for each individual conditional on their covariate characteristics, with the reported marginal effect reflecting the average of these values).

[18] To further explore this effect, the income increase variable was separated according to the size of the income increase (e.g. an increase of one, two, three, etc… $5,000 income buckets). The effect of an income increase and the interaction with the cash-out variable consistently appear for each of the income increase variables.

[19] Interpretation of this interaction term requires derivation of the marginal effect, which may differ in sign and significance from the reported effect. The interpretation of the interaction effect in this paragraph is based on the derived marginal effect (see Ai and Norton 2003).

A final comment on the product choice estimations shown in Table 5 is to note the weak role of many of the remaining covariates. The majority of the covariates are signed as expected and several near significance. However, several variables notably do not appear to predict ARM choice among CAP borrowers. One possible explanation for this finding is that multicollinearity, along with the small sample size, limits the ability of this model to identify these effects. However, statistical tests for multicollinearity do not reveal it to be problematic.[20] A second possibility is that the set of CAP borrowers is relatively homogenous, producing less variation on these factors than that observed in other analyses.

Table 6 applies the ARM/FRM model to households' use of higher-cost mortgage products. The dependent variable in these models defines high-cost mortgages to include products whose interest rates exceed the prime rate plus 150 basis points, consistent with the high-cost variable shown in Table 4. Given the above-prime interest rates observed on ARM products in the CAP dataset, this second set of estimations examines whether the relationship between equity extraction and ARM use implies the use of higher-cost ARMs. However, interpretation of the estimates is limited by the relatively small number of borrowers who refinance into high-cost loans. Of the 342 borrowers who refinanced, 52 (15%) received loans with interest rates 150 basis points or more above the prime rate.

[20] Descriptive analysis of the covariates does not show strong correlation between factors. Additionally, exploratory analyses removed individual covariates and/or the set of demographic characteristics. None of the associated analyses are suggestive that the results are sensitive to model specification.

Despite this small sample, the results shown in Table 6 show a strong relationship between cash-out refinancing and the use of higher-cost mortgage products. Similar to the effect for ARM choice, the implied marginal effect suggests that cash-out refinancing is associated with a 13 percentage point increase in the likelihood of a higher-cost product. The second model in Table 6 further investigates this effect, separating cash-out refinances into ARM and FRM products. This model shows that equity extraction is associated with a higher likelihood that both product types are higher-cost. However, the magnitude and strength of this effect is significantly larger for the set of cash-out ARMs.

The remaining coefficients in the models of high-cost product receipt are generally signed as expected, but carry coefficients and t-statistics whose magnitudes are dwarfed by those of the cash-out refinancing variable. Of particular interest, origination through a mortgage broker is not significantly associated with a high-cost refinancing product. The effect is positive in both models, but much weaker than the effect of broker origination on ARM/FRM choice. This result suggests that the higher incidence of ARMs among broker-originated mortgages may not translate into a higher-incidence of high-cost ARMs. However, this effect may also be due to the relatively smaller number of high-cost mortgages.

The measures of borrower credit quality exhibit a similar pattern. Ever 30 day delinquency positively predicts receipt of a high-cost product, but carries a weak z-statistic. The measure of borrowers' loan-to-value ratios suggests that a higher loan-to-value ratio is associated with a higher likelihood of receiving high-cost refinancing

products, but does not reach significance. The origination credit score buckets, as well as the remaining underwriting characteristics, show similarly weak effects. Beyond the measure of cash-out refinancing, the model only identifies the FRM rate and the Hispanic indicator variable as significant predictors of high-cost product use. The effect of the FRM rate is likely mechanical, as both this variable and the high-cost measure are calculated using the outstanding market interest rates. This mechanical relationship also explains the estimates for the yield variable.[21] However, the higher incidence of high-cost mortgages among Hispanic borrowers cannot be similarly explained. Instead, the significance of the Hispanic indicator raises concerns about the pricing of the refinancing products received by Hispanic borrowers.[22]

Discussion and Policy Implications

The rise of risk-based pricing not only dramatically expanded access to credit, but also altered the context surrounding targeted lending programs. Where underserved borrowers previously faced limited access to mortgage credit, the growth of the subprime market created multiple product options for both home purchase and refinancing. In this way, the subprime market began to overlap and interact with the targeted lending activities of existing lenders. Unfortunately, very little research has examined these interactions, particularly the extent to which the increasing range of product options led

[21] As a test of the influence of this mechanical effect, estimation is repeated after excluding the FRM rate and yield variables. The remaining effects are robust to this specification choice.

[22] Hispanic borrowers in the CAP sample do not have worse credit characteristics than other borrowers, and if anything exhibit lower likelihoods of entering delinquency and default on the CAP mortgage. Additionally, the Hispanic borrowers tend to be located in hot housing markets, suggesting that strong home appreciation should make these borrowers the most able to secure lower-cost refinancing products.

households to transition between low- and high-cost markets in response to changes in their economic circumstances and credit characteristics.[23]

This article examines one specific type of transition, namely borrower refinancing out of community reinvestment mortgage products. The empirical analysis is specific to the borrowers in the Community Advantage Program (CAP), and therefore must be interpreted within the context of the CAP program. However, examination of this dataset offers interesting insight into borrowers' refinancing decisions. While the majority of refinancing CAP borrowers transitioned into lower-cost fixed-rate products, a small number selected adjustable rate and higher-cost mortgages. This article presents and tests an economic rationale for the transition to subprime, examining the role of equity extraction in the refinancing behavior of CAP borrowers. The results first show differences between rate and cash-out refinancing. Specifically, the financial predictors implied by option theory more strongly explain rate refinancing, whereas cash-out refinancing appears to be less responsive to credit history and other determinants of loan price.

This difference between rate and cash-out refinancing carries over into borrowers' selection of refinancing products. Where rate refinancing is hypothesized to be driven by the financial incentive to secure a lower interest rate, cash-out refinancing confronts

[23] The primary exception is Courchane, Surette, and Zorn (2004), who document transitions between prime and subprime mortgages through refinancing. While the focus of the analysis is on the ability of subprime borrowers to refinance into prime credit, the survey documents that 13 percent of prime borrowers who refinance transition into subprime products. Pennington-Cross and Chomsisengphet (2007) examine equity extraction and refinancing out of subprime mortgages, but focus on mortgage termination and do not observe the subsequent product.

borrowers with the tradeoff between the long-term cost of the mortgage, the monthly payment obligation, and the ability to extract equity for current consumption. Within the CAP sample, this tradeoff appears to lead a minority of borrowers to use ARM refinancing products in order to extract equity while minimizing the monthly payment obligation in the short-term. Equity extraction is strongly associated with the likelihood of refinancing into an ARM product, and the effect is concentrated among the households most likely to be constrained by payment-to-income requirements. Given that 50 percent of the refinanced ARMs carry interest rates more than 150 basis points above the prime rate, this relationship suggests that the desire to extract equity led some households to accept subprime credit in exchange for lower monthly payment obligations and the ability to extract equity.

This phenomenon adds complexity to the interpretation of refinancing activity within targeted lending programs. While the transition into subprime products might be viewed as a negative outcome, such refinancing behavior does not have unambiguously negative (or positive) implications for the achievement of policy goals. Instead, the normative interpretation of such transitions varies across goals, as potentially higher long-term financing costs must be weighed against the benefits of access to accumulated equity in the present. A first upshot for policy is that efforts to encourage homeownership must consider the long-term costs of homeownership across a potentially diverse set of homeownership experiences. Where community reinvestment mortgage borrowers previously faced few higher-cost refinancing options, the advent of risk-based pricing dramatically expanded the set of alternatives.

As a result, observing homeownership entry (and mitigating default) is no longer sufficient to ensure low long-term costs of homeownership. Instead, evaluation of the economic outcomes associated with such programs requires access to data that follows homeowners across the full homeownership tenure, linking the initial mortgage product to any subsequent refinancing products. For instance, it may be the case that CAP homeowners used subprime ARMs to weather a temporary financial shortfall, refinancing back into prime fixed-rate mortgages shortly after regaining their financial footing. Given the low nominal rates on ARMs during the period of observation, such a use is consistent with the goals of homeownership policy. Alternatively, the transition of some borrowers into subprime products may increase the financing costs of homeownership over the long-term and/or increase the risk of default and foreclosure. Unfortunately, the data necessary to draw clear conclusions regarding the long-term implications of such transitions does not yet exist. Instead, the CAP dataset is unique in allowing analysts to observe the first transition out of the initial mortgage.

In the absence of clear evidence, policymakers are faced with uncertainty regarding the implications of refinancing transitions for the achievement of policy goals. In the long-term, much more research is necessary to understand the full implications of risk-based pricing for community reinvestment lending and other targeted lending activities. In the meantime, mortgage and/or credit counseling at the point of refinancing may reduce concerns over adverse outcomes. Given the frequent use of equity to pay down other

debts, such counseling might also help to resolve any underlying credit issues that threaten households' financial solvency.

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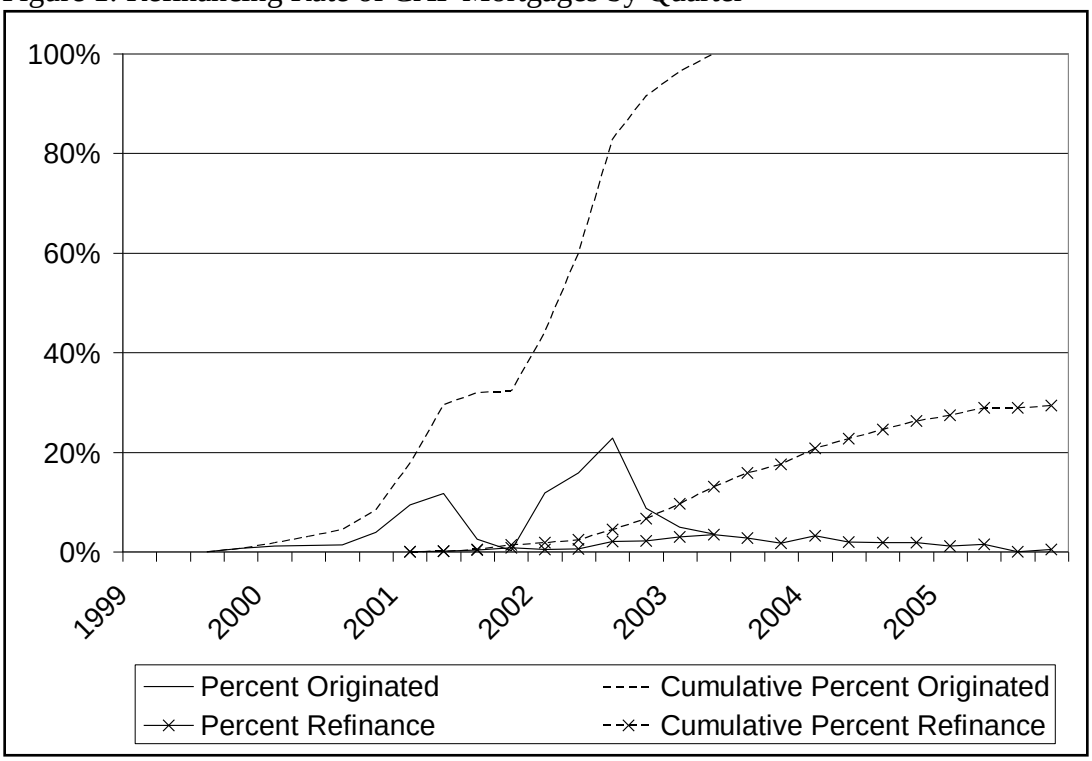
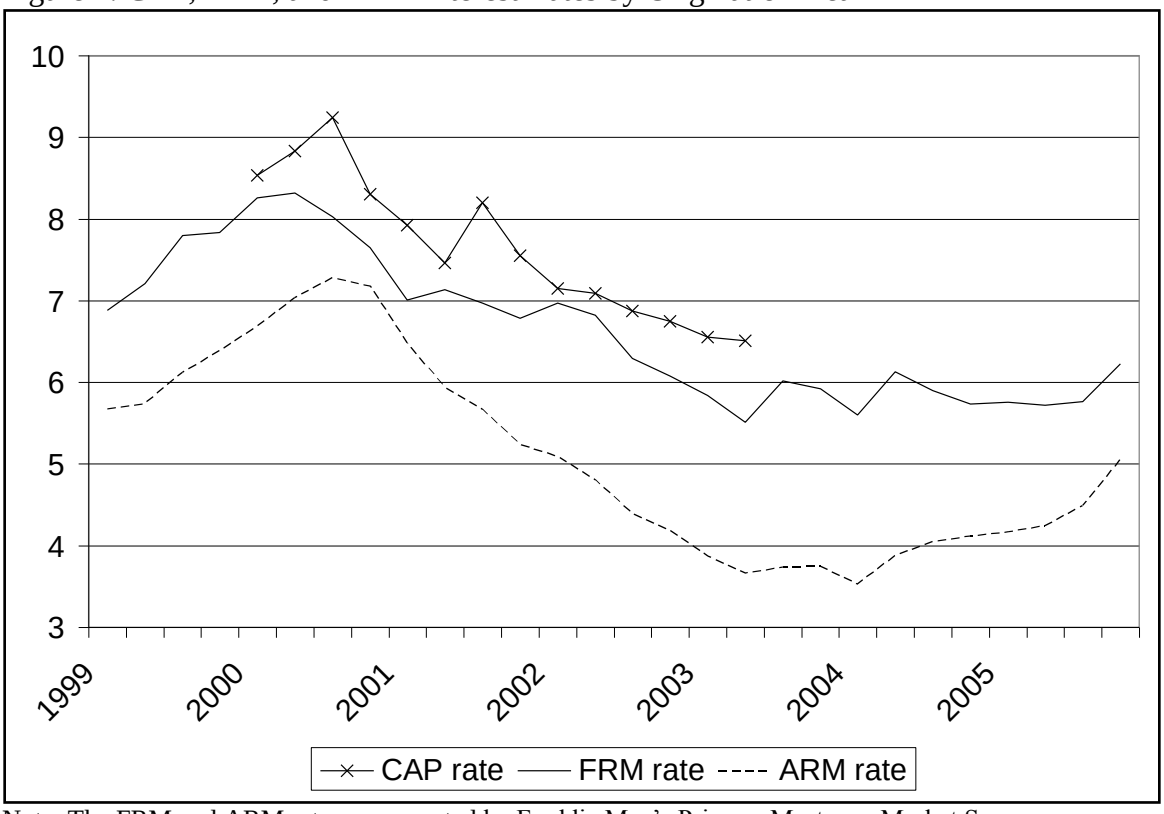
TABLES AND FIGURES

Figure 1: Refinancing Rate of CAP Mortgages by Quarter



N=1,163 loans.

Figure 2: CAP, FRM, and ARM Interest Rates by Origination Year



Note: The FRM and ARM rates are reported by Freddie Mac's Primary Mortgage Market Survey.

Table 1: Descriptive statistics of CAP sample

Variable:	Mean
Origination Date	Feb. 2002
Income	$42,452
Home Value at Origination	$83,836
Unpaid Balance: Outstanding amount on CAP mortgage	$77,701
Equity: Difference between appreciated home value and the unpaid balance	$21,953
Ever 30 days delinquent	26%
Origination Credit Score <580	4%
Origination Credit Score 580-619	10%
Origination Credit Score 620-659	23%
Origination Credit Score 660-719	35%
Origination Credit Score ≥720	27%
Liquid assets more than 2 monthly payments	53%
Respondent lost at least one week of work to unemployment	14%
Divorced/Separated/Widowed following origination	4%
Income Increased	49%
Income decreased	24%
Added a child to the household	18%
White	63%
Black	18%
Hispanic	15%
Other race/ethnicity	4%
High School Degree or less	27%
Some post-secondary education	44%
College degree	28%
Married/Partnered	57%
Age	35.1

N=1,163

Table 2: MMNL Competing Risks Model of Refinancing, Default, and Home Sale.

Dependent Variable:	Refinance		Default		Home Sale	
	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)
Spread	1.321**	(.128)	.029	(.213)	.534*	(.213)
Unpaid Balance	.017**	(.003)	-.001	(.006)	.001	(.005)
Equity	.015**	(.004)	.008	(.007)	.018**	(.006)
Reserves	.364*	(.145)	-.482	(.306)	.022	(.276)
Credit score<620	-.765**	(.271)	2.277**	(.639)	.073	(.454)
Credit score 620-659	-.004	(.196)	1.389*	(.641)	-.224	(.406)
Credit score 660-719	.115	(.178)	.840	(.664)	.118	(.351)
Black	-.953**	(.217)	1.338**	(.374)	-.315	(.430)
Hispanic	-.247	(.221)	-.320	(.476)	-.810	(.504)
Other race/ethnicity	.210	(.360)	.032	(.775)	-.282	(.759)
Some college	.041	(.175)	-.066	(.332)	.370	(.368)
College degree	-.298	(.210)	-.419	(.470)	.451	(.419)
Age	.007	(.007)	-.015	(.016)	-.031	(.017)
Log household income	.148	(.154)	.121	(.287)	.375	(.350)
Married/Partnered	-.083	(.157)	.385	(.335)	.179	(.318)
Unemployment Shock	-.724**	(.237)	.658	(.351)	.409	(.361)
Divorced/separated	.310	(.379)	1.333**	(.441)	.672	(.659)
Income increased	-.269	(.167)	-.451	(.388)	.337	(.369)
Income decreased	-.244	(.212)	.600	(.381)	.515	(.440)
Added a child	-.159	(.193)	.381	(.362)	.759*	(.312)
Intercept	-10.066**	(1.70)	-9.982**	(3.22)	-11.918**	(3.78)
Origination period, $\chi^2(5)$[a]	--**	(16.9)	--	(6.98)	--	(1.93)
Random Part:						
Var(α_j)	.956**	(.339)	.151	(.394)	.800	(.815)
Cov(α_j, α_r)			-.366	(.489)	-.736	(.467)
Cov(α_j, α_d)					.235	().454

[a] The reported significance relates to the joint significance of the five origination period indicator variables. As a result, no coefficient is reported, and the chi-squared statistic is reported in place of a standard error.
N=38,392 monthly observations (1,163 loans).
* p<.05; ** p<.01

Table 3: MMNL Model of Rate vs. Cash-Out Refinancing

Dependent Variable:	Rate Refinance		Cash-out Refinance		Default		Home Sale	
	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)
Spread	1.378**	(.160)	1.301**	(.203)	.029	(.214)	.552*	(.214)
Unpaid Balance	.021**	(.003)	.009*	(.004)	-.001	(.006)	.000	(.005)
Equity	.009*	(.004)	.027**	(.006)	.008	(.007)	.019**	(.006)
Reserves	.438*	(.177)	.229	(.231)	-.479	(.308)	.031	(.277)
Score <620	-.957**	(.326)	-.367	(.469)	2.281**	(.640)	.074	(.458)
Score 620-659	-.365	(.243)	.719*	(.340)	1.387*	(.642)	-.208	(.408)
Score 660-719	-.125	(.211)	.690*	(.321)	.838	(.665)	.142	(.354)
Black	-1.024**	(.262)	-.768*	(.354)	1.344**	(.375)	-.336	(.434)
Hispanic	-.090	(.266)	-.516	(.359)	-.319	(.477)	-.835	(.506)
Other race/ethnicity	.055	(.458)	.342	(.553)	.037	(.777)	-.271	(.762)
Some college	.266	(.220)	-.271	(.262)	-.070	(.333)	.368	(.369)
College degree	.000	(.257)	-.820*	(.343)	-.417	(.472)	.448	(.421)
Age	.027*	(.008)	-.012	(.012)	-.015	(.016)	-.032	(.017)
Log household income	.131	(.188)	.151	(.244)	.121	(.288)	.377	(.351)
Married/Partnered	-.099	(.190)	-.063	(.253)	.388	(.336)	.175	(.319)
Unemployment Shock	-.914**	(.307)	-.408	(.347)	.653	(.354)	.404	(.364)
Divorced/separated	.264	(.474)	.383	(.597)	1.325**	(.444)	.675	(.652)
Income increased	-.279	(.201)	-.224	(.271)	-.456	(.389)	.355	(.371)
Income decreased	-.166	(.256)	-.376	(.347)	.601	(.383)	.520	(.443)
Added a child	-.133	(.234)	-.180	(.314)	.376	(.363)	.730*	(.310)
Intercept	-10.949**	(2.10)	-10.956**	(2.70)	-9.997**	(3.24)	-11.961**	(3.81)
Origination period, $\chi^2(5)$[a]	--**	(21.9)	--	(6.21)	--	(6.95)	--	(1.90)
Random Part:								
Var(α_j)	1.155*	(.487)	1.513	(.903)	.188	(.427)	.861	(.814)
Cov(α_j, α_r)			.615	(.421)	-.364	(.566)	-.852	(.491)
Cov(α_j, α_c)					-.451	(.635)	-.120	(.601)
Cov(α_j, α_d)							.178	(.485)

[a] The reported significance relates to the joint significance of the five origination period indicator variables. As a result, no coefficient is reported, and the chi-squared statistic is reported in place of a standard error.
N=38,392 monthly observations (1,163 loans).
* p<.05; ** p<.01

Table 4: Characteristics of Refinancing Products

	FRM	ARM
Variable:	Mean	Mean
CAP Interest Rate	7.62	7.56
Refinanced Rate	5.99	5.96
Pricing: Rate minus PMMS rate	0.07	1.95
Percent High-Cost: Pricing > 1.50	7%	50%
Amount Refinanced	$90,590	$100,247
Percent who Extract Equity	30%	47%
Amount of Equity Extracted	$17,647	$15,452
N	274	68

N=274 FRM Refinances; N=68 ARM Refinances.
Note: The PMMS rates used to calculate the pricing measure are the monthly average rates on FRM and ARM mortgages reported by Freddie Mac's Primary Mortgage Market Survey.

Table 5: Probit selection models of ARM (vs. FRM) choice.

Dependent Variable:	ARM		ARM	
	Coef.	z-stat	Coef.	z-stat
FRM interest rate	0.191	0.86	0.239	1.14
Yield	0.222	1.70	0.236	1.86
Updated LTV	0.734	0.87	0.755	0.92
Reserves	-0.126	0.74	-0.201	1.19
Ever 30 day delinquency	0.018	0.09	-0.052	0.26
Credit score <620	0.226	0.75	0.169	0.58
Credit score 620-659	0.117	0.53	0.050	0.24
Credit score 660-719	0.007	0.04	-0.123	0.61
Cashout refinance	0.444*	2.53	0.879**	3.77
Mortgage broker			0.458**	2.93
Black	-0.087	0.35	-0.059	0.25
Hispanic	0.304	1.24	0.268	1.11
Other race/ethnicity	-0.238	0.55	-0.137	0.33
Some college	-0.025	0.12	0.002	0.01
College degree	0.363	1.47	0.299	1.23
Age	0.000	0.03	-0.004	0.45
Household income (logged)	0.119	0.78	0.137	0.93
Married/partnered	0.062	0.23	-0.148	0.56
Unemployment shock	-0.107	0.59	-0.118	0.68
Divorced/separated	-0.472	0.89	-0.389	0.72
Income increased	-0.445*	2.38	-0.017	0.08
Cashout * Income increased			-1.168**	3.47
Income decreased	0.107	0.46	0.080	0.35
Added a child	0.032	0.15	-0.027	0.13
Constant	-4.875*	2.25	-5.595**	2.77
Rho, $\chi^2(1)$	--	2.74	--*	5.86
Uncensored N	342		342	
N	1,163		1,163	

* p<.05; ** p<.01

Table 6: Probit selection models of high-cost mortgage use.

Dependent Variable:	High-cost		High-cost	
	Coef.	z-stat	Coef.	z-stat
FRM interest rate	-0.640	1.92	-0.787*	2.11
Yield	-0.155	1.06	-0.290	1.69
Updated LTV	1.853	1.73	1.747	1.51
Reserves	-0.063	0.30	-0.028	0.12
Ever 30 day delinquency	0.301	1.22	0.279	1.03
Credit score <620	0.261	0.68	0.142	0.31
Credit score 620-659	0.190	0.66	0.194	0.62
Credit score 660-719	-0.136	0.48	-0.069	0.22
Cashout refinance	1.042**	4.17		
Cashout refinance-ARM			2.165**	5.23
Cashout refinance-FRM			0.562*	2.14
Mortgage broker	0.385	1.90	0.354	1.59
Black	0.593	1.88	0.490	1.42
Hispanic	0.760*	2.55	0.816*	2.50
Other race/ethnicity	0.182	0.35	0.520	0.98
Some college	-0.127	0.56	-0.115	0.46
College degree	-0.319	1.06	-0.321	0.96
Age	0.005	0.51	0.006	0.54
Household income (logged)	-0.065	0.34	-0.186	0.80
Married/partnered	0.064	0.22	0.092	0.28
Unemployment shock	0.007	0.03	0.006	0.02
Divorced/separated	-0.597	0.95	-0.831	1.01
Income increased	-0.372	1.62	-0.108	0.42
Income decreased	0.293	1.04	0.155	0.49
Added a child	-0.246	0.85	-0.470	1.34
Constant	0.877	0.30	3.471	0.96
Rho, $\chi^2(1)$	--	1.76	--	0.39
Uncensored N	342		342	
N	1,163		1,163	

* p<.05; ** p<.01

Center for Community Capital
The University of North Carolina at Chapel Hill
1700 Martin Luther King Blvd
Campus Box 3452, Suite 129
Chapel Hill NC 27599-3452
(919) 843-2140
communitycapital@unc.edu
www.ccc.unc.edu

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