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Portfolio Adjustment to Home Equity Accumulation among CRA Borrowers

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Abstract

This paper identifies the financial implications of equity accumulation for low- and moderate-income (LMI) borrowers. The analysis examines whether the accumulation of equity crowds out other investments, as well as whether equity is substantially extracted through other borrowing. The data come from a unique panel study of Community Reinvestment Act (CRA) borrowers and matched renters. A copula modeling approach estimates the distribution of a financial portfolio; the distribution is used to simulate the effect of equity accumulation on the portfolios of the renters. The analysis reveals no evidence that equity accumulation crowds out other investments, or that CRA beneficiaries deplete equity through borrowing.

Home ownership is assumed to build wealth in two ways: it forces owners to save by paying down the principal owed and it increases owners' net worth when the house appreciates beyond the cost of the down payment and mortgage. For many Americans, especially less affluent Americans, the resulting home equity represents the greater part of their household wealth. This is especially true for lower-income people: the Joint Center for Housing Studies estimates that home equity makes up almost 80% of the wealth of the median owner with income below $20,000 (Di, 2003).

In 1977, Congress passed the Community Reinvestment Act (CRA), which placed upon banks the affirmative obligation that they meet the credit needs of the communities in which they are chartered, consistent with the ''safe and sound operation'' of the issuing institutions. Regulated financial institutions can meet their CRA obligations in a variety of ways, one of which is through the provision of affordable home loans. While not limited to the promotion of mortgage finance, the CRA has served to extend the financial benefits of homeownership to low- and moderate-income (LMI) people.

Recently, however, there has been much debate among scholars regarding the financial implications of facilitating home ownership for LMI households through the CRA (Russakoff, 2008; Seidman, 2009; Silver and Marsico, 2009). Home ownership has long been understood as a mechanism for consistently adding value to net worth through the accumulation of equity (Hollaway, 1991; Turner and Luea, 2009). Yet, especially in the context of the contemporary real estate market, many question the wisdom of encouraging ownership when renting often appears a lower risk and more affordable option (Fratantoni, 1998; Smith and Smith, 2007). Though much research has considered the performance of home equity as an investment instrument in general (Walden, 1983;

Hansen and Skak, 2008), surprisingly few studies have focused specifically on the role of equity accumulation in the portfolios of LMI borrowers. The current study fills this gap.

This study examines how lower-income borrowers' portfolios respond to the accumulation of home equity that is associated with their CRA loans. Two potential negative consequences of the use of home equity as an investment mechanism are: (1) the crowding out of other investment tools and a resulting under-diversification of the portfolio (Turner, 2003; Hilber, 2005) and (2) the tendency to over-borrow against equity (Klyuev and Mills, 2007; Benjamin and Chinloy, 2008).

In response to these concerns, this investigation examines two important questions: (1) Are CRA homeowners increasing their levels of borrowing in response to the accumulation of home equity? and (2) Are CRA borrowers limiting their investments in other financial instruments and savings, effectively establishing the accumulation of home equity as a substitute for other wealth-building activities? These questions are addressed using data from a unique panel study, the Community Advantage Program (CAP), which links extensive loan-level information with in-depth household-level survey data. This paper is one in a series of articles that provide in-depth analysis of the CAP data.[1] These papers examine, among other things, the performance of CAP loans (Quercia, Stegman, Davis, and Stein, 2002; Stegman, Quercia, and Davis, 2007; Ding, Quercia, Li, and Ratcliffe, 2011), including various factors that affect performance (Stegman, Quercia, Ratcliffe, Ding, and Davis, 2007; Ding, Quercia, and Ratcliffe, 2008a; Quercia and Spader, 2008; Spader and Quercia, 2011), the interrelationship between CRA and subprime lending (Ding, Quercia, and Ratcliffe, 2008b; Spader and Quercia, 2010), the transition from renting to owning (Cohen, Lindblad, Paik, and Quercia, 2009), the mobility of low-income owners (Spader and Quercia, 2008), and homeownership and civic engagement (Manturuk, Lindblad, and Quercia, 2009a, 2009b, 2010).

Equity Accumulation and CRA Borrowers

Many scholars have noted the positive externalities of home ownership, including better scholastic performance of children (Barker and Miller, 2009), better maintenance of neighborhoods (Santiago et al., 2010), and greater neighborhood stability and a higher level of voluntary and civic engagement (Rohe, McCarthy, and Van Zandt, 2000). However, the driving argument in support of promoting home ownership to LMI people has been that owning a home provides financial benefits, principally the accumulation of equity.

The question naturally arises as to whether the accumulation of equity offsets the additional costs of home ownership relative to renting, i.e., home maintenance (Evans, 1995), lower mobility (Gabriel and Painter, 2008), and risk in the real estate market (Saegert, Fields, and Libman, 2009). Even if the accumulation of equity outweighs the true costs of home ownership, some have argued that that the purchase of a home is inadvisable for investment reasons. Two of the major criticisms of the pursuit of equity are that it crowds out other investment options and that it is diminished through excessive borrowing.

How might the home serve to crowd out other investment options? First, the scale of investment in the home is fairly inflexible, meaning the consumer cannot adapt the

amount allocated to the mortgage payment to the expected return on investment in the home. Though there may be some leeway available in terms of the down payment amount, building equity requires a regular and fairly invariant payment. Especially for LMI borrowers, due to their well-documented comparatively high marginal propensity to consume (Fan, 2006), the mortgage payment may represent a large proportion of income, leaving little for other investments and resulting in an under-diversified portfolio. Second, the home is by nature illiquid and its exchange generally involves significant costs (McCarthy, Van Zandt, and Rohe, 2001); one cannot buy and sell the housing investment rapidly and inexpensively as one might trade other investment instruments in order to maximize returns.

A second criticism of the home as an investment instrument is that the associated wealth gains are diminished through excessive borrowing. While the accrual of equity might be a benefit for LMI households, it comes with the temptation to borrow that money back for other uses. It is true of any asset that an investor must be careful regarding decisions to leverage that asset in the form of new borrowing, but in the case of home equity, this is particularly important since there is an entire industry devoted to soliciting homeowners to borrow against their home. The subprime mortgage market arose in the 1980s to extend cash-out refinance and debt consolidation loans to borrowers with weak credit but plenty of home equity. In 1986, when tax reform meant taxpayers could no longer deduct consumer loan interest but could still deduct home mortgage interest, homeowners began shifting debt to their homes by borrowing against them to fund purchases and pay off consumer debt.

A critical task in evaluating the financial impact of CRA lending is to determine whether LMI borrowers (1) accumulate too much debt along with their equity and (2) would be well invested and diversified in other instruments in lieu of the investment in the home. It is important to note that with regards to the second issue, this study is not trying to render a comprehensive theoretical assessment of the *potential* alternative investments to homeownership, as is done by Cauley, Pavlov and Schwartz (2007), but is instead attempting to determine whether there is evidence that the accumulation of equity crowds out other investing activity.

The CAP Data

The data come from a six-year-long panel study conducted as part of the Community Advantage Program. CAP began as a secondary mortgage market program developed out of a partnership between the Ford Foundation, Fannie Mae, and Self-Help, a leading community development financial institution. Under the CAP program, participating lenders are able to sell nonconforming CRA mortgages to Self-Help, which then securitizes and sells them to Fannie Mae and other investors; Self-Help retains recourse on these loans. CAP loans are characterized by flexible underwriting that usually requires little or no down payment, nontraditional proofs of creditworthiness, and sometimes no requirement for mortgage insurance. CAP borrowers are either low-income, LMI minority borrowers, or LMI borrowers in low-income or minority neighborhoods. By the end of 2004, more than 28,000 families had purchased homes through lenders participating in the CAP programs.

Who are CAP's borrowers? CAP's borrowers are concentrated in the southeastern United States and tend to live in more developed regions, with only 12% living in rural areas. The median borrower is 32 years old. Some 41% of CAP's borrower households are headed by a woman, and almost half of CAP borrowers have children living in the home. Approximately 57% of CAP borrowers are white, 58% are married or in a committed relationship, and 88% have at least a high school diploma. CAP's borrowers have a median annual household income of $30,972, with 25% of borrower households having an annual income below $24,372 and 75% having annual income below $38,400. The median loan balance at origination for CAP's borrowers was $80,985, and this amount was issued at an interest rate of 7.13%.

Clearly the question of the wealth building effects of homeownership for LMI families is compelling only if those families are able to hold on to their homes (and thereby build equity and wealth). How do CAP's CRA borrowers fare in terms of delinquency and foreclosure? Descriptive analysis of the CAP portfolio reveals that these loans perform better than fixed- and adjustable-rate subprime products and also better than adjustable-rate *prime* products. As of the fourth quarter of 2009, only 7.6% of CAP Program loans were 90 days or more delinquent. CAP's rate of serious delinquency—7.6%—compares favorably with the serious delinquency rates of 22% for fixed-rate subprime borrowers, 18% for adjustable-rate *prime* borrowers, and 43% for adjustable-rate subprime borrowers; it is slightly higher than the serious delinquency rate of 5% for prime fixed-rate borrowers.[2] As of the writing of this paper, fewer than 5% of CAP's owners have lost their homes to foreclosure.[3] Considering the depressed state of the market and the limited resources of these households, this is remarkable performance.

Since this paper concerns, in part, equity gains and the possible crowding out of other investments by investment in the home, it bears noting how CAP's rates of home appreciation have fared relative to other investment opportunities. From loan origination through the second quarter of 2009, CAP program home owners saw their homes go up in value by a median annualized rate of 2.5%, yielding a median equity increase of $21,400. In comparison, during that same period, the Dow Jones Industrial Average *declined* by 3.4% on an annualized basis, and six-month CD rates averaged an annual return of 3.4%. While it's true that investing in a CD might have brought greater returns in the short run, there are three benefits to investing one's money in a home. First, a home is a consumption good and therefore is an investment that also provides the tangible benefits of an inviolable shelter. Second, homeownership is a unique opportunity for leveraged investment: an owner/investor puts down only a fraction of the value of the home on purchase but gains any increase in its overall value at resale. Third, and most importantly, the analysis detailed in this paper reveals that LMI households are unlikely to engage in investing *other than* the money they put into a home. By virtue of buying an affordable home, CAP's owners have gained wealth that would not otherwise have been available to them.

Empirical Analysis

In 2004, the Center for Community Capital at the University of North Carolina at Chapel Hill began conducting annual surveys with a panel of CAP participants to evaluate the

impacts of home ownership on their lives. In order to conduct this analysis, a random sample of CAP borrowers was selected to participate in a series of annual surveys. Once the sample of homeowners was selected, a comparison group of renters was matched to the home owners based on neighborhood proximity and income. This matching was limited to the 30 metropolitan areas in the U.S. with the highest number of CAP owners. The renter sample was obtained by randomly selecting households who lived within the same census blocks as participating home owners, based on public telephone directory lists. Like the CAP owners, the renters had to have an annual income no more than 80% of area median income (AMI) if white or no more than 115% of AMI if non-white. Respondents also had to be between 18 and 65 years old and pay rent to the owner of their residence.

The current analysis draws on two years of CAP data and focuses on 982 owners and 595 renters matched to owners. (Exhibit 1 gives a descriptive overview of owners and renters.) The two years in question, 2005 and 2008, are the years in which the panel survey included an extensive module related to participants' finances and wealth holdings. The goal in this current analysis is to identify any possible effect of equity accumulation on the rest of the respondents' financial portfolios.

In the method employed, respondents' financial portfolios are described as a system where the individual components are dependent upon each other. The data from the survey are non-normal, with high kurtosis. The data are therefore unfit for methods designed for normally distributed data, such as seemingly unrelated regression. Multivariate copulas have seen broad application in economic applications lately (e.g., Chan and Kroese, 2010; Eluru, Bhat, Pendyala, and Konduri, 2010; Zhao and Zhou, 2010), and their development is motivated, at least in part, to handle dependence (i.e., correlation) among non-normal variables (Papaefthymiou and Kurowicka, 2009). In this approach to multivariate modeling, flexible univariate distributions are used to describe the individual variables (margins), and dependence structures are introduced to the model via a copula function. The marginal and copula (see the Appendix) parameters give the full joint distribution of the variables under study (Sungur, 2000). From this joint distribution, all quantities of interest—conditional distributions/expectations (i.e., regression functions), bivariate distributions, variances and conditional variances—can be derived. What is of greatest interest is that the joint distribution derived from the copula can be used to derive the adjustment of any element of the financial portfolio in response to a shift in home equity.

Similar to the approach in Cutter and DeWoody (2010), this study uses simulation to explore the results from the empirical analysis. In the first step, the copula and marginal parameters are estimated using the demographic and financial characteristics of CRA owners (specifically, those CAP owners who remained owners through the end of the study in 2008). Next, for the renters (again, who remained renters through the end of the study in 2008) matched to these owners, they are assigned the home equity of their matches, and then a set of response variables are drawn 10,000 times. These response variables are dependent upon a set of fixed variables drawn from the literature as likely to be determinants of the response variables, but not dependent upon home equity values. The effect of equity accumulation is identified as the simulated change in the renters' response variables, that is, the difference in their simulated portfolio values accounting

Exhibit 1. Descriptive Statistics

	Owners				Renters			
	Levels in 2008				Levels in 2008			
	Mean	Std. Dev.	Skew	Kurtosis	Mean	Std. Dev.	Skew	Kurtosis
Home Equity $	28,770.11	32,949.37	2.06	11.53	—	—	—	—
Transactions Accounts $	6,305.41	14,816.40	7.48	90.27	3,642.37	13,071.41	15.40	353.59
Investments $	7,199.33	32,485.90	13.51	269.51	5,804.20	47,879.92	20.76	508.71
Non-Residence Equity $	17,148.77	77,764.18	13.60	256.94	11,374.36	112,101.57	25.47	728.20
Credit Card Debt $	4,362.22	6,801.78	2.42	10.07	2,271.51	5,581.62	4.42	28.77
Student Loan Debt $	5,836.77	14,830.54	3.71	19.45	6,082.27	16,912.43	4.16	23.16
Borrow Against Home $	3,056.63	10,905.23	5.31	39.68	—	—	—	—
Age (yrs)	37.15	10.80	0.99	3.79	40.07	12.82	0.47	2.26
Income $	51,580.06	31,779.59	1.68	7.84	42,572.93	32,107.79	1.68	7.51
Number of Children	1.17	1.22	1.02	4.13	0.95	1.17	1.26	4.33
% With Bachelor's Deg.	30	—	—	—	25	—	—	—
% Black	20	—	—	—	37	—	—	—
% Hispanic	16	—	—	—	29	—	—	—
	Change from 2005–2008				Change from 2005–2008			
Home Equity $	−1,732.86	48,797.06	−7.86	126.40	—	—	—	—
Transactions Accounts	2,782.39	13,313.68	8.66	124.48	1,309.88	11,501.43	15.30	374.15
Investments $	4,712.75	30,195.08	14.09	294.96	3,939.24	46,268.72	20.48	498.07
Non-Residence Equity $	10,451.71	95,714.81	6.31	106.19	8,633.21	115,970.79	22.76	622.31
Credit Card Debt $	977.14	6,850.14	0.70	12.68	548.26	5,375.28	2.56	29.12
Student Loan Debt $	1,648.17	9,949.25	2.68	21.61	2,302.55	12,388.36	4.56	40.69
Number of Children	0.14	0.87	0.53	7.97	0.10	0.86	0.35	12.09
Borrow Against Home $	−205.00	13,733.96	−0.11	26.86	—	—	—	—
Income $	15,194.55	28,091.67	1.92	10.52	12,824.29	26,634.29	1.90	10.19
% With Bachelor's Deg.	3	—	—	—	4	—	—	—

Note: Summary statistics given for the sample composed of the 982 owners and 595 renters. All financial variables are given in 2008 dollars.

Exhibit 2. The Relationship between Home Equity and Transaction Account Balances

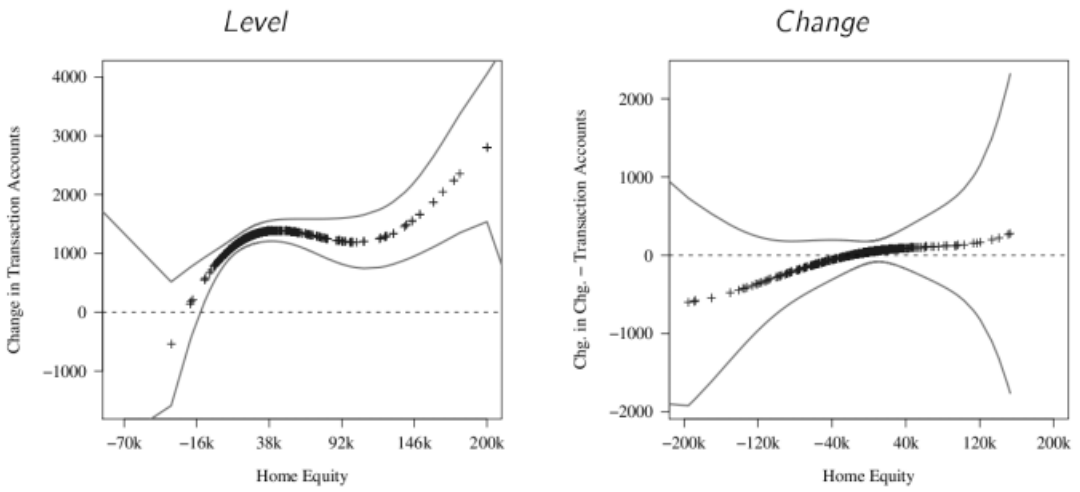
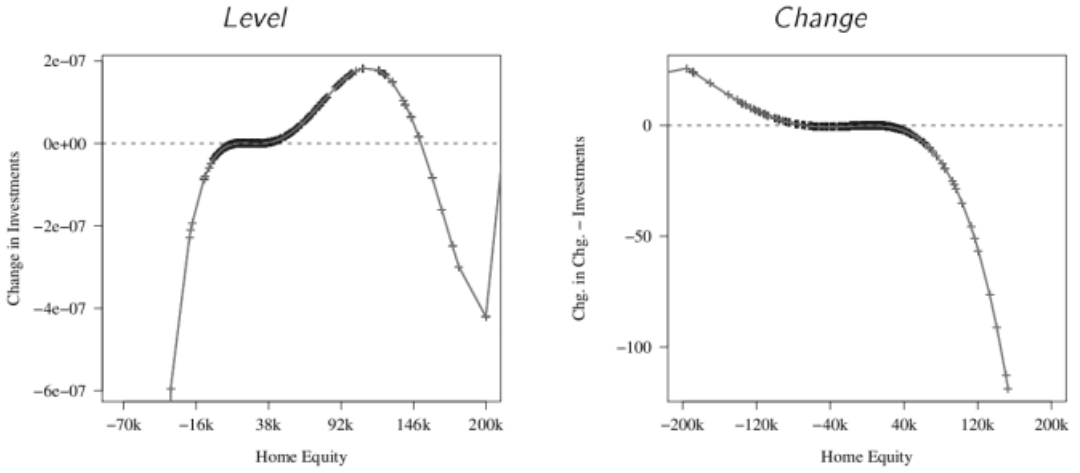


Exhibit 3. The Relationship between Home Equity and the Value of Investments



for the matched owners' home equity and the observed values of the renters' response variables. This design comes close to answering the question a policymaker should pose in evaluating the CRA: What, if anything, would be the effect of placing an eligible renter in the condition of CRA-funded homeownership? The particular copula functions that are used result in somewhat nonlinear relationships between home equity and the rest of the portfolio, so the results are presented graphically (Exhibits 2–7) and the marginal and copula parameter estimates are presented in Exhibits 8–10.

Exhibit 4. The Relationship between Home Equity and Non-Primary Residence Equity

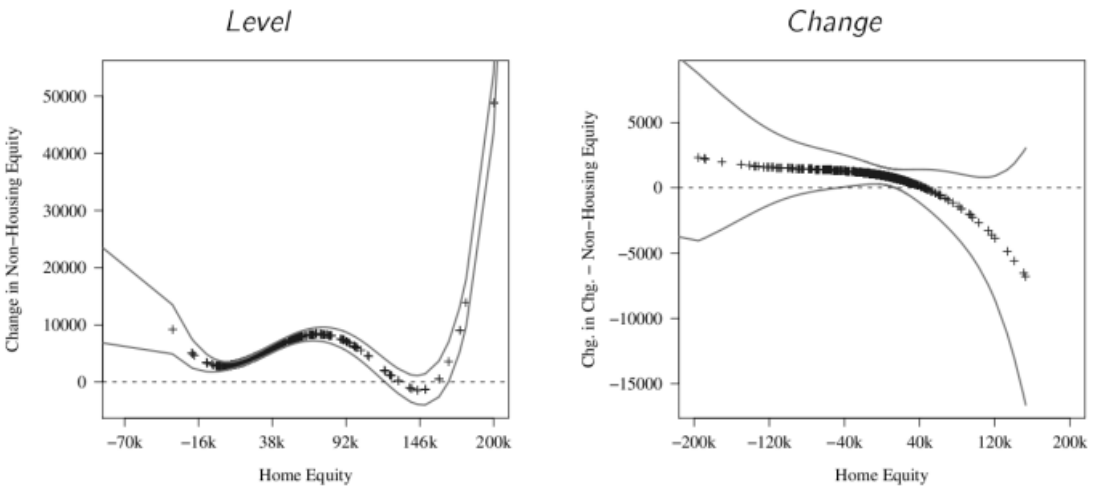
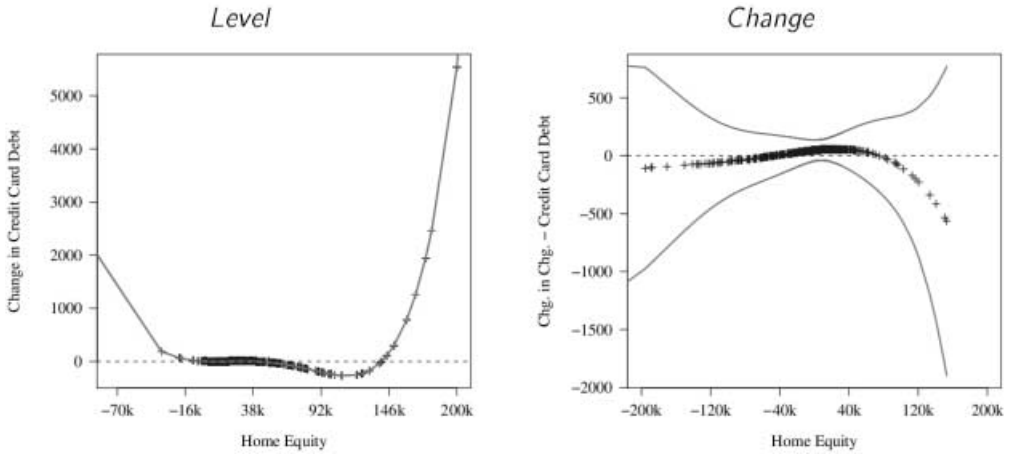


Exhibit 5. The Relationship between Home Equity and Credit Card Debt



The literature is examined to identify factors that may be influenced by home equity, and the fixed (i.e., control) variables were chosen that correspond to those which have been identified to influence one or more of the selected response variables. The relationships between home equity and the assets constituting the following variables are considered—all measured in 2008 dollars.[4] The response variables include: (1) transaction account balances (total amount held in all checking, savings, and CDs at the time of the interview); (2) investments (stocks, bonds, mutual funds, and retirement accounts); (3) credit/charge card debt; (4) equity (value − corresponding debt[5]) in non-primary-residence properties and major durables (vacation homes, commercial property, land, investment properties,

Exhibit 6. The Relationship between Home Equity and Student Loan Debt

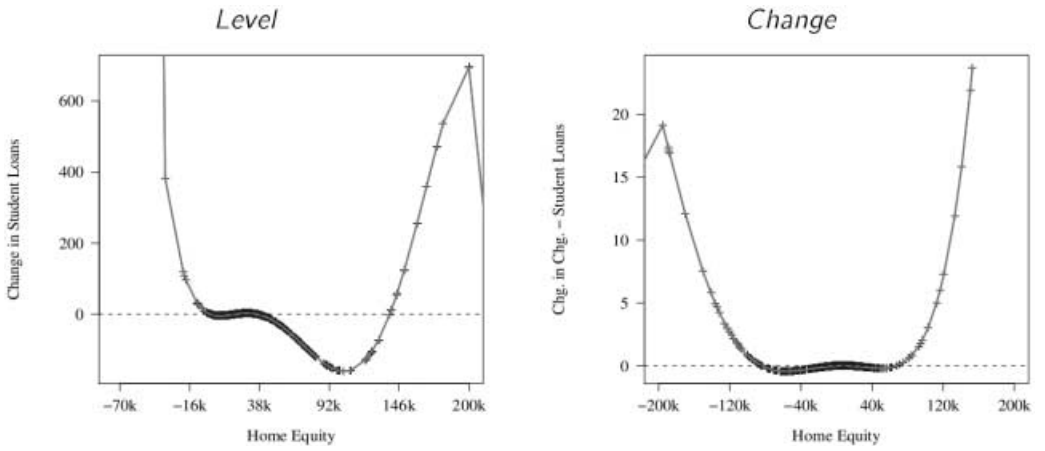
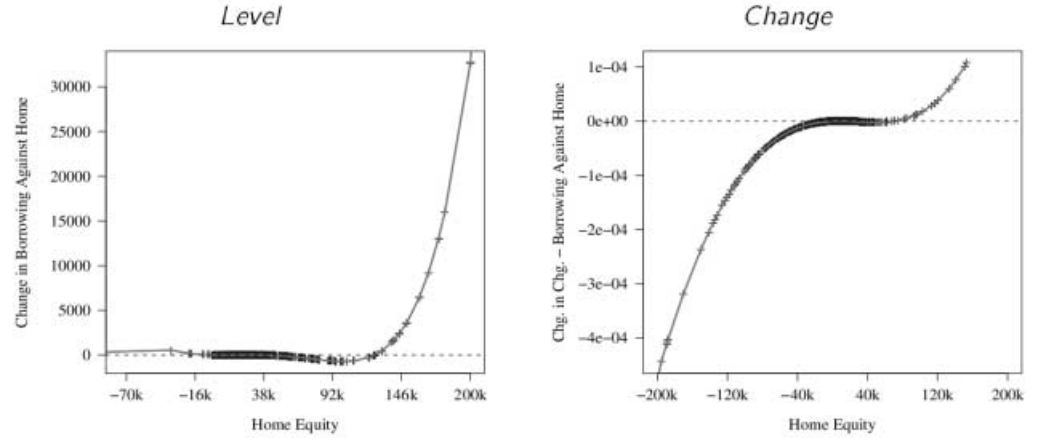


Exhibit 7. The Relationship between Home Equity and Borrowing against the Home



timeshares, and vehicles); (5) student loan debt; and (6) borrowing against the home (value of home equity lines of credit + second mortgage value + cash-out refinance amount). The fixed variables include: (1) age; (2) income; (3) education (a seven point ordinal scale: 1 = no HS diploma, 2 = high school graduate/GED, 3 = some college/trade school but no degree, 4 = associate degree/trade school certificate/non-traditional: vocational or other license, 5 = bachelors degree, 6 = some graduate school but no graduate degree, 7 = graduate or professional degree); (4) number of children; (5) race (black, Hispanic, or non-Hispanic white/other); and (6) home equity (home value[6] − mortgage balance at interview time).

Exhibit 8. Estimates of the Marginal Parameters

	Levels in 2008		
	Location	**Variance**	**Kurtosis**
Home Equity	0.0	−59.56	−3.50
Transaction Accounts	7,050.20	−2.52	−2.14
Student Loans	10.0	−4.51	1.01
Credit Card Debt	6,543.30	−2.59	−0.69
Children	1.9	−1.00	−0.43
Investments	21,867.10	−2.85	0.71
Non Housing Equity	4,162.20	8.61	0.13
Borrowing Against the Home	1.0	−48.13	−2.15
Age	8.9	−4.62	−7.69
Education	0.4	−1.54	—
Income	42,828.00	−5.09	−5.12
	Change 2005–2008		
Home Equity	0.00	−56.28	−3.60
Transaction Accounts	19.10	7.26	−0.10
Student Loans	0.00	−59.32	−3.11
Credit Card Debt	34.80	6.82	−0.35
Children	0.00	−55.50	−2.99
Investments	0.00	−59.95	−3.29
Non Housing Equity	930.60	8.86	−0.01
Borrowing Against the Home	0.00	−52.73	−2.55
Education	0.00	−2.57	—

Note: Correlations are posterior means from the MCMC simulations with a burn-in of 10k and posterior sample of 50k.

The model is repeated for both cross-sectional amounts in 2008 and is changed from 2005 to 2008. It is important to note that the questions about debt related to non-housing equity (response variable number four) were not asked in the 2005 wave of the survey. Multiple imputation is used to deal with these missing variables.[7]

A critical choice in the modeling process is the specification of the marginal distributions. As can be seen by the empirical kurtosis in the fourth column of Exhibit 1, the tails in the data are very heavy [the kurtosis of a normally distributed random variable is 3 (Boutahar, 2010)]. There are four types of variables in the data: (1) a dichotomous variable, race, broken down into three binary variables (black, Hispanic, or non-Hispanic white/other); (2) a bounded discrete variable, education, which is a seven-point ordinal variable; (3) strictly non-negative variables, such as credit card debt, second mortgage value, investments, etc.; and (4) unbounded variables, such as net worth and 2005–2008 changes in non-negative variables. Marginal distributions that can accommodate the support of the variables were selected that also allow for heavier than normal tails. A Bernoulli distribution is used for race. A beta-binomial distribution is used for education, which allows for variance beyond that of the binomial, the three-parameter zero-adjusted

Exhibit 9. Correlation Matrix from the Multivariate Normal Copula for the "Level" Model

	HE	TA	IV	NRE	CC	SL	H	Age	INC	CLD	ED	BL	HP
Home Equity (HE)	1	0.225	0.068	0.149	0.105	0.039	0.353	0.078	0.290	0.038	0.151	−0.190	−0.160
Transactions Accounts (TA)	0.225	1	0.221	0.175	−0.009	0.046	0.017	0.065	0.392	−0.074	0.195	−0.049	−0.107
Investments (IV)	0.068	0.221	1	0.063	−0.006	−0.014	0.020	−0.037	0.146	−0.062	0.091	0.048	−0.059
Non-Residence Equity (NRE)	0.149	0.175	0.063	1	0.045	0.005	0.050	0.015	0.128	0.005	0.057	−0.011	−0.046
Credit Card Debt (CC)	0.105	−0.009	−0.006	0.045	1	0.156	0.182	0.098	0.237	−0.003	0.155	−0.097	−0.116
Student Loan Debt (SL)	0.039	0.046	−0.014	0.005	0.156	1	0.058	0.210	0.234	−0.030	0.390	−0.022	0.021
Borrow Against Home (BAH)	0.353	0.017	0.020	0.050	0.182	0.058	1	0.071	0.179	0.053	0.089	−0.083	−0.064
Age	0.078	0.065	−0.037	0.015	0.098	0.21	0.071	1	0.331	0.314	0.213	−0.214	−0.054
Income (INC)	0.290	0.392	0.146	0.128	0.237	0.234	0.179	0.331	1	0.047	0.417	−0.185	−0.226
Children (CLD)	0.038	−0.074	−0.062	0.005	−0.003	−0.030	0.053	0.314	0.047	1	−0.142	−0.170	−0.014
Education (ED)	0.151	0.195	0.091	0.057	0.155	0.390	0.089	0.213	0.417	−0.142	1	−0.048	−0.089
Black (BL)	−0.190	−0.049	0.048	−0.011	−0.097	−0.022	−0.083	−0.214	−0.185	−0.170	−0.048	1	−0.222
Hispanic (HP)	−0.160	−0.107	−0.059	−0.046	−0.116	0.021	−0.064	−0.054	−0.226	−0.014	−0.089	−0.222	1

Note: Correlations are posterior means from the MCMC simulations with a burn-in of 10k and posterior sample of 50k.

Exhibit 10. Correlation Matrix from the Multivariate Normal Copula for the "Change" Model

	HE	TA	IV	NRE	CC	SL	CLD	BAH	Age	INC	ED	BL	HP
Dif in Home Equity (HE)	1	0.05	0.02	0.12	0.05	0.04	−0.02	0.09	0.04	0.07	0	0.03	0.03
Dif in Transaction Accounts (TA)	0.05	1	0.14	0.16	−0.01	0.02	0	−0.12	0.05	0.25	−0.03	−0.03	−0.06
Dif in Investments (IV)	0.02	0.14	1	0.03	0	−0.01	0.01	0	−0.03	0.1	−0.01	0.05	−0.04
Dif in Non-Residence Equity (NRE)	0.12	0.16	0.03	1	0.06	0	0.02	0	0.02	0.1	0.01	0	−0.03
Dif in Credit Card Debt (CC)	0.05	−0.01	0	0.06	1	0.01	0.03	0.06	0.06	0.04	0	−0.02	−0.01
Dif in Student Loans (SL)	0.04	0.02	−0.01	0	0.01	1	0	−0.07	0.11	0.13	0.14	0.01	0
Dif in Children (CLD)	−0.02	0	0.01	0.02	0.03	0	1	0.01	0.22	0.07	0	−0.04	−0.08
Dif in Borrowing Against Home (BAH)	0.09	−0.12	0	0	0.06	−0.07	0.01	1	−0.01	−0.03	0	0.01	0.02
Age	0.04	0.05	−0.03	0.02	0.06	0.11	0.22	−0.01	1	0.26	0.09	−0.21	−0.05
Dif in Income (INC)	0.07	0.25	0.1	0.1	0.04	0.13	0.07	−0.03	0.26	1	0.04	−0.05	−0.13
Dif in Education (ED)	0	−0.03	−0.01	0.01	0	0.14	0	0	0.09	0.04	1	0.05	0.03
Black (BL)	0.03	−0.03	0.05	0	−0.02	0.01	−0.04	0.01	−0.21	−0.05	0.05	1	−0.22
Hispanic (HP)	0.03	−0.06	−0.04	−0.03	−0.01	0	−0.08	0.02	−0.05	−0.13	0.03	−0.22	1

Note: Correlations are posterior means from the MCMC simulations with a burn-in of 10k and posterior sample of 50k. "Dif. in" means the 2005–2008 change.

inverse-Gaussian distribution for the non-negative variables, and the three-parameter generalized Student's t distribution for the unbounded variables. See Rigby and Stasinopoulos (2005) for details on these distributions.

The next step in specifying the model is to choose the copula function. One challenge in the construction of the model is the estimation of the dependence relations among a mixture of discrete (e.g., race) and continuous (e.g., equity) random variables. This means it is inappropriate to use many of the copulas developed for and/or applied to financial data in previous work because of their inability to accommodate discrete margins (Sungur, 2000). The Bayesian estimator developed by Pitt, Chan, and Kohn (2006) is used here to estimate a multivariate normal dependence structure for a mixture of discrete and continuous variables. This structure can then accommodate the non-normal shapes and different support types of the margins. The familiar multivariate normal correlation matrix can be used to describe the dependence as well.[8]

The results are presented in Exhibits 2–7. There are two plots in each exhibit. The plot labeled ''Level'' refers to the results from the 2008 cross-sectional analysis, and the plot labeled ''Change'' refers to the 2005–2008 change model. In each ''Level'' analysis, the x-axis gives the amount of home equity transferred to the matched renter, and the y-axis gives the simulated change in the renter's asset/debt. In the ''Change'' analysis, the x-axis gives the difference in 2008 and 2005 home equity that is transferred to the renter, and the y-axis gives the difference between the simulated 2005–2008 change in the debt or asset value and the actual change experienced by the matched renter. All quantities are in 2008 dollars. Confidence intervals around the effects are used to determine whether it is likely that large negative reactions in portfolio components result from the accumulation of equity. The points are placed at actual home equity values from the sample, and 99% confidence intervals from the simulation are placed around the estimates; 99% confidence intervals are used in the interest of conservative inference. Since there is little reason to believe that equity accumulation will positively impact other investments or reduce debt, the finding that would favor the CRA as a policy prescription would be that home equity accumulation has a relatively small effect on the other portfolio components. Larger than conventional confidence intervals are drawn in order to consider any possible large effects of home equity, and the analysis is biased toward concluding that large increases in debt or decreases in other assets are plausible outcomes. This way, if large (i.e., offsetting) effects lie outside of the confidence bands, justifiable claims can be made that CRA loans represent a strong forced-savings mechanism for the target borrowers, in that equity accumulation does not result in off-setting negative reactions in the portfolio.[9]

The results from the empirical analysis provide strong support for the claim that CRA lending acts as a strong forced-savings tool. There is very little evidence that either alternative investments and/or savings are reduced as a result of equity accumulation or that debt is incurred at levels that offset equity-based gains in net worth. The results regarding the individual asset/debt values are discussed next.

First, the relationship between home equity and other assets is considered. As the closed 99% confidence intervals indicate, the estimate of the relationship between home equity and investments (Exhibit 3) is very precise. In the ''Level'' analysis, the effect is less than

a penny for the entire observed range of home equity. In the ''Change'' analysis, there does seem to be a negative relationship between change in home equity and change in investments, but this is a very small-scale relationship, with a $120,000 increase in home equity corresponding to a $100 reduction in investments. Non primary-residence equity does seem to exhibit a notable relationship with home equity (Exhibit 4): the majority of renters would be predicted to see an increase of approximately $5,000 to $10,000 given home equity between $20,000 and $90,000 in 2008. However, the ''Change'' analysis indicates that the accumulation of home equity over time is associated with a decline of approximately $5,000 to $15,000 in non-primary residence equity. Generally speaking, it appears there is not much reason to expect significant asset-related opportunity costs to home equity accumulation for CRA borrowers. There is little evidence that investments or savings suffer from the resources tied up in the generation of equity.

Debt accumulation is examined by looking in particular for debt levels that might offset wealth gains from equity accumulation. There is a possibility of a moderate positive relationship between the accumulation of home equity and credit card debt, particularly for those with higher levels of home equity (Exhibit 5): an accumulation of home equity greater than $150,000 corresponds to an *average* predicted increase of $1,000 or more in credit card debt. The scale of the relationship for the ''Change'' analysis is much smaller, however, with the *maximum* upper-bound in the confidence interval of approximately $700, an increase in credit card debt as a result of home equity accumulation. Student loan debt, though precise, exhibits a very small-scale relationship with home equity accumulation (Exhibit 6): extremely high or low values of equity correspond with an increase of approximately $600 in student loan debt. The change-in-time effect of home equity on student loan debt is negligible. The last relationship considered is that between equity accumulation and borrowing against the home (Exhibit 7). As would be expected, the direction of the cross-sectional relationship is positive—people with more equity borrow against that equity—but the relationship is non-linear: notable borrowing against home equity only occurs where equity levels are $100,000 or greater, and such borrowing never reaches a scale that would offset wealth gains from home equity. The ''Change'' relationship is on a very small scale. This last result may seem counter-intuitive, since an increase in equity might be expected to correspond with an increase in borrowing against equity, but it may be that the compressed time scale of three years is simply not long enough to observe the expected equity-gain/borrowing cycle. Overall, there is some evidence that debt levels—credit card debt and borrowing against the home—may increase in response to substantial home equity accumulation, but there is no indication that these increases would come near the scale necessary to offset levels of home equity.

Conclusion

Many view the CRA as a policy that clearly enhances opportunities for wealth-building among LMI families. However, some critics emphasize potential drawbacks of reliance upon homeownership as a wealth-building tool. Chief among the problems with homeownership are, first, that the scale of the investment is comparatively inflexible and

tends to tie up resources, which leads to under-diversification of the portfolio, and, second, that homeowners draw down the added value of home equity by borrowing against the home. Any policymaker must confront these potential drawbacks in the evaluation of the CRA's true potential for wealth generation.

Few prior studies have focused directly on the financial implications of homeownership for CRA beneficiaries. Using a unique panel study of CRA-financed homeowners and a matched sample of renters, this study estimates the relationships between equity accumulation and major components of households' financial portfolios. Overall, though there appears to be some association between the accumulation of large amounts of equity—in the order of $150,000 and greater—and an increased indebtedness of between 10% and 30% of that amount, this effect is far from expected for the typical LMI homeowner. There is no evidence that debt accumulation offsets the wealth-building effect of home equity. Further, there is also no evidence of shortfalls in alternative investments or savings resulting from the growth of equity. In conclusion, it appears that CRA lending serves as an effective means for promoting stable wealth-building for LMI households through the forced-savings mechanism of equity accumulation.

Appendix

An Introduction to Copulas

Copulas offer an option for modeling the interdependence among a vector of random variables ($\boldsymbol{x}$) (e.g., a portfolio) without separating the variables into sets of strictly endogenous and strictly exogenous groups. A copula is a function that binds together marginal (i.e., univariate) distributions to give a joint distribution for $\boldsymbol{x}$. Let $\boldsymbol{u} = \{u_1, u_2, ..., u_n\}$ be an n-vector where the ith element is the value of the cumulative distribution function (CDF) of the ith random variable in $\boldsymbol{x} = \{x_1, x_2, ..., x_n\}$, such that $\boldsymbol{u} = \{F_1(x_1), F_2(x_2), ..., F_n(x_n)\}$. The copula function C:$[0,1]^n \Rightarrow [0,1]$ has a few important properties:

1. If at least one element of $\boldsymbol{u}$ is 0, then $C(\boldsymbol{u}) = 0$.
2. If all of the elements of $\boldsymbol{u}$ are 1 except u_i, then $C(\boldsymbol{u}) = u_i$.
3. C is n-increasing, meaning the first partial derivatives are strictly positive on $[0,1]^n$.

According to Sklar's theorem, there exists some C that binds the marginal distributions to give the true joint distribution of $\boldsymbol{x}$ (Nelsen, 2006). The process of modeling $\boldsymbol{x}$ with a copula is separated into the steps of (1) specifying the marginal distributions and (2) specifying the copula. This approach is particularly useful when $\boldsymbol{x}$ contains variables of different types, as familiar joint distributions (e.g., multivariate normal, Dirichlet, multivariate Poisson) are typically derived for variables of the same support. Since the portfolios and accompanying demographic data modeled include discrete, bounded continuous, and unbounded continuous variables, the copula method is ideal for the current application.

The marginal distributions are selected to fit the empirical properties of the variables. The benefit of copula modeling is that distributions are not restricted to those that can be incorporated into familiar multivariate distributions. The Bernoulli distribution (f_b) is used for the binary variable. The beta-binomial distribution (f_o) is used for the ordinal

variable. The zero-adjusted inverse-Gaussian distribution (f_n) is used for the strictly non-negative variables, and the generalized Student's t distribution (f_c) is used for the unbounded continuous variables. The mass/density functions are:

$$f_b(y, p) = y^p(1 - y)^{1-p},$$

where p is the probability of success.

$$f_o(y, \alpha, \beta) = \binom{y_M}{y} \frac{B(y + \alpha, y - y_M + \beta)}{B(\alpha, \beta)},$$

where α and β are the parameters, y_M is the maximum value of y, and B is the beta function.

$$f_n(y, \mu, \sigma, \upsilon) = \begin{cases} \upsilon & \textit{if } y = 0 \\ (1 - \upsilon) \dfrac{1}{\sqrt{2\pi\sigma y^3}} \exp\left(\dfrac{-(y - \mu)^2}{2\mu^2\sigma^2 y}\right) & \textit{otherwise}, \end{cases}$$

where μ, σ, and υ are the parameters. Lastly,

$$f_c(y, \mu, \sigma, \nu) = \frac{\Gamma\left(\dfrac{\nu + 1}{2}\right)}{\sigma\sqrt{\nu\pi}\,\Gamma\left(\dfrac{\nu}{2}\right)} \left[\frac{\nu + \left(\dfrac{y - \mu}{\sigma}\right)^2}{\nu}\right]^{-(\nu+1/2)},$$

where μ, σ, and ν are the parameters. These are very flexible distributions for their respective variable types, with parameters that can account for location, variance, and kurtosis.

Note that the marginal parameters for each distribution are not conditioned on any of the other variables in the portfolios. The dependencies among the variables in the portfolios are estimated through the copula. The Gaussian copula $C(\mathbf{x}) = \Phi_n(\Phi^{-1}(F_1(x_1)), \Phi^{-1}(F_2(x_2)),..., \Phi^{-1}(F_n(x_n)))$ is employed, where Φ_n is the standard multivariate normal CDF, which has covariance matrix equal to the full correlation matrix, and Φ is the univariate standard normal CDF. The Gaussian copula allows the estimation of association among all of the variables in the portfolio. The correlation matrix in the Gaussian copula gives the association (positive or negative) between every pair of variables, controlling for all of the other variables in the analysis. The model represents a regression-like dependency of each variable on every other variable in the portfolio, and leaves each variable in its natural, un-transformed state. The exploration of the results via simulation is motivated by two features of the copula model. First, since the variables in the model are of mixed types (e.g., binary, continuous, or strictly non-negative etc.), the conditional relationships estimated are inherently non-linear. Second, since many of the variables in the analysis are endogenous, the ceteris paribus assumption underlying regression-style interpretation is inappropriate. Therefore, the bivariate relationships are recovered from the many simulated adjustments in the portfolios.

For more reading on copula modeling, see Nelsen (2006) and Cherubini, Luciano, and Vecchiato (2004). One challenge in the application here that is relatively uncommon in

the literature with applications of copula modeling is that there is a mixture of discrete and continuous variables. The algorithm described in section 3 of Pitt, Chan, and Kohn (2006), which is implemented in the R statistical software, is used to estimate the copula and marginal parameters via Markov Chain Monte Carlo analysis.

Endnotes

[1] For a comprehensive overview of both the CAP data and the long-term research project analyzing these data, please see: Center for Community Capital. Community Advantage Panel Study. Policy Brief of the Center for Community Capital. 2009. Available at: http://ccc.unc.edu/documents/CAP_Policy_Brief_July09.pdf.

[2] Prime and subprime delinquency figures come from the Mortgage Bankers Association's National Delinquency Survey data. Rates of ''serious delinquency'' include loans that are 90 days or more delinquent, as well as loans that are in the process of foreclosure.

[3] Extensive analysis of default within the CAP portfolio has determined that CAP's strong performance, relative to that of subprime lending, can be attributed primarily to product design and origination channel. The analysis utilized propensity score matching methods to pair CAP borrowers with borrowers who differed from the CAP households, mainly in the type of loan they received (i.e., these borrowers were similar along demographic lines, but had received subprime loans). The findings reveal things. First, a CAP loan is over 70% *less* likely to default than a subprime loan issued to a comparable borrower. Second, subprime loans with both adjustable interest rates and prepayment penalties have a substantially higher default risk than loans without these traits; a subprime adjustable-rate mortgage without prepayment penalty has an estimated cumulative default rate of 6.5%, but if the adjustable-rate subprime mortgage has a prepayment penalty, the estimated default rate doubles to 13.5%. Third, those who used mortgage brokers were three to five time more likely to default than those who borrowed through other channels, all things being equal. For full details, see Ding, Quercia, Ratcliffe, and Lei (2011).

[4] Since many financial institutions consider the loan-to-value (LTV) ratio rather than the raw value of home equity in making lending decisions (i.e., in deciding to issue home equity lines of credit), the model is run with just home equity, just LTV, and home equity as well as LTV.

[5] For equity in non-primary-residence properties and major durables, both value and debt levels were reported by respondents.

[6] This paper calculates home values using a ZIP Code-level house price index that is proprietary to Fannie Mae. The Fannie Mae index provides a more accurate estimate of home value than do publicly available house price indices (such as the FHFA index, formerly OFHEO) because it relies on information at the ZIP Code, rather than MSA or state, level. A robustness check is conducted to assess the accuracy of the values provided through Fannie Mae's proprietary index. To do so, the Fannie Mae house price estimates are compared with actual sale prices for a subset of properties owned by CAP borrowers. Of the original sample of 3,743 CAP borrowers who have been followed annually since 2003, 499 sold their CAP properties and reported the actual sale prices that they received. These sales prices are matched with the closest Fannie Mae house price estimates based on the date of sale, and a correlation of 0.83 is identified between these two measures. The actual sales price is over-estimated for two-thirds of these observations and under-estimated in the remaining cases. The median discrepancy between the two measures is approximately $3,000, or about 3% of the final sales price.

[7] The current study uses the 2005 wave of the CAP panel study. One challenge that arises in using the 2005 wave of the study is that data on debt corresponding to several asset

categories were not collected. Specifically, collect information was not collected on debt related to apartment buildings, investment properties, land, commercial properties, vacation homes, timeshares, and vehicles. Since excluding this debt from the calculation of respondents' net worth would bias upward the net worth of respondents who own said assets, a decision was made to impute the data. With the CAP data, the debt variables that were missing in 2005 were measured in 2008. It is assumed that the data are missing completely at random. The imputation models for the debt variables are estimated on the 2008 data, and these models are used for multiple imputation with the missing 2005 data. Specific details on the methods are available from the authors upon request.

[8] All analyses were conducted in the R statistical software. The replication code is available from the authors upon request.

[9] All of the results reported use current house value − current loan value to determine home equity. Results using LTV did not differ substantively from the results using home equity.

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