SYMPOSIUM ON
HOUSING TENURE AND
FINANCIAL SECURITY

Food Insecurity among Older Adults in the US: The Role of Mortgage Borrowing

SEPTEMBER 2019 | STEPHANIE MOULTON, CÄZILIA LOIBL, DONALD HAURIN, CHRISSE EDMUNDS

JCHS JOINT CENTER FOR HOUSING STUDIES OF HARVARD UNIVERSITY

Food Insecurity among Older Adults in the US: The Role of Mortgage Borrowing

September 2019

Stephanie Moulton
The Ohio State University

Cäzilia Loibl
The Ohio State University

Donald Haurin
The Ohio State University

Chrisse Edmunds
The Ohio State University

This paper was originally presented at a national **Symposium on Housing Tenure and Financial Security**, hosted by the Harvard Joint Center for Housing Studies and Fannie Mae in March 2019. A decade after the start of the foreclosure crisis, the symposium examined the state of homeownership in America, focusing on the evolving relationship between tenure choice, financial security, and residential stability.

This paper was presented as part of Panel 3: "Older Adults."

Author contacts:
Cäzilia Loibl (corresponding author)
Department of Human Sciences
College of Education and Human Ecology, The Ohio State University
1787 Neil Avenue, Columbus, Ohio 43210
Email: loibl.3@osu.edu

Donald Haurin
Department of Economics, The Ohio State University
1945 N. High Street, Columbus, Ohio 43210
Email: haurin.2@osu.edu

Stephanie Moulton
John Glenn College of Public Affairs, The Ohio State University
1810 S. College Road, Columbus, Ohio 43210
Email: moulton.23@osu.edu

Chrisse Edmunds
Department of Sociology, The Ohio State University
1885 Neil Avenue, Columbus, Ohio 43210
Email: edmunds.32@osu.edu

Abstract:
As of 2016, close to 10 million older adults faced the threat of hunger in the U.S., constituting an urgent food policy issue. For older adults, heterogeneity in household wealth is even more important than income in predicting whether or not a household is food insecure. Yet not all wealth is equally accessible for households experiencing food hardship. Housing wealth—an illiquid asset—is the primary source of wealth for many older adults, particularly those with lower incomes. We use data for homeowners aged 62 and older from the Health and Retirement Study to identify the mechanism that links housing wealth to food insecurity. The results document the critical role of home equity as a "protective buffer" and point to the importance of access to mortgage borrowing to reduce material hardship late in life.

Keywords:
Food insecurity, older adults, housing wealth, mortgage borrowing

Acknowledgement:
The authors gratefully acknowledge a grant from The Ohio State University's Initiative for Food and AgriCultural Transformation (InFACT), a Discovery Themes program. Learn more at discovery.osu.edu/infact.

1. Introduction

As of 2016, close to 10 million older adults faced the threat of hunger in the U.S., about 13.6 percent of the population age 60 and older—a 27 percent increase since 2001 (Ziliak and Gundersen, 2018). Not having enough money to buy food, as food insecurity is defined, poses "a major health care challenge in the United States" (Ziliak and Gundersen, 2018, p. 2). In older age, food insecurity is associated with poor physical and mental health (for a review, see Gundersen and Ziliak, 2015), higher health care utilization (Bhargava and Lee, 2016), and higher mortality (Ferri et al., 2012), thus consituting an urgent food policy issue.

Lack of income and wealth are key hindrances to achieving food security (Gualtieri and Donley, 2016; Wolfe et al., 2003). For older adults, studies have found that heterogeneity in household wealth is even more important than income in predicting whether or not a household is food insecure (Ziliak et al., 2008). Yet not all wealth is equally accessible for households (Gundersen and Gruber, 2001). Housing wealth—an illiquid asset—is the primary source of wealth for many older adults, particularly those with lower incomes or who are black. In 2016, about 80 percent of U.S. older adults owned a home. Equity in a home comprised 69 percent of net wealth for older homeowners in the bottom 40 percent of the income distribution, compared to 24 percent for those in the top 20 percent.[1] To access this wealth, it must first be converted to a liquid form.

Borrowing through a mortgage is the predominate mode by which older adults liquefy housing wealth.[2] Newly borrowed funds may be used for consumption, thereby reducing food insecurity. However, high levels of existing mortgage debt reduce the ability to be approved for

[1] Authors' calculations from the Federal Reserve Board's 2016 Survey of Consumer Finances.
[2] Most older adults do not liquidate housing wealth through home sale until the last years of life, typically upon entry into assisted living or nursing home care (Mayer, 2017).

additional borrowing in the future; for example, if older adults encounter a health shock (Gupta et al., 2018).[3] Understanding the relationship between housing wealth and food insecurity thus requires careful consideration of home equity as well as new mortgage borrowing.

This paper adds to the literature by presenting new evidence on the impact of housing wealth on food insecurity for older adults. While prior studies find that status as a homeowner is associated with reduced food insecurity (Bartfeld and Collins, 2017; Huang et al., 2010; Men, 2017; Swann, 2017), the mechanisms underlying this relationship are poorly understood. Using data from the U.S. Health and Retirement Study (HRS), we identify financial mechanisms by which homeownership affects food insecurity. We isolate the effects of both home equity changes and new mortgage borrowing on food insecurity, allowing both to be endogenous, while controlling for a rich list of financial and social measures that are available in the HRS.

Our results confirm that there is a statistically significant relationship between housing wealth and food insecurity. We first find that exogenous house price changes predict changes in food insecurity. Next, we find evidence of a causal relationship between changes in home equity and changes in food insecurity. While this finding suggests that increased housing wealth reduces the likelihood of food insecurity, the specific mechanism is not identified given that home equity is illiquid. In our final specification, we find evidence that new mortgage borrowing reduces food insecurity—with an effect size that is larger than that for financial wealth. The results document the critical role of home equity and access to new mortgage borrowing as a "protective buffer" (Ziliak et al., 2008) above and beyond other financial resources.

This paper is organized as follows. Section 2 reviews the literature on housing wealth and consumption, and housing wealth and food insecurity more specifically. Section 3 describes the

[3]The percentage of older adults who carry an existing mortgage into retirement has increased from 20% in 1992 to more than 40% in 2016 (Moulton et al., 2017b).

empirical methods. Section 4 describes the data and measures used in the study. Section 5 presents results and Section 6 discusses the findings and concludes.

2. Previous literature

Our study draws from two lines of literature: housing wealth and consumption studies and studies of food insecurity. There is a relatively large body of literature that estimates the effects of housing wealth on consumption, including but not limited to food consumption (Bostic et al., 2009; Campbell and Cocco, 2007; Case et al., 2005; Cooper, 2013; Engelhardt, 1996; Skinner, 1996). Early studies using data from the Panel Study of Income Dynamics (PSID) estimated the relationship between changes in self-reported house value and food consumption. Skinner (1996) observed a positive relationship, but only for younger households. Engelhardt (1996) found that a reduction in self-reported house value was associated with reduced food consumption, but found no evidence of an increase in house value on food consumption.

More recent research using richer data find a positive and consistent relationship between housing wealth and total consumption (Bostic et al., 2009; Campbell and Cocco, 2007; Cooper, 2013). Campbell and Cocco (2007) use data on regional house price change combined with micro-data on British homeowners to estimate the impact of changes in house prices on changes in consumption, finding that a 1 percent increase in house prices is associated with a 0.08 percent increase in consumption. In a cross-sectional analysis, Bostic et al. (2009) estimate the relationship between self-reported house value and the level of consumption, finding estimated house value elasticities of 0.04 to 0.06; nearly twice as large as the elasticities for financial wealth. Unlike earlier findings by Skinner (1996), Campbell and Cocco (2007) and Bostic et al. (2009) find larger housing wealth elasticities on consumption for older adults relative to younger adults, as older adults may be more willing to liquidate housing wealth as they age, consistent

with the lifecycle hypothesis. Using panel data from the PSID, Cooper (2013) finds that households consume $0.06 per $1 increase in home equity—an effect similar to prior studies using data on house values. This result was confirmed by a recent study that uses the HRS panel data (Angrisani et al., 2019). Cooper (2013) further finds larger effects of increased home equity on consumption for those with lower levels of non-housing wealth, who may be borrowing constrained. These studies do not identify mechanisms through which housing wealth is related to food consumption.

Turning to studies of food insecurity, a positive effect of income on food security is consistently documented (Gundersen and Gruber, 2001; Guo, 2011). Fewer studies account for wealth, yet those that do find a significant inverse association of financial wealth and food insecurity (Shobe et al., 2018) and a smaller effect of income on food insecurity when controlling for asset levels (Guo, 2011; Huang et al., 2010). A primary limitation of studies of wealth and food insecurity is their treatment of housing wealth. Studies often represent housing wealth with a simple binary measure of whether the home is owned (Bartfeld and Collins, 2017; Chang et al., 2013; Huang et al., 2010; McIntyre et al., 2017; Men, 2017; Ribar and Hamrick, 2003; Rose et al., 1998). These studies find that homeowners are significantly less likely to be food insecure then renters. The reasons offered include homeowners borrowing against the equity in their homes, having relatively fixed housing costs, and, having higher discretionary income compared to renters of similar means once the mortgage is paid off (Gundersen and Gruber, 2001).

While these studies highlight the importance of accounting for homeownership when estimating food insecurity, they fail to identify the specific mechanisms that underlie this relationship. Conceptually, it is not clear that there is a causal relationship between

homeownership and food insecurity; rather, homeownership status may simply be a proxy for variables omitted from the model. Only very few food-insecurity studies have accounted for the components of housing wealth, for example by including binary measures of whether a mortgage is held (Shobe et al., 2018) or whether a household fell behind with mortgage payments (Alley et al., 2011). A primary contribution of our paper is to model the financial mechanisms through which homeownership—and specifically housing wealth and its components—affects food insecurity.

3. Empirical methodology

3.1 Conceptual framework

The relationship between housing wealth and food insecurity is complicated by the fact that housing wealth is the difference between house value and mortgage debt. House value depends on the purchase price of a home and subsequent house price changes. House price change is largely exogenous, aside from depreciation and renovations that increase the value of a home.[4] A reduced form approach is to model the relationship between changes in house price and food insecurity, where house prices differ over both geographic area and time.[5] Models that include a binary indicator for homeownership as an exogenous determinant of food insecurity conflate home equity and other unobserved homeownership effects. A third approach is to include home equity as the measure of housing wealth, treating it as exogenous. However, the amount of home equity depends on mortgage borrowing, which is a choice variable and thus endogenous.

[4] Most home maintenance simply offsets dwelling depreciation and does not increase home values.
[5] An alternative approach is to use house value, a component of housing wealth. However, this approach ignores the role of mortgages.

An alternative approach is to model the structural mechanism by which house value is converted to a liquid asset that can be used for consumption. We focus on mortgage borrowing. In our model of food insecurity, the amount borrowed using a mortgage is considered endogenous, thus accounting for it being a choice variable for the homeowner. This approach recognizes that home equity cannot affect food insecurity directly because it is illiquid.[6] A second advantage of this approach is that some households may be less able or willing to liquidate housing wealth, a form of heterogeneity not recognized by reduced-form models. For example, an increase in house prices may have little impact on food consumption among groups of older adults with historically reduced access to housing wealth (Duca and Rosenthal, 1993; Immergluck, 2009; Killewald, 2013; Moulton et al., 2017; Rugh and Massey, 2010).

3.2 Empirical methods

The primary model focuses on the relationship of new mortgage borrowing and food insecurity and is of the form:

$$F_{i,t} = \beta_0 + \beta_1 M_{i,t-n} + \beta_2 A_{i,t-n} + \beta_3 X_{i,t-n} + \beta_4 F_{i,t-n} + \varepsilon_{i,t} \quad (1)$$

where $F_{i,t}$ is an indicator of food insecurity in year t for the i-th older adult, M is a lagged measure of new mortgage borrowing, A is lagged wealth (both housing and financial), X is a set of lagged control variables, and ε is normally distributed random error component. We estimate the model with a probit specification. Equation (1) includes $F_{i,t-n,}$ the lagged value of food insecurity, and thus our estimation is a test of whether new mortgage borrowing affects the

[6] We recognize that there may be indirect effects of housing wealth on food security. For example, a household with increased housing wealth could spend some of their financial assets on food consumption rather than pay the origination cost of a new mortgage.

intertemporal change in food insecurity. Because liquidating home equity by borrowing is a choice, we use an instrumental variable estimation.

We also estimate models similar to those in the literature for comparison purposes. One alternative is to replace M with an exogenous measure of house price change. Another alternative is to replace M with the intertemporal change in home equity, treated as endogenous.

4. Data

4.1. The Health and Retirement Study (HRS)

We employ the Health and Retirement Study (HRS), a long-standing and well-regarded survey of American older adults with a response rate above 80 percent. Respondents are surveyed every two years, with new birth cohorts added to the existing sample every three waves. Each wave has around 20,000 respondents. The HRS has detailed wealth information and contains two food insecurity questions.[7] We use the restricted geocoded HRS data from 2004 to 2014 for the present study.

For this analysis, we limit our sample to one respondent per household. When there are multiple respondents per household, we include the person identified in the household as the financial respondent. If households do not have a designated financial respondent, we designate one member. The financial respondent answers all income and asset questions in addition to the questions about housing and food insecurity. Our outcome variable is food insecurity from the 2014 wave of the HRS and all control variables (including lagged food insecurity) are from the 2008 wave, this choice increasing their exogeneity. Variables that measure changes in house

[7] Studies of food insecurity using the HRS include research predicting food insecurity on the basis of food deserts (Fitzpatrick et al., 2016) and among veterans (Brostow et al., 2017). The HRS has been used in studies where food insecurity is a predictor of food assistance program participation (Kim and Frongillo, 2007; Kim and Frongillo, 2009), mental health condition, or functional limitations (Bishop and Wang, 2018; Brostow et al., 2017).

price, home equity, and mortgage borrowing indicate differences between the 2008 and 2012 waves. The two-year gap from 2012 to 2014 occurs because the HRS food insecurity questions ask respondents about their food insecurity over the previous two years.

We limit our sample to households who have a respondent or spouse age 62 or older in the 2014 survey wave. We also limit our sample to homeowners who did not move between 2006 and 2014. By dropping older adults who move, our measure of change in mortgage borrowing excludes households who increase their total mortgage debt through the purchase of a new home. We also drop older adults living in a mobile home, nursing home or institution, who have foreclosed on their home during the 2008, 2010, and 2012 waves, or who consider themselves to be living rent free. This approach provides us with a more homogeneous sample. As a result, the regression-analysis sample of homeowners is comprised of 4,244 households.[8]

4.2. Food insecurity

Food insecurity is measured with two questions. The focus of our main analysis is on the question "(Since your last interview/in the last two years), have you always had enough money to buy the food you need?" This variable is coded as 0 for no and 1 for yes. Don't know responses and refusals are coded as missing. This question has been part of the HRS Core Questionnaire since 1995 (Q415) and has been posed to all HRS respondents. We use the 2014 value as the dependent variable.

We also use a second measure of food insecurity, which is asked only of HRS respondents who answered "yes" to the first question, "In the last 12 months, did you ever eat

[8] Observations with missing values are dropped from the sample except for two variables with a larger number of missing values: help with future needs and number of living children. They were accounted for by coding the missing values as zero and adding a binary indicator for the missing value.

less than you felt you should because there wasn't enough money to buy food?" This variable is again coded as 0 for no and 1 for yes. Non-responses are also coded as 0; don't know responses and refusals are coded as missing. This question has been part of the HRS Core Questionnaire since 2008 (Q516). We treat the second measure as an indicator of severe food insecurity.

4.3. Housing characteristics

Changes in house prices are measured as changes in the Federal Housing Finance Agency five-digit ZIP code level Housing Price Index (HPI) from 2008 to 2012. The home value of the primary residence and outstanding mortgage balances on the primary residence are based on the HRS respondent's estimates. Home equity is the difference between respondent's estimate of the house value and outstanding mortgage balance and the change in home equity is the difference between 2012 and 2008. New mortgage borrowing is the amount of the increase in the mortgage balance on the primary residence from 2008 to 2012; negative values (mortgage repayments) are set to 0.[9]

4.4. Household characteristics

Household characteristics include the number of household members, location of residence (urban (omitted), suburban, rural area), and nine regional indicators (New England (omitted), Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, Pacific).

[9] Decreasing mortgage balances most often occur due to standard mortgage repayments. We do not expect a decreasing mortgage balance to affect food insecurity. Respondents with home equity or mortgage debt amounts greater than $2,000,000 in 2008 or 2012 are omitted from our sample (16 cases).

Financial characteristics include monthly household income, net financial assets (including cash and investment assets), net other assets (including non-housing real estate, transportation, and business assets), and net non-housing debt.[10] Multiple studies of food insecurity estimate the causal impact of the Supplemental Nutrition Assistance Program (SNAP) program (e.g., Gundersen et al., 2017; Nam and Hyo, 2008; Swann, 2017). Rather than include observed SNAP participation in our model, which would require another instrumental variable treatment, we use an exogenous measure of eligibility for SNAP.[11] Eligibility depends on state level income and asset criteria. The most common gross income limit is 130 percent of the poverty threshold, adjusted by household size (Food and Nutrition Service, 2018). The HRS reports for each respondent the ratio of family income to the applicable poverty threshold, which we compare to the 130 percent level, yielding a dummy variable measure of eligibility for SNAP (St.Clair et al., 2011).

4.5. Financial respondent characteristics

The financial respondent's characteristics include age (both linear and quadratic), gender (male=1), race (white (omitted), black, or other), Hispanic origin, immigrant, education (less than high school education (omitted), GED, high school diploma, some college, or college degree or more), marital status (married (omitted), separated/divorced/widowed, never married), and number of living children of the respondent or spouse. The social support network is measured with a dummy variable that indicates whether the respondent has friends or relatives to

[10] We exclude extreme cases with monthly household income higher than $60,000 per month; or cash assets, investment assets, and other assets higher than $2,000,000 (96 cases).

[11] Given that participation in SNAP is a household choice, it must be treated as endogenous. This recognition is important because if SNAP is treated as exogenous then estimates indicate that it, counterintuitively, increases the likelihood of food insecurity. However, a careful application of instrumental variables yields the expected result that SNAP reduces food insecurity (e.g., Gundersen et al., 2017; Swann, 2017).

provide help if needed (Cheng, 2017). Functional limitations are measured with a five-item activities of daily living (ADL) scale (walking across a room, dressing, getting out of bed, bathing, eating) (e.g., Capistrant et al., 2014).

4.6. Macroeconomic indicators

In order to account for unobserved local economic shocks that are correlated with both mortgage borrowing and food insecurity, we control for the lagged average annual county unemployment rates and the 2008 to 2012 difference in rates (U.S. Bureau of Labor Statistics (2019).

4.7. Instruments

We identify the causal effect of home equity and mortgage borrowing on food insecurity using an instrumental variable approach. Good instruments should be theoretically and empirically correlated with the change in home equity and mortgage borrowing, but uncorrelated with the error term in the estimation of food insecurity. We include four instruments. The first is house price change between 2008 and 2012, measured using the change in the Federal Housing Finance Agency's five-digit ZIP code level house price index (FHFA, 2018; Gatzlaff and Haurin, 1998). Increased house prices increase home equity, permitting increased withdrawal through new mortgages. Regional and temporal variation in house prices are assumed to affect changes in food insecurity only through new mortgage borrowing. The second instrument is the number of bank branches in the respondent's in the respondent's ZIP code in 2008. A greater number of local banks reduces transport costs to a lender, reducing the cost of obtaining a mortgage. The third instrument is a 2008 indicator of whether the respondent was delinquent in making mortgage payments. Such a delinquency would reduce a respondent's credit score, making obtaining a mortgage more difficult in the future (credit scores are not available in the HRS). Lagged mortgage delinquency should not directly affect food insecurity six years later. The fourth instrument is the lagged value of new mortgage borrowing between 2004 and 2006. We expect that there is heterogeneity in respondents' preferences toward accessing home equity and a history of borrowing provides an indication of this preference. Thus, past borrowing is expected to predict future borrowing (Moulton et al., 2013). We implement standard instrument tests with each of our models that treat home equity or mortgage borrowing as endogenous. A Wald test rejects the exogeneity of home equity or mortgage borrowing in all cases. Weak

instrument tests reject the null hypothesis in all regressions but one.[12]

5. Results

5.1. Descriptive analysis

Table 1 presents descriptive statistics for our model variables, first for the sample as a whole (N=4,244) and then separately for food secure (N=4,048) and food insecure (N=196) older homeowners. The table also indicates the p values of t-statistic for a test of the equality of the means for both groups.

Food secure and insecure older homeowners differ in several regards. Food insecure older homeowners report lower home values in 2008, at $151,200, and lower home equity in 2008, at $108,170 compared to $239,110 and $194,230, respectively, for food secure homeowners. In contrast, they reported higher new mortgage borrowing, but the difference is not significant at the 5 percent level. Home equity change and home value change from 2008 to 2012 are smaller for food insecure homeowners, but these differences are also not significant at the 5 percent level.

Food secure and insecure older homeowners also differ with regard to household characteristics. Food insecure homeowners report lower household incomes and net financial assets. In addition, their gross household incomes are more often below the 130 percent poverty threshold for SNAP eligibility compared to food secure older homeowners.

Finally, food insecure and secure homeowners differ with regard to the characteristics of the financial respondent. Food insecure older homeowners are younger, more often female,

[12] Weak instrument tests include both the conditional likelihood ratio (CLR) test and the Anderson-Rubin (AR) test. When new mortgage borrowing is treated as endogenous, there is evidence to reject the null hypothesis. The test statistics for the food insecurity model are: CLR=2.61 (p=0.13) and AR, $chi^2(4)$=13.11 (p=0.01). The test statistics for severe food insecurity are: CLR=3.15 (p=0.10), and AR, $chi^2(4)$=20.39 (p=0.00). When home equity is treated as endogenous, we can reject the null hypothesis that our instruments are weak. The test statistics for the food insecurity model are: CLR=6.69 (p=0.01) and AR, $chi^2(4)$=13.13 (p=0.01). The test statistics for the severe food insecurity model are CLR = 10.14 (p=0.02) and AR, $chi^2(4)$=20.19 (p=0.01).

black, and Hispanic compared to food secure older homeowners. They are less likely to have completed high school and are less often college graduates. Food insecure homeowners are also less often married and more often separated, divorced or widowed and report a higher number of functional limitations with regard to activities of daily living compared to food secure older homeowners. Not surprisingly, food insecure homeowners in 2014 were more often food insecure in 2008, with 23 percent of those who are food insecure in 2014 also reporting being food insecure in 2008, compared with only 2.4 percent of those who are not food insecure in 2014 being food insecure in 2008.

	(1) Full sample Mean (SD)	(2) Food secure Mean (SD)	(3) Food insecure Mean (SD)
Food insecure, 2014	0.046 (0.210)	0	1
Severely food insecure, 2014	0.024 (0.152)	0	0.515*** (0.501)
Food insecure, 2008	0.033 (0.179)	0.024 (0.152)	0.230*** (0.422)
Housing characteristics			
New mortgage borrowing, 2008-2012	0.695 (3.275)	0.674 (3.148)	1.128 (5.241)
Home equity, 2008	19.025 (17.776)	19.423 (17.906)	10.817*** (12.275)
Home equity change, 2008-2012	-3.144 (11.316)	-3.184 (11.319)	-2.322 (11.261)
Home value, 2008	23.505 (19.489)	23.911 (19.632)	15.120*** (13.858)
Home value change, 2008-2012	-3.822 (10.460)	-3.885 (10.445)	-2.519 (10.694)
Household characteristics			
Number of household members, 2008	2.095 (1.028)	2.080 (0.983)	2.413** (1.685)
Urban residence, 2008	0.497 (0.500)	0.496 (0.500)	0.515 (0.501)
Suburban residence, 2008	0.241 (0.427)	0.240 (0.427)	0.260 (0.440)
Rural residence, 2008	0.262 (0.440)	0.264 (0.441)	0.224 (0.418)
Household monthly gross income, 2008	5.324 (5.384)	5.432 (5.379)	3.100*** (5.014)
Gross income below 130% poverty threshold	0.080 (0.271)	0.070 (0.256)	0.270*** (0.445)
Net financial assets, 2008	18.842 (30.675)	19.527 (31.095)	4.690*** (14.006)
Net other assets, 2008	9.488 (21.997)	9.769 (22.290)	3.681*** (13.486)
Other debt, 2008	0.410 (2.633)	0.405 (2.685)	0.496 (1.098)
Financial respondent characteristics			
Age, 2008	68.535 (8.375)	68.635 (8.401)	66.485*** (7.569)
Male, 2008	0.429 (0.495)	0.436 (0.496)	0.291*** (0.455)
White, 2008	0.821 (0.383)	0.832 (0.374)	0.592*** (0.493)
Black, 2008	0.138 (0.345)	0.129 (0.335)	0.321*** (0.468)
Other race, 2008	0.041 (0.198)	0.039 (0.193)	0.087*** (0.282)
Hispanic, 2008	0.072 (0.259)	0.068 (0.253)	0.153*** (0.361)
Immigrant, 2008	0.088 (0.283)	0.086 (0.280)	0.128 (0.334)
Less than high school, 2008	0.141 (0.348)	0.134 (0.341)	0.286*** (0.453)
GED, 2008	0.039 (0.193)	0.037 (0.189)	0.071 (0.258)

High school, 2008	0.317 (0.465)	0.316 (0.465)	0.342 (0.476)
Some college, 2008	0.244 (0.429)	0.246 (0.431)	0.194 (0.396)
College or more, 2008	0.259 (0.438)	0.266 (0.442)	0.107*** (0.310)
Married, 2008	0.649 (0.477)	0.656 (0.475)	0.500*** (0.501)
Separated, divorced, or widowed, 2008	0.323 (0.468)	0.316 (0.465)	0.474*** (0.501)
Never married, 2008	0.028 (0.164)	0.028 (0.164)	0.026 (0.158)
Number of living children, 2008	3.082 (2.040)	3.063 (2.030)	3.480** (2.199)
Help with future needs, 2008	0.610 (0.488)	0.611 (0.488)	0.597 (0.492)
Problem with activities of daily living, 2008	0.156 (0.560)	0.138 (0.513)	0.546*** (1.101)
Macro-economic indicators			
County unemployment rate, 2008	6.088 (1.609)	6.078 (1.613)	6.310* (1.503)
County unemployment rate change, 2008-2012	2.297 (1.232)	2.287 (1.231)	2.503* (1.241)
Instruments			
FHFA HPI change, 2008-2012	-0.169 (0.133)	-0.168 (0.132)	-0.191* (0.149)
Number bank branches, 2008	8.182 (6.602)	8.209 (6.595)	7.633 (6.729)
Mortgage delinquency, 2008	0.005 (0.073)	0.004 (0.063)	0.036* (0.186)
New mortgage borrowing, 2004-2006	0.913 (3.700)	0.902 (3.734)	1.125 (2.930)
Number of observations	4,244 (100%)	4,048 (95.38%)	196 (4.62%)

Table 1: Descriptive sample characteristics

Notes: *** p<0.001, ** p<0.010, * p<0.050. All financial variables are in units of $10,000.

5.2. Probit results

Table 2 presents the coefficients from the probit specifications predicting food insecurity, first with the exogenous change in FHFA House Price Index (HPI), and then with home equity change (Column 2) and new mortgage borrowing (Column 3), each treated as endogenous. The first stage results for estimating home equity change and new mortgage borrowing are presented in Appendix Table 1.

We first explore how changes in HPI are related to food insecurity. Our results in Table 2, Column 1, show that there is a negative relationship between the change in HPI from 2008 to 2012 and food insecurity among homeowners (beta= -0.899, p=0.02). This result is generally consistent with the direction and significance of findings in the consumption and food insecurity literatures. We next replace the change in HPI with the change in home equity from 2008 to 2012. The first stage results from the IV probit regression are in Appendix Table 1, Column 1. Regression results indicate that treating the change in home equity as endogenous is appropriate: the Wald test statistic rejects the null hypothesis of exogeneity (chi^2=7.88, p=0.001).[13] The coefficient for the change in home equity from 2008 to 2012 is negative as expected (-0.070) and statistically significant (t=4.31, p=0.00, see Table 2, Column 2).[14] Our next specification replaces the change in home equity with the amount of new mortgage borrowing, this also treated as endogenous. The first stage results from the IV probit regression are in Appendix Table 1, Column 2. Again, the Wald test statistic rejects the null hypothesis of exogeneity (chi^2=6.49, p=0.01). The coefficient for new mortgage borrowing is negative (-0.235) and statistically significant (t=4.36, p=0.00).[15] We note that the change in home equity and new mortgage

[13] The estimation uses Stata, with the instrument tests created with the rivtest post-estimation command.
[14] If the change in home equity is treated as exogenous, then its coefficient is much smaller (-0.010) with a t statistic of -2.11.
[15] If new mortgage borrowing is treated as an exogenous variable in the food insecurity model, the coefficient is

borrowing are in the same units, yielding coefficients that can be compared. We find that per $10,000, the impact on food insecurity of new mortgage borrowing is more than three times larger than that of a change in home equity.

To better interpret the substantive effect of mortgage borrowing on food insecurity, we estimate the change in the predicted probability of being food insecure in response to a $10,000 increase in new mortgage borrowing. For this exercise, we specify the values of explanatory variables to be representative of the modal type of a food insecure household. This household has home equity of $50,000, financial assets of $10,000, monthly income of $1,500, and falls below the poverty line. The financial respondent is a married black male age 70, with a high school degree, two children, and needs help with two ADLs. The current household size is two, they live in an urban area in the middle Atlantic region, and were food insecure previously. The unemployment rate is the sample mean. The resulting predicted probability of food insecurity is 57.2 percent. We calculate that a $10,000 increase in new mortgage borrowing reduces the predicted probability of food insecurity to 48.0 percent – a reduction in food insecurity of 9.2 percentage points (or 16.1 percent). This reduction is much larger than the less than 1 percentage point reduction in food insecurity associated with a $10,000 increase in financial wealth.[16]

With regard to the control variables in the new mortgage borrowing estimation in Table 2, Column 3, larger household sizes and household income at 130 percent of poverty in 2008 are positively associated with food insecurity in 2014. Net financial assets are negatively associated with food insecurity. With regard to personal characteristics, black, other non-white older adults,

positive (beta=0.019, t=2.33), which points to the need for endogenous treatment. This result is similar to the need to treat SNAP participation as endogenous (Gundersen et al., 2017; Swann, 2017).

[16] An alternative exercise sets all of the model variables at their mean (continuous variables) or modal values (binary variables). In this case, $10,000 of new mortgage borrowing reduces the predicted probability of food insecurity from 13.3% to 8.9%.

separated/divorced/widowed status, and lagged food insecurity are positively related to food insecurity. Other control variables are not statistically significant at the 5 percent level.

	(1) Food insecurity Coefficient (SE)	(2) Food insecurity Coefficient (SE)	(3) Food insecurity Coefficient (SE)
Housing characteristics			
FHFA HPI change, 2008-2012	-0.899*		
	(0.383)		
Home equity change (endogenous), 2008-2012		-0.070***	
		(0.016)	
New mortgage borrowing (endogenous), 2008-2012			-0.235***
			(0.054)
Home equity, 2008	-0.008*	-0.035***	-0.001
	(0.004)	(0.006)	(0.003)
Household characteristics			
Number of household members, 2008	0.058	0.053	0.061*
	(0.033)	(0.029)	(0.026)
Suburban residence, 2008	-0.054	-0.069	-0.024
	(0.101)	(0.085)	(0.076)
Rural residence, 2008	-0.102	-0.061	-0.123
	(0.115)	(0.101)	(0.085)
Region FE[1)]	Yes	Yes	Yes
Household monthly gross income, 2008	-0.009	-0.003	0.007
	(0.011)	(0.010)	(0.010)
Gross income below 130% poverty threshold	0.312**	0.278**	0.212*
	(0.114)	(0.103)	(0.103)
Net financial assets, 2008	-0.010**	-0.004	-0.009**
	(0.004)	(0.004)	(0.003)
Net financial assets squared, 2008	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Net other assets, 2008	-0.000	0.000	-0.001
	(0.003)	(0.002)	(0.002)
Other debt, 2008	0.001	-0.003	0.005
	(0.013)	(0.012)	(0.009)
Financial respondent characteristics			
Age, 2008	0.095	0.100	0.072
	(0.061)	(0.051)	(0.044)
Age squared, 2008	-0.001	-0.001*	-0.001
	(0.000)	(0.000)	(0.000)

Male, 2008	-0.105	-0.055	-0.101
	(0.085)	(0.074)	(0.060)
Black, 2008	0.191	0.197*	0.204**
	(0.104)	(0.090)	(0.078)
Other race, 2008	0.338*	0.222	0.272*
	(0.161)	(0.147)	(0.128)

Hispanic, 2008	0.076	0.175	0.040
	(0.156)	(0.135)	(0.115)
Immigrant, 2008	-0.079	-0.032	-0.002
	(0.144)	(0.122)	(0.103)
GED, 2008	0.216	0.148	0.199
	(0.179)	(0.157)	(0.134)
High school, 2008	-0.002	0.043	0.034
	(0.112)	(0.097)	(0.081)
Some college, 2008	-0.200	-0.127	-0.036
	(0.125)	(0.109)	(0.106)
College or more, 2008	-0.181	-0.044	0.001
	(0.145)	(0.131)	(0.122)
Separated, divorced, or widowed, 2008	0.187*	0.108	0.166*
	(0.094)	(0.084)	(0.070)
Never married, 2008	-0.007	-0.121	0.011
	(0.247)	(0.208)	(0.171)
Number of living children, 2008	0.006	-0.000	0.010
	(0.020)	(0.017)	(0.014)
Number of living children, 2008, missing	0.066	0.032	0.156
	(0.254)	(0.217)	(0.181)
Help with future needs, 2008	-0.016	-0.039	0.059
	(0.092)	(0.077)	(0.066)
Help with future needs, 2008, missing	-0.055	-0.100	0.074
	(0.145)	(0.123)	(0.108)
Problems with ADLs, 2008	0.219***	0.167**	0.115
	(0.054)	(0.054)	(0.063)
Food insecure, 2008	0.987***	0.762***	0.651**
	(0.128)	(0.166)	(0.215)
Macro-economic indicator			
County unemployment rate, 2008	-0.006	-0.025	0.000
	(0.030)	(0.026)	(0.020)
County unemployment rate change, 2008-2012	-0.009	-0.022	-0.02
	(0.040)	(0.034)	(0.028)
Constant	-4.531	-4.061	-2.949
	(2.101)	(1.795)	(1.631)
Log Likelihood	-641.408	-16,067.32	-11,574.76
Pseudo R^2	0.192	-	-
LR/Wald chi^2	305.450***	458.340***	910.150***
Number of observations	4,244	4,244	4,244

Table 2: Probit coefficients predicting food insecurity

Notes: *** p<0.001, ** p<0.010, * p<0.050; [1]) 8 regions include residence in 2008 in: Middle Atlantic region; East North Central region, West North Central region, South Atlantic region,

East South Central region, West South Central region, Mountain region, Pacific region

Table 3 presents the results of our specification predicting *severe* food insecurity (the respondent ate less because there "wasn't enough money to buy food"), focusing on the change in home equity and new mortgage borrowing estimations. The estimation model is the same as above, with the focal variables again treated as endogenous.[17] Results of the first stage are in Appendix Table 2. In the severe food insecurity regression, the coefficient of home equity change is negative (-0.085), statistically significant (t=9.11, p=0.00), and slightly larger than for the previous measure of food insecurity. The coefficient of new mortgage borrowing is (-0.268), also is statistically significant (t=7.77, p=0.00) and is slightly larger than previously. These results suggest that access to housing wealth reduces severe food insecurity.

	(1) Severe food insecurity Coefficient (SE)	(2) Severe food insecurity Coefficient (SE)	(3) Severe food insecurity Coefficient (SE)
Housing characteristics			
FHFA House Price Index (HPI) change, 2008-2012	-1.361*		
	(0.534)		
Home equity change (endogenous), 2008-2012		-0.085***	
		(0.009)	
New mortgage borrowing (endogenous), 2008-2012			-0.268***
			(0.035)
Home equity, 2008	-0.014*	-0.041***	-0.002
	(0.006)	(0.004)	(0.004)
Household characteristics			
Number of household members, 2008	0.071	0.047	0.063*
	(0.040)	(0.028)	(0.027)
Suburban residence, 2008	-0.075	-0.074	-0.029
	0.137	0.085	0.084
Rural residence, 2008	-0.229	-0.089	-0.200
	0.166	-0.108	0.114
Region FE[1)]	Yes	Yes	Yes

[17] The Wald tests for both regressions indicate endogeneity is present.

Household monthly gross income, 2008	-0.025	-0.008	0.003
	(0.020)	(0.012)	(0.013)
Gross income below 130% poverty	0.186	0.139	0.135
	(0.152)	(0.102)	(0.100)
Net financial assets, 2008	-0.044***	-0.020*	-0.025*
	(0.013)	(0.009)	(0.010)
Net financial assets squared, 2008	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Net other assets, 2008	-0.003	-0.001	-0.002
	(0.006)	(0.004)	(0.003)
Other debt, 2008	-0.015	-0.014	-0.002
	(0.040)	(0.024)	(0.021)
Financial respondent characteristics			
Age, 2008	0.247*	0.167*	0.139
	(0.111)	(0.069)	(0.071)
Age squared, 2008	-0.002*	-0.001**	-0.001*
	(0.001)	(0.001)	(0.001)
Male, 2008	0.005	0.038	-0.039
	(0.118)	(0.073)	(0.067)
Black, 2008	-0.219	-0.085	-0.017
	(0.144)	(0.095)	(0.098)
Other race, 2008	0.325	0.120	0.248
	(0.210)	(0.144)	(0.138)
Hispanic, 2008	-0.259	-0.013	-0.156
	(0.218)	(0.144)	(0.137)
Immigrant, 2008	-0.251	-0.111	-0.063
	(0.212)	(0.133)	(0.126)
GED, 2008	0.195	0.076	0.172
	(0.230)	(0.152)	(0.143)
High school, 2008	0.036	0.072	0.056
	(0.152)	(0.097)	(0.090)
Some college, 2008	-0.085	-0.018	0.056
	(0.170)	(0.107)	(0.102)
College or more, 2008	-0.106	0.064	0.078
	(0.213)	(0.133)	(0.127)
Separated, divorced, or widowed, 2008	0.198	0.073	0.155*
	(0.129)	(0.084)	(0.078)
Never married, 2008	0.077	-0.097	0.050
	(0.326)	(0.204)	(0.185)
Number of living children, 2008	0.012	0.001	0.013
	(0.027)	(0.017)	(0.016)
Number of living children, 2008, missing	0.305	0.147	0.284
	(0.292)	(0.195)	(0.183)

Help with future needs, 2008	-0.073	-0.067	0.042
	(0.129)	(0.079)	(0.076)
Help with future needs, 2008, missing	-0.028	-0.075	0.114
	(0.193)	(0.120)	(0.113)
Problems with ADLs, 2008	0.237***	0.125*	0.099
	(0.067)	(0.052)	(0.061)
Severely food insecure, 2008	1.467***	0.727**	0.772**
	(0.189)	(0.222)	(0.292)
Macro-economic indicator			
County unemployment rate, 2008	-0.061	-0.059*	-0.022
	(0.043)	(0.025)	(0.023)
County unemployment rate change, 2008-2012	0.044	0.004	0.007
	(0.055)	(0.035)	(0.033)
Constant	-8.901*	-5.546*	-4.676
	(3.695)	(2.339)	(2.466)
Log Likelihood	-332.614	-15,756.451	-11,267.453
Pseudo R2	0.303	-	-
LR/Wald chi^2	289.45***	573***	844.60***
Number of observations	4,244	4,244	4,244

Table 3: Probit coefficients predicting severe food insecurity

Notes: *** p<0.001, ** p<0.010, * p<0.050

[1]) 8 regions include residence in 2008 in: Middle Atlantic region; East North Central region, West North Central region, South Atlantic region, East South Central region, West South Central region, Mountain region, Pacific region

5.3. Alternative specifications

We probe our results with several alternative specifications. First, to replicate findings in the food insecurity literature, we extended the sample to include renters and individuals who moved during our study period, and replace the housing wealth variables with a simple binary indicator of homeownership. Consistent with the literature we find that homeownership has a negative coefficient (-0.19) and is statistically significant (t=3.10, p=0.00).[18] However, this finding does not shed light on the mechanisms underlying the relationship.

We next estimate a model that includes measures of both the change in home equity and new mortgage borrowing—with both treated as endogenous. The research question is whether there is a relationship of food insecurity with home equity beyond that due to new mortgage borrowing. This relationship could occur because a household that is subject to an increase in home equity may not increase new mortgage borrowing, but instead draw upon existing financial wealth to fund consumption or it may reduce its rate of savings. In this case, even when the new mortgage borrowing variable is included in the estimation, the change in home equity would have a positive coefficient.

For the food insecurity estimation, we find that the coefficient of new mortgage borrowing variable is -0.20 with a t statistic of 2.27 (p=0.02), while the coefficient for the change in home equity is -0.06 with t statistic of 2.54 (p=0.01). Thus, new mortgage borrowing has a substantial effect on reducing the prevalence of older adults' food insecurity, it being more than three times as large as the home equity effect. However, increases in home equity continue to reduce food insecurity even when new mortgage borrowing is included in the estimation.

In the estimation of severe food insecurity, the coefficient of the new mortgage

[18] Consistent with the literature, we treat homeownership as being exogenous. Results are available from the authors.

borrowing variable is -0.16 with a t statistic of 1.24 (p=0.22), while the coefficient for the change in home equity is -0.08 with t statistic of 4.26 (p=0.00). While the relationship of coefficients is similar to that for food insecurity, the coefficient of new mortgage borrowing is no longer statistically significant.

6. Conclusions

Prior research indicates that homeownership is associated with lower levels of food insecurity. This is true in our population of older adults as well— as of the 2014 wave of the HRS, more than 16 percent of older adults who are renters report being food insecure, compared with less than 6 percent of homeowners. A homeowner's ability to borrow from the equity in their homes is often cited as the primary causal mechanism underlying this relationship (Gundersen and Gruber, 2001). To our knowledge, our study is the first to empirically investigate this mechanism.

6.1 Policy implications

These results document the critical role of housing wealth as a "protective buffer" (Ziliak et al., 2008) for material hardship and as an indicator of economic security. For older adults, borrowing from home equity can provide a means to smooth consumption in the presence of income or health shocks, thereby allowing for households to meet basic needs—in this case, sufficient resources to buy food. The significance of home equity in the wealth portfolio of older adults is only expected to increase over the next few decades, as the baby boomer generation enters retirement with lower levels of financial assets than previsous generations (Rutledge and Sanzenbacher, 2019). Our study highlights the importance of providing this population with

affordable and accessible instruments to convert home equity into a more liquid form, such as through federally insured reverse mortgages.

References

Alley, D.E., Lloyd, J., Pagán, J.A., Pollack, C.E., Shardell, M., Cannuscio, C., 2011. Mortgage Delinquency and Changes in Access to Health Resources and Depressive Symptoms in a Nationally Representative Cohort of Americans Older Than 50 Years. American Journal of Public Health 101, 2293-2298.

Angrisani, M., Hurd, M., Rohwedder, S., 2019. The effect of housing wealth losses on spending in the great recession. Economic Inquiry 57, 972-996.

Bartfeld, J., Collins, J.M., 2017. Food Insecurity, Financial Shocks, and Financial Coping Strategies among Households with Elementary School Children in Wisconsin. Journal of Consumer Affairs 51, 519-548.

Bhargava, V., Lee, J.S., 2016. Food Insecurity and Health Care Utilization Among Older Adults in the United States. Journal of Nutrition in Gerontology and Geriatrics 35, 177-192.

Bishop, N.J., Wang, K., 2018. Food insecurity, comorbidity, and mobility limitations among older U.S. adults: Findings from the Health and Retirement Study and Health Care and Nutrition Study Preventive Medicine 114, 180-187.

Bostic, R., Gabriel, S., Painter, G., 2009. Housing wealth, financial wealth, and consumption: New evidence from micro data. Regional Science and Urban Economics 39, 79-89.

Brostow, D.P., Gunzburger, E., Thomas, K.S., 2017. Food insecurity among veterans: Findings from the Health and Retirement Study. Journal of Nutrition, Health and Aging 21, 1358-1364.

Bureau of Labor Statistics, 2019. Local Area Unemployment Statistics (LAUS). United States Department of Labor, Washington.

Campbell, J.Y., Cocco, J.F., 2007. How do house prices affect consumption? Evidence from micro data. Journal of Monetary Economics 54, 591-621.

Capistrant, B.D., Mejia, N.I., Liu, S.Y., Wang, Q., Glymour, M.M., 2014. The disability burden associated with stroke emerges before stroke onset and differentially affects blacks: Results From the Health and Retirement Study cohort. Journals of Gerontology: Medical Sciences 69, 860-870.

Case, K.E., Quigley, J.M., Shiller, R.J., 2005. Comparing Wealth Effects: The Stock Market versus the Housing Market. Advances in Macroeconomics 5, 1534-6013.

Chang, Y., Chatterjee, S., Kim, J., 2013. Household finance and food insecurity Journal of Family and Economic Issues 35, 499-515.

Cheng, C., 2017. Anticipated support from children and later-life health in the United States and China. Social Science and Medicine 179, 201-209.

Cooper, D., 2013. House price fluctuations: The role of housing wealth as borrowing collateral. Review of Economics and Statistics 95, 1183-1197.

Duca, J., Rosenthal, S., 1993. Borrowing constraints, household debt, and racial discrimination in loan markets. Journal of Financial Intermediation 3, 77-103.

Engelhardt, G.V., 1996. House prices and home owner saving behavior. Regional Science and Urban Economics 26, 313-336.

Ferri, C.P., Acosta, D., Guerra, M., Huang, Y., Llibre-Rodriguez, J.J., Salas, A., Sosa, A.L., Williams, J.D., Gaona, C., Liu, Z., Noriega-Fernandez, L., Jotheeswaran, A.T., Prince,

M.J., 2012. Socioeconomic factors and all cause and cause-specific mortality among older people in Latin America, India, and China: A population-based cohort study. PLoS Medicine 9, e1001179.
FHFA, 2018. House price index. Federal Housing Finance Agency, Washington.

Fitzpatrick, K., Greenhalgh-Stanley, N., Ploeg, M.V., 2016. The Impact of Food Deserts on Food Insufficiency and SNAP Participation among the Elderly. American Journal of Agricultural Economics 98, 19-40.
Food and Nutrition Service, 2018. Am I Eligible for SNAP? U.S. Department of Agriculture, Washington.
Gatzlaff, D.H., Haurin, D.R., 1998. Sample Selection and Biases in Local House Value Indices. Journal of Urban Economics 43, 199-222.
Gualtieri, M.C., Donley, A.M., 2016. Senior Hunger: The Importance of Quality Assessment Tools in Determining Need. Journal of Applied Social Science 10, 8-21.
Gundersen, C., Gruber, J., 2001. The dynamic determinants of food insufficiency, in: Andrews, M., Prell, M. (Eds.), Second Food Security Measurement and Research Conference: Food Assistance and Nutrition Research Report. USDA, Economic Research Service, pp. 92-110.
Gundersen, C., Kreider, B., Pepper, J.V., 2017. Partial identification methods for evaluating food assistance programs: A case study of the causal impact of snap on food insecurity American Journal of Agricultural Economics 99, 875-893.
Gundersen, C., Ziliak, J.P., 2015. Food insecurity and health outcomes. Health Affairs 34, 1830-1839.
Guo, B., 2011. Household Assets and Food Security: Evidence from the Survey of Program Dynamics. Journal of Family and Economic Issues 32, 98-110.
Gupta, A., Morrison, E.R., Fedorenko, C.R., Ramsey, S.D., 2018. Home equity mitigates the financial and mortality consequences of health shocks: Evidence from cancer diagnoses. New York University, Stern School of Business, New York.
Huang, J., Guo, B., Kim, Y., 2010. Food insecurity and disability: Do economic resources matter? Social Science Research 39, 111-124.
Immergluck, D., 2009. Foreclosed: High-Risk Lending, Deregulation, and the Undermining of America's Mortgage Market. Cornell University Press, Ithaca.
Killewald, A., 2013. Return to 'being black, living in the red': A race gap in wealth that goes beyond social origin. American Sociological Review 78, 477-502.
Kim, K., Frongillo, E.A., 2007. Participation in food assistance programs modifies the relation of food insecurity with weight and depression in elders. Journal of Nutrition 137, 1005-1010.
Kim, K., Frongillo, E.A., 2009. Patterns of food insecurity and participation in food assistance programmes over time in the elderly. Public Health Nutrition 12, 2113-2119.
Mayer, C.J., 2017. Housing, mortgages, and retirement, in: Fennell, L.A., Keys, B.J. (Eds.), Evidence and innovation in housing law and policy. Cambridge University Press, Cambridge, pp. 203-230.
McIntyre, L., Wu, X., Kwok, C., Emery, J.C.H., 2017. A natural experimental study of the protective effect of home ownership on household food insecurity in Canada before and after a recession (2008-2009). Canadian Journal of Public Health 108, E135-E144.
Men, F., 2017. Mothers' Within-Marriage Economic Prospects and Later Food Security: Does Marital Outcome Matter? . Journal of Consumer Affairs 51, 682-702.
Moulton, S., Dodini, S., Haurin, D.R., Schmeiser, M.D., 2017. How house price dynamics and credit constraints affect the equity extraction of senior homeowners Federal Reserve Board, Washington, D.C.
Moulton, S., Loibl, C., Samek, A., Collins, J.M., 2013. Borrowing capacity and financial

decisions of first-time homebuyers. Journal of Consumer Affairs 47, 375-403.

Nam, Y., Hyo, J.J., 2008. Welfare reform and older immigrants: Food stamp program participation and food insecurity. Gerontologist 48, 42-50.
Ribar, D.C., Hamrick, K.S., 2003. Dynamics of poverty and food sufficiency. United States Department of Agriculture, Economic Research Service, Washington.
Rose, D., Gundersen, C., Oliveira, V., 1998. Socio-Economic Determinants of Food Insecurity in the United States: Evidence from the SIPP and CSFII Datasets. Food and Rural Economics Division, EconomicResearch Service, U.S. Department of Agriculture, Washington.
Rugh, J.S., Massey, D.S., 2010. Racial segregation and the American foreclosure crisis. American Sociological Review 75, 629-651.
Rutledge, M.S., Sanzenbacher, G.T., 2019. What financial risks do retirees face in late life? Center for Retirement Research at Boston College, Boston.
Shobe, M.A., Narcisse, M.-R., Christy, K., 2018. Household financial capital and food security. Journal of Poverty 22, 1-22.
Skinner, J.S., 1996. Is housing wealth a sideshow? Chicago, University of Chicago Press.
St.Clair, P., Bugliari, D., Campbell, N., Chien, S., Hayden, O., Hurd, M., Main, R., Miu, A., Moldoff, M., Panis, C., Pantoja, P., Rastegar, A., Rohwedder, S., Oshiro, M., Zissimopoulos, J., 2011. RAND HRS Data Documentation, Version L. Labor & Population Program, RAND Center for the Study of Aging, Santa Monica.
Swann, C.A., 2017. Household history, SNAP participation, and food insecurity. Food Policy 73, 1-9.
Wolfe, W.S., Frongillo, E.A., Valois, P., 2003. Understanding the experience of food insecurity by elders suggests ways to improve its measurement. Journal of Nutrition for the Elderly 133, 2762-2769.
Ziliak, J.P., Gundersen, C., 2018. The state of senior hunger in America 2016. Feeding America Chicago.
Ziliak, J.P., Gundersen, C., Haist, M., 2008. The causes, consequences, and future of senior hunger in America. University of Kentucky, Center for Poverty Research, Lexington.

Appendix Table 1: First stage IV probit coefficients: Food insecurity

	(1) Home equity change 2008-2012 Coefficient (SE)	(2) New mortgage borrowing 2008-2012 Coefficient (SE)
Instruments		
FHFA House Price Index (HPI) change, 2008-2012	12.195***	0.566
	(1.546)	(0.481)
Number bank branches, 2008	0.002	-0.011
	(0.021)	(0.007)
Mortgage delinquency, 2008	-2.325	-1.283*
	(1.787)	(0.516)
New mortgage borrowing, 2004-2006	-0.083*	0.049**
	(0.038)	(0.015)
Household characteristics		
Number of household members, 2008	0.089	0.099
	(0.161)	(0.056)
Suburban residence, 2008	-0.530	0.172
	(0.381)	(0.132)
Rural residence, 2008	-0.006	-0.021
	(0.420)	(0.144)
Region FE	Yes	Yes
Home equity, 2008	-0.394***	0.018***
	(0.010)	(0.003)
Household monthly gross income, 2008	0.097**	0.065***
	(0.033)	(0.011)
Gross income below 130% poverty threshold	0.350	0.101
	(0.571)	(0.198)
Net financial assets, 2008	0.060***	-0.011**
	(0.011)	(0.004)
Net financial assets squared, 2008	-0.000*	0.000
	(0.000)	(0.000)
Net other assets, 2008	0.003	-0.003
	(0.007)	(0.002)
Other debt, 2008	-0.046	0.021
	(0.054)	(0.019)
Financial respondent characteristics		
Age, 2008	0.339	0.064
	(0.212)	(0.074)
Age squared, 2008	-0.002	-0.001
	(0.002)	(0.001)
Male, 2008	0.380	-0.162
	(0.309)	(0.107)

Black, 2008	0.630	0.361*
	(0.466)	(0.161)
Other race, 2008	-0.697	0.342
	(0.772)	(0.268)
Hispanic, 2008	1.691*	-0.013
	(0.682)	(0.236)
Immigrant, 2008	0.615	0.136
	(0.574)	(0.199)
GED, 2008	-0.466	0.271
	(0.827)	(0.287)
High school, 2008	0.644	0.165
	(0.490)	(0.170)
Some college, 2008	0.404	0.360*
	(0.517)	(0.179)
College or more, 2008	1.400*	0.505**
	(0.547)	(0.190)
Separated, divorced, or widowed, 2008	-0.536	0.272*
	(0.375)	(0.130)
Never married, 2008	-1.803	0.116
	(0.923)	(0.320)
Number of living children, 2008	-0.064	0.025
	(0.078)	(0.027)
Number of living children, 2008, missing	-0.390	0.453
	(1.072)	(0.372)
Help with future needs, 2008	-0.342	0.305**
	(0.325)	(0.113)
Help with future needs, 2008, missing	-0.777	0.456*
	(0.572)	(0.198)
Problems with ADLs, 2008	-0.140	-0.083
	(0.281)	(0.097)
Food insecure, 2008	-0.365	0.216
	(0.810)	(0.281)
Macro-economic indicator		
County unemployment rate, 2008	-0.242*	-0.041
	(0.111)	(0.038)
County unemployment rate change, 2008-2012	-0.213	-0.065
	(0.149)	(0.052)
Constant	-5.547	-1.095
	(7.402)	(2.567)
Log Likelihood	-16,067.322	-11,573.760
Number of observations	4,244	4,244

Notes: *** p<0.001, ** p<0.010, * p<0.050

Appendix Table 2: First stage IV probit coefficients: Severe food insecurity

	(1) Home equity change 2008-2012 Coefficient (SE)	(2) New mortgage borrowing 2008-2012 Coefficient (SE)
Instruments		
FHFA House Price Index (HPI) change, 2008-2012	11.781***	0.592
	(1.548)	(0.488)
Number bank branches, 2008	0.001	-0.010
	(0.021)	(0.007)
Mortgage delinquency, 2008	-3.603*	-1.488**
	(1.407)	(0.500)
New mortgage borrowing, 2004-2006	-0.083*	0.043**
	(0.035)	(0.016)
Household characteristics		
Number of household members, 2008	0.092	0.100
	(0.161)	(0.056)
Suburban residence, 2008	-0.519	0.170
	(0.381)	(0.132)
Rural residence, 2008	0.040	-0.026
	(0.420)	(0.144)
Region FE	Yes	Yes
Home equity, 2008	-0.394***	0.018***
	(0.010)	(0.003)
Household monthly gross income, 2008	0.097**	0.065***
	(0.032)	(0.011)
Gross income below 130% poverty threshold	0.370	0.106
	(0.570)	(0.198)
Net financial assets, 2008	0.060***	-0.011**
	(0.011)	(0.004)
Net financial assets squared, 2008	-0.000*	0.000
	(0.000)	(0.000)
Net other assets, 2008	0.003	-0.003
	(0.007)	(0.002)
Other debt, 2008	-0.044	0.021
	(0.054)	(0.019)
Financial respondent characteristics		
Age, 2008	0.335	0.064
	(0.212)	(0.074)
Age squared, 2008	-0.002	-0.001
	(0.002)	(0.001)
Male, 2008	0.376	-0.162
	(0.309)	(0.107)

Black, 2008	0.646	0.369*
	(0.465)	(0.161)
Other race, 2008	-0.660	0.346
	(0.772)	(0.268)
Hispanic, 2008	1.695*	-0.010
	(0.682)	(0.236)
Immigrant, 2008	0.599	0.141
	(0.574)	(0.199)
GED, 2008	-0.464	0.267
	(0.827)	(0.287)
High school, 2008	0.648	0.165
	(0.490)	(0.170)
Some college, 2008	0.411	0.362*
	(0.517)	(0.179)
College or more, 2008	1.404*	0.506**
	(0.547)	(0.190)
Separated, divorced, or widowed, 2008	-0.528	0.272*
	(0.375)	(0.130)
Never married, 2008	-1.801	0.110
	(0.923)	(0.320)
Number of living children, 2008	-0.064	0.025
	(0.078)	(0.027)
Number of living children, 2008, missing	-0.389	0.446
	(1.072)	(0.372)
Help with future needs, 2008	-0.344	0.305**
	(0.325)	(0.113)
Help with future needs, 2008, missing	-0.779	0.456*
	(0.572)	(0.198)
Problems with ADLs, 2008	-0.123	-0.079
	(0.281)	(0.098)
Severe food insecure, 2008	-1.137	0.165
	(1.204)	(0.418)
Macro-economic indicator		
County unemployment rate, 2008	-0.254*	-0.040
	(0.111)	(0.038)
County unemployment rate change, 2008-2012	-0.214	-0.065
	(0.149)	(0.052)
Constant	-5.410	-1.079
	(7.402)	(2.567)
Log Likelihood	-15,756.451	-11,267.453
Number of observations	4,244	4,244

Notes: *** p<0.001, ** p<0.010, * p<0.050