

# The Great Recession and the retirement decisions of older workers

Authors: Jan Ondrich, Alexander Falevich

Persistent link: <http://hdl.handle.net/2345/bc-ir:104778>

This work is posted on [eScholarship@BC](#),  
Boston College University Libraries.

---

Chestnut Hill, Mass.: Center for Retirement Research at Boston College, December 2013

These materials are made available for use in research, teaching and private study, pursuant to U.S. Copyright Law. The user must assume full responsibility for any use of the materials, including but not limited to, infringement of copyright and publication rights of reproduced materials. Any materials used for academic research or otherwise should be fully credited with the source. The publisher or original authors may retain copyright to the materials.



**THE GREAT RECESSION AND THE RETIREMENT DECISIONS  
OF OLDER WORKERS**

Jan Ondrich and Alexander Falevich

CRR WP 2013-24

Date Submitted: October 2013

Released: December 2013

Center for Retirement Research at Boston College  
Hovey House  
140 Commonwealth Ave  
Chestnut Hill, MA 02467  
Tel: 617-552-1762 Fax: 617-552-0191  
<http://crr.bc.edu>

The research reported herein was pursuant to a grant from the U.S. Social Security Administration (SSA), funded as part of the Retirement Research Consortium (RRC). The opinions and conclusions expressed are solely those of the authors and do not represent the views of SSA, any agency of the federal government, the RRC, Syracuse University, or Boston College. The authors would like to thank Gary Engelhardt, James Follain, Stuart Rosenthal, Coady Wing, and Douglas Wolf for helpful discussion and both Mukta Mukherjee and Can Zhou for research assistance.

© 2013, Jan Ondrich and Alexander Falevich. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

### **About the Center for Retirement Research**

The Center for Retirement Research at Boston College, part of a consortium that includes parallel centers at the University of Michigan and the National Bureau of Economic Research, was established in 1998 through a grant from the Social Security Administration. The Center's mission is to produce first-class research and forge a strong link between the academic community and decision-makers in the public and private sectors around an issue of critical importance to the nation's future. To achieve this mission, the Center sponsors a wide variety of research projects, transmits new findings to a broad audience, trains new scholars, and broadens access to valuable data sources.

Center for Retirement Research at Boston College  
Hovey House  
140 Commonwealth Avenue  
Chestnut Hill, MA 02467  
phone: 617-552-1762 fax: 617-552-0191  
e-mail: [crr@bc.edu](mailto:crr@bc.edu)  
[crr.bc.edu](http://crr.bc.edu)

*Affiliated Institutions:*  
The Brookings Institution  
Massachusetts Institute of Technology  
Syracuse University  
Urban Institute

## **Abstract**

To determine how asset values of older workers affect their future retirement decisions, it is important to take into account how asset values change over asset cycles. This study uses *Health and Retirement Study* data from waves 1992 through 2010 together with restricted SSA data on geographic location to estimate a model of the age at first self-reported retirement for the subsample of married males. The model covariates include demographic variables, workplace variables, non-housing financial wealth, and housing equity. The proportional hazard estimates are, for the most part, significant and of the correct sign. The estimated models suggest that declines in housing wealth during the Great Recession lowered retirement probabilities of married males by as much as 15 to 19 percent. This delay was offset in cases where the household had defined benefit or defined contribution pensions.

## 1. INTRODUCTION

The present Social Security system in the United States insures a greater percentage of workers and offers better income replacement than the program established by President Franklin Roosevelt during the Great Depression. For Americans older than 65 Social Security accounts for about 40 percent of total income, with even larger shares even larger for middle- and low-income families (see Burtless 2008). The newly retired workers who invested all their saving in the American stock market saw the value of their retirement saving fall by more than 40 percent between October 2007 and October 2008. However the purchasing power of their Social Security benefits was unaffected.

Of course, it is important to understand that Social Security benefits are not totally secure. Over the next 75 years, the United States Social Security system faces a \$5.4 trillion shortfall, and if Congress does not raise the contribution rate or trim benefits, the trust fund reserves will be depleted shortly after 2037, at which point only three-quarters of scheduled benefits could be covered (see Urban Institute 2010). Understanding the scope of the menu of options for fixing the present system should take into account the possibility of long periods of increased unemployment and declines in wealth for older workers, such as the one that the United States has faced in the five years since the start of the Great Recession. Older workers who lose their jobs and struggle to find new ones are more likely to retire early, while those who have lost substantial wealth are more likely to postpone their retirements to save more. In an effort to quantify these effects this study examines the retirement behavior of household heads over the last two decades, a period that covers two major economic downturns.<sup>1</sup>

Economists have used duration analysis to estimate the effect of the socio-economic characteristics of households on the conditional probability of retirement by household members (see, for example, Gustman and Steinmeier 1986 and 2000; Hurd 1990). However, an accurate assessment also requires an understanding both of how the levels of the various sources of retirement income have fluctuated in the last several years.

The first of the two recent major downturns in the U.S. economy started in late 2000. As a result of the sharp downward pressure on profits, firms laid off millions of employees to

---

<sup>1</sup> Retirement can mean Social Security claiming age, self-reported retirement, or full retirement (see Gustman and Steinmeier 2002). The econometric analysis below will be performed for a self-reported retirement definition.

contain costs. While employment outcomes for older workers in fact remained favorable during the recession and recovery (see Munnell, Sass, Soto and Zhivan 2006; Cooper 2008), the recession brought substantial declines in the value of their defined contribution plans and other non-housing equity assets. The S&P 500 index fell in 2003 to a value last seen in 1997; it passed 1500 in the year 2000 but next attained that level only in 2007. The declines in retirement assets meant delays in the decision to retire (see Cooper 2008).

The recession that started in late 2007 brought with it both a decline in financial asset values and a decline in property values unprecedented in recent decades. By October 24, 2008 equities were off 43 percent from their highs in October 2007, while the Housing Bust of 2007-2008 not only caused a decline in home values of 28 percent in the United States (see Reinhart and Rogoff 2009), it also increased the uncertainty about the current and future values of a particular home (see Goodman 2012). Levitz (2008) provides anecdotal evidence that this double decline has delayed the retirement of older workers.

The Prentice-Gloeckler or complementary log-log proportional hazard model (see Prentice and Gloeckler 1978) and the Prentice-Gloeckler-Meyer proportional hazard model, which takes unobserved heterogeneity into account (see Meyer 1990), are used to estimate the determinants of the retirement decision of married males. By including a dummy indicating the retirement status of the female spouse in the covariate list of the male spouse, the estimated model takes into account coincidence in tastes for leisure, since each spouse's utility depends on the retirement status of the other (see Hurd 1990; Gustman and Steinmeier 2000).

The proportional hazard model of time to first self-reported retirement will be estimated using all Health and Retirement Study (HRS) waves from 1992 through 2010. Demographic data and data on income, pensions, and housing and non-housing financial wealth will form the basis of the covariate list. The restricted Social Security Administration data is used to obtain the geographic location of the primary residence to aid in the construction of growth in the real value of housing.

The remainder of the paper is laid out as follows. Section 2 constitutes the literature review, while section 3 presents the estimation theory of the semiparametric proportional hazard duration model. Section 4 describes the data in greater detail. Section 5 presents the empirical results and section 6 concludes.

## **2. LITERATURE REVIEW**

Work by Diamond and Hausman (1984) is among the first important studies to examine the determinants of the retirement behavior of older men. Diamond and Hausman suggest that individual uncertainty concerning wealth accumulation, financial needs, health and job opportunities should be a central focus in using longitudinal data for this purpose. The authors argue that there are distinct advantages to using a duration model instead of other statistical methods to study retirement. First, in most longitudinal data there will be a degree of censoring (the respondent will not have retired by the end of the sample period), which can easily be incorporated into the likelihood function for duration. Second, the fact that relevant regressors are likely to change over time can be handled in a straightforward manner in a hazard analysis.

Diamond and Hausman find that wealth in the form of both private pensions and Social Security have strong positive effects on the retirement hazard of older men. The Social Security effect is strong when benefits first become available at age 62 and rises for workers over 62. Surprisingly, the authors find little effect for marital status, which may be due to fact that they do not control for work status of the wife. A working or recently retired wife may provide additional financial security. On the other hand, a retired wife or a wife who has never worked may enhance the utility of retirement, since the additional leisure can be shared with a partner with similar interests.

Accordingly, much of the work on the timing of retirement until the 2000 Recession focused on the joint retirement decision of the husband and the wife. Hurd (1990) finds evidence of the co-ordination of retirement dates of working spouses and rules out similarity of tastes caused by assortative mating and economic variables as a cause. The only hypothesis left is the complementarity of leisure. Blau (1997) uses data from the Retirement History Survey to show that the spousal benefit provision has a small negative impact on labor force participation of older female spouses and a small positive impact on the labor force participation of older married men. Blau (1998) uses the same survey to analyze the joint labor force dynamics of older couples in the United States and finds strong associations between the labor force transition probabilities of one spouse and the labor force status of the other. Blau and Riphahn (1999) use data from the German Socio-Economic Panel (GSOEP) to model the labor force behavior of older married couples in Germany.

Gustman and Steinmeier (2000) develop a structural model of the joint retirement decision of married couples and estimate this model using panel data from the NLS for Mature Women. Utility in the model depends on family lifetime consumption, the separate labor supply of the husband and the wife, as well as the age and health of each. The value that each spouse places on leisure is influenced by the retirement status of the other spouse. Because people who share the same tastes are more likely to marry, the retirement preferences of the husband and wife may be correlated. The husband and wife choose paths of consumption, work, and ultimate retirement that maximize their preferences over a time subject to the restriction that lifetime family consumption cannot exceed lifetime family income. As individuals age, the value of retirement eventually outweighs the value of wages, and the individuals retire. Gustman and Steinmeier find strong evidence for the hypothesis that husbands and wives tend to retire together despite the younger ages of wives. Their estimation suggests that one reason for coordinated retirement is a coincidence of tastes for leisure. They also find that spouses generally, but husbands in particular, value retirement more if their partner has already retired.

Gustman and Steinmeier (2003) construct a structural dynamic stochastic model of the way individuals make retirement and saving choices in an uncertain world and use it to analyze the effects of the stock market bubble on retirement behavior. The model includes individual variation both in retirement preferences and in time preferences. Estimates are based on information covering the period 1992 through 2000 from the HRS. The high stock market returns in the second half of the 1990's increased retirement rates for the HRS sample of workers by over 3 percentage points and would have decreased the average retirement age by about a quarter of a year if it had not been interrupted. The subsequent decline in the market neutralized the effect on retirement of the preceding stock market gains. Gustman and Steinmeier speculate in their paper that any continuing effects of the bubble after its end would probably be minimal.

The focus of the present study is the effect of financial wealth and housing equity wealth on the retirement decision. One important study in this regard is by Case, Quigley, and Schiller (2005), who examine the links between increases in housing wealth, financial wealth, and consumer spending. They draw on annual data from 14 countries and quarterly state-level data from the United States to estimate regression models in levels, first differences and in error-correction form relating consumption to income and wealth measures. The authors find a large, statistically significant effect of housing wealth on household consumption.



Writing before the Housing Bust of 2007-2008, Farnham and Sevak (2007) use cross-MSA variation in house-price movements in data provided by the Office of Housing Enterprise Oversight to show that changes in housing wealth affect retirement timing for a sample of older workers from the HRS. They also find evidence that housing-wealth shocks affect retirement expectations as well as present retirement rates. They estimate that a 10 percent increase in housing wealth is associated with a reduction in expected retirement age of between 3.5 and 5 months.

Finally, there have been several relevant papers written since the Housing Bust. Copeland (2010) uses the March Current Population Survey to examine how employment rates of workers aged 55 and older changed over the period from 1987 to 2008. He finds that the percentage of older workers working full-time throughout the year increased steadily from 1993 to 2007 before decreasing during the recession year of 2008. Gustman, Steinmeier and Tabatabai (2011) investigate both labor market and asset outcomes over the Great Recession. They find that workers age 53 to 58 before the Great Recession saw wealth decline only 2.8 percent by 2010. It is important to note that the authors use sample responses for wealth measures and a variety of imputation methods, described in the paper, for missing responses.

Goda, Shoven, and Slavov (2010) use the HRS to investigate the relationship between stock market performance and retirement expectations over the 1998 to 2008 period. The authors find a statistically significant negative relationship between expectations of working full-time at age 62 and the value of the S&P 500 index toward the end of their study period. They do not, however, find strong evidence that changes in equity markets influence changes in retirement plans over the period as a whole. They conclude that the higher probabilities of working in recent years may be related to factors other than stock market performance, such as pessimism about economic security.

Finally, at least two papers examine actual retirements. Honoré and de Paula (2011) examine the joint retirement decision of spouses, as Gustman and Steinmeier, Blau, and Blau and Riphahn did previously, presenting a statistical model based on Nash bargaining that allows simultaneous retirement with positive probability. The authors find an insignificant effect for financial wealth and do not consider housing wealth. In contrast Bender, Mavromaras, Theodossiou, and Wei (2011) present a dynamic probit model of retirement, considering

retirement not as a one-time event for each sample member, but as a state from which the sample member moves in and out.

### 3. SEMIPARAMETRIC PROPORTIONAL HAZARD ESTIMATION

In this study, like Honoré and de Paula (2011), we consider retirement to be a one-time event and focus on the determinants of the retirement behavior of married men. Unmarried men are not included in the estimation because their financial requirements are likely to be different than their married counterparts. Men rather than women are used because men have typically considered to be the primary breadwinners.

Specifically, using the sample of work-able married males aged 59 and greater drawn from the 1992-2010 waves of the HRS, we seek to analyze the determinants of the conditional retirement rate (retirement hazard rate). Some care must be taken with the terminology being used. The retirement rate might be defined as the retirement rate at a point in time within the calendar year or as the retirement rate for a given year. Somewhat arbitrarily the first possibility will be called the retirement rate and the second possibility the retirement probability.

Not all of the sample members will have retired by the end of their sample period and those that have not are said to have censored work histories. The estimation method does not require that these sample members be dropped from the analysis, but instead uses the information that they have not retired from age 59 to the time they leave the sample. In this study we will also censor the history of a sample member 1) after a non-response for whether he is retired (since the estimation requires histories to be gap-free); 2) in the wave before a marriage is ended (since we want to consider only married males; and 3) in the wave before he is disabled (since we want to consider only work-able men).

Suppose that a given sample is composed of  $N$  work histories. The  $N$  work histories provide information on  $N$  independent individual retirement ages. Let  $T_i$  be the retirement age for individuals  $i = 1, \dots, N$ . The age  $T_i$  is properly considered to be a continuous variable. The retirement hazard rate for individual  $i$  takes the proportional hazard form developed by Cox (1972):

$$\lambda_i(t) = \lambda_0(t) \exp(z_i(t)' \beta), \quad (1)$$

where  $\lambda_0(t)$  is the unknown baseline hazard at time  $t$ ,  $z_i(t)$  is the vector of time-varying covariates, and  $\beta$  is the coefficient vector.

To estimate the coefficient vector, we use the technique proposed by Prentice and Gloeckler (1978) as well as the adaptation of Meyer (1990) that allows controls for unobserved heterogeneity. In the Prentice-Gloeckler technique the parameters  $\lambda_0(t)$  of the log-integrated baseline hazard are non-parametrically estimated simultaneously with the coefficient vector. The estimation method does not use the continuous quality of the duration variable, but rather discrete sizes this variable into time intervals. The Prentice-Gloeckler technique uses the extreme-value distribution function to estimate the conditional survivor function at age  $t+1$ :

$$\Pr[T_i \geq t+1 | T_i \geq t] = \exp(-\exp(z_i(t)' \beta + \gamma(t))), \quad (2)$$

where the covariate vector  $z_i(t)$  is assumed to remain constant over the period from  $t$  to  $t+1$ . (This type of estimation is called “grouped” or “interval-censored”.) Generally when the Prentice-Gloeckler technique is used, a  $\gamma$  parameter is estimated for each interval.

The interpretation of parameters is an important component of the estimation procedure. The  $\beta$  coefficients in the Prentice-Gloeckler likelihood have an interpretation similar to that of the regression coefficients in a log-linear or semi-log regression model. In a log-linear model where both the dependent variables and regressors are logged, a regression coefficient can be interpreted as an elasticity. Similarly if a regressor is logged in the Prentice-Gloeckler likelihood, its coefficient can be interpreted as a hazard elasticity. In a semi-log regression in which the dependent variable is logged but the regressors are not, the elasticity of the dependent variable with respect to a regressor is given by the value the regressor times the coefficient. Similarly if a regressor is not logged in a Prentice-Gloeckler likelihood, its hazard elasticity is given by the value the regressor times the coefficient.

The theoretical contribution of Meyer (1990) is to use random effects to incorporate unobserved heterogeneity into the Prentice-Gloeckler likelihood. The resulting likelihood is now called the Prentice-Gloeckler-Meyer likelihood. The random effect summarizes the effects of all (unobserved) excluded regressors that are constant over the work lifetime and orthogonal to included regressors. It is well known that failure to control for such unobserved heterogeneity will result in inconsistent parameter estimates.

Incorporating the multiplicative random effect  $\theta$  into the hazard results in

$$\lambda_i(t) = \theta_i \lambda_0(t) \exp(z_i(t)' \beta) \quad . \quad (3)$$

Meyer (1990) assumes that the random effects  $\theta_i$  are independent of the  $z_i(t)$  and are i.i.d. Gamma variates with mean one and variance  $\sigma^2$ . The variance  $\sigma^2$  must now be estimated together with the coefficient vector  $\beta$  and the  $\gamma(t)$ 's.

Note that when  $\theta_i$  equals one, the value of the hazard is the same as that in the Prentice-Gloeckler likelihood. This means that conditional on the random affect assuming its mean value, the regressor coefficients have the same interpretation in both likelihoods. The Prentice-Gloeckler-Meyer technique estimates the survivor function at age  $t+1$  using the following probability:

$$\Pr[T_i \geq t+1] = \left[ 1 + \sigma^2 \sum_{k=0}^t \exp(z_i(k)' \beta + \gamma(k)) \right]^{-\sigma^2} . \quad (4)$$

#### 4. THE DATA

The data used in this study comes from the HRS, originally a longitudinal survey of a nationally representative sample of the U.S. population who were 51 to 61 years old in 1992. In 1998 the sample membership of the HRS increased in size when it was merged with the Asset and Health Dynamics among the Oldest Old (AHEAD) survey and two new special cohorts were added, the Children of the Depression Era (CODA), born in 1924-30 and War Babies (WB), born in 1942-47. It was also decided in 1998 to add new sample members every six years.

As discussed previously, a continuous work history is constructed for each sample individual starting at age 59. Work histories are not constructed for the husband if either he or his wife became disabled before 1991, the first year for which data in the HRS is given. These restrictions on the disability-ability status of the spouse(s) were added to guarantee that a retirement decision was not forced on the household by functional limitations. After additionally dropping a handful of work histories because of missing data that could not be filled in any reasonable way, the number of work histories that we ended up with was 2,582. These 2,582 work histories provided a total of 12,538 person-year intervals to the present study.

There are six types of variables used in the estimation. The first type is demographic variables. Time-invariant demographic variables are obtained from the HRS 2010 Tracker file. Time-varying demographic variables are obtained from the HRS core for the various waves.

There are two race indicators, one for if the husband is African-American and the second for if the husband is non-White and non-African-American. There is an indicator for whether the husband has a college degree and another for whether he reports very good health. Included in the list of demographic variables are four variables that describe the wife. Three of them are indicator variables, one for whether the wife is disabled, one for whether the wife is retired, and one for whether the wife has been a nonworking homemaker.

The final variable of the demographic type is meant to capture the effect of the Social Security spousal benefit on retirement behavior. The spousal benefit will be larger if the principal breadwinner, typically the husband, waits until the Social Security normal retirement age before he retires. The effect of the Social Security spousal benefit is more likely to come into play when the wife is a homemaker. The final variable of the demographic type, then, gives the number of years to the husband's Social Security normal retirement age when the wife is a homemaker. The variable is zero otherwise.

There are five workplace variables. These variables are obtained, as are all financial and housing wealth values, from the Rand HRS Data Set, Version L and the Rand HRS Income and Wealth Imputations. The first variable is the real annual log income of the wife, and the second is the real annual log income of the husband. (Current-dollar values in this study have been deflated by the implicit GDP deflator for personal consumption expenditures (year 2005=100) constructed by the Bureau of Economic Analysis.) Although we did not feel that we could get accurate information on employment-related pension plans, we did create three indicators for the type of pension plan. The first indicator is for whether the husband has ever had a defined benefit plan; the second is an indicator for whether he has not had a defined benefit plan but has had a defined contribution plan; and the third is an indicator for whether the husband has both a defined benefit plan and a defined contribution plan.

We experimented with three housing variables in preliminary estimations.<sup>2</sup> The first is the log of the home value, set to zero when the household does not own its own home. The second variable is the log of the value of the sum of mortgage and home loans. Both these variables had significant coefficients with the correct sign in virtually all of the estimations in which they were used, although none of the results are presented here. The final variable is the value of home equity, home value minus mortgage value, in millions of dollars.

---

<sup>2</sup> We also experimented with adding an indicator for home ownership, but this did not improve the fit.

The HRS is a biannual survey, although in a few cases it may interview households three years apart. Because our study constructs annual work histories from the HRS, there is clearly the need for some imputation across years. One of the unique features of our model is that we do not impute home equity for 2007, 2008, or 2009 based on a trend for the individual household. Nor do we even rely on the household's own assessment of home equity over the Great Recession years.

Even in cases where a household reports a value for home equity during the Great Recession, it is likely that the household is less certain about this value compared to values in previous years because of the nature of the substantial decline in housing demand. It is clear from the high foreclosure rates that many homes reverted to the lending institutions. In order to stay liquid, these institutions sold these properties at greatly reduced prices. The extent to which the outcomes of such sales were made public is debatable, since municipalities had an incentive to "hide" such sales to protect their tax base. As a result, unless a household attempted to sell its home, which fewer households did, it is unlikely that it would feel confident about its assessment of its home equity.

Nor does it seem to be appropriate to use a value from a general house price index to construct home equity, which can be accomplished with the HRS by combining the county information from the restricted HRS geography data with the Federal Housing Finance Agency MSA-level Repeat Sales House Price Index. It seems likely that the spread around any median or mean value in the decline of home values in a given county would likely have increased from 2007 to 2009.

On the other hand, households are likely to know their peak home value preceding the general fall in home values. Because municipalities had an incentive to keep assessments high, households were likely to know these peak home values. Moreover, many households may have believed that these peak values were the true long-run values. Accordingly, over the Great Recession years, we use the 2006 value reported by households as the basis for the calculation of home equity. In one specification we allow the effect of home equity to remain constant over the Great Recession years and in another we allow it to vary year by year. We compare the results of these specifications with results that do not use a value for home equity during the Great Recession years, but instead use either the county-wide percentage of high-interest rate loans originated from 2004 to 2006 (calculated by [foreclosure-response.org](http://foreclosure-response.org)) or this percentage

interacted with home ownership.<sup>3</sup> For years preceding the Great Recession years, we used a two-piece spline in home equity (with the knot at median value to 2006), together with a log mortgage value in all specifications.

We also experimented with several financial wealth variables, based for the most part on non-housing wealth. Several variants of these are based on a two-part spline. The estimation presented in this study has an unexpected sign for non-housing wealth in the period preceding the Great Recession. However, a spline with a knot at the median value of non-housing wealth had an expected sign for the lower part of the spline (lower values of non-housing wealth) and an unexpected sign only for the upper part of the spline (the same was true of the home-equity spline). More analysis in this regard is called for, but the conclusion that the wealthiest individuals have jobs from which they do not want to retire is not entirely unreasonable.

Some care must be taken with imputations for net non-housing financial wealth across 2007, 2008, and 2009 because of the fall in financial equity values in 2008. In performing the imputations for the final wave, care was taken not to impute values for 2007, 2008, or 2009 based on a trend for the individual household. Instead, the components of wealth for the eighth (2005-2006) wave were taken from the RAND HRS Data, Version L, and values of the changes in the S&P 500 and Barclay's Bond Index, and the levels of the three-month Certificates of Deposit Index (CODI) were used to construct imputations across years 2007, 2008, and 2009.

In the year 2000 Congress completely eliminated the earnings test for Social Security for workers who retire at or above the Social Security normal retirement age. By allowing these individuals to work without actuarial penalty after previously collecting Social Security, the average probability of an initial retirement at or after normal retirement age should have increased. Accordingly, we experimented with a variable interacting a post-1999 year with the male being of normal retirement age. It turned out that a simple indicator for post-1999 worked better (perhaps because of the general effect of the two recessions) and we used the simple indicator in all our specifications.

Areas with distressed housing are likely to be areas with high unemployment rates. It is possible that a retirement occurs after a layoff so that local unemployment rates may be more

---

<sup>3</sup> When the percentage is not interacted with home ownership, it is a proxy for local business conditions.

important than falling home values in determining retirement rates. State-level unemployment rates were found to be statistically insignificant and were omitted from the final specification.

The final type of variable is the age-indicator variable. Together the age-indicator variables allow a flexible baseline for the Prentice-Gloeckler-Meyer proportional hazard estimation.

## 5. RESULTS

Figure 1 presents married male annual retirement rates for both early and normal retirement ages. Early retirement rates clearly fell after the Tech Bust Recession of 2000 and started to rise again after falling to 9.6 percent in 2004. Except for 2008 when it fell to 12.7 percent, it remained within 1.5 percentage points of 15.5 percent from 2005 to 2009. Normal retirement age rates have shown a steady decline over the entire period from 1997 to 2009, starting at 29.6 percent in 1997 and finishing at 9.7 percent in 2009. This steady decline was punctuated by major declines during the Tech Bust Recession, when it fell to 18.8 percent from its 25.5 percent level in the previous year, and during the Great Recession, when it fell from 15.0 percent in 2006 to 13.7 percent in 2007 and 6.8 percent in 2008. Our modeling goal is to understand the extent to which the retirement rate declines were due to declines in financial and housing wealth

Variable definitions are presented in Table 1 and means and standard deviations for the data are presented in Table 2, both for all years in the work history and for the first year of the work history when the husband was 59. The hazard results for the first self-reported retirement of husbands are presented in Tables 3 through 6. Tables 3 and 4 present the results for Prentice-Gloeckler estimations and Tables 5 and 6 present the results for the Prentice-Gloeckler-Meyer estimations that incorporate controls for unobserved heterogeneity. Hazard covariates in the three models of Table 3 are, respectively, identical to those in the three models of Table 5, while the hazard covariates in the three models of Table 4 are, respectively, identical to those in the three models of Table 6. Tables 3 and 5 constrain the effect of 2006 home equity or the county-wide percentage of high interest rate mortgages originated from 2004 to 2006 to have a constant effect during the Great Recession years, while Tables 4 and 6 allow the effects to vary year by year from 2007 to 2009.



The first important result is that heterogeneity matters. The variance of the Gamma-distributed random effect is (strongly) significant in all specifications in Tables 5 and 6. The second important result is that the household-specific home equity effect during the Great Recession has more explanatory power than the county-specific measure of risky loans. In comparing the results of the Great Recession home-equity specification of Table 5 (Model 7) with that of Table 6 (Model 10), we see that Model 10 has a somewhat higher log-likelihood than Model 7. However, the higher log-likelihood of Model 10 is insufficient to compensate for the increase in the number of covariates. By the Schwarz Criterion (BIC), Model 7 is the preferred model. The results of Model 7 are as follows.

Looking first at the demographic variables in Model 7, race does not matter for retirement behavior, but having a college degree and being in very good health both significantly delay retirement. Surprisingly, husbands do not retire sooner if their wives have already retired, as complementarity in tastes for leisure would imply. Nor do husbands significantly delay retirement to maximize the spousal benefit for a non-working wife.

The workplace variables are better predictors of retirement behavior than the demographic variables. A husband will delay his retirement the higher is his own income, and the higher is his wife's. The effect of having a defined benefit plan apparently swamps the effect of having a defined contribution plan, although having either type of plan significantly increases the retirement hazard.

The retirement hazard rate increases sharply at early retirement age and again at normal retirement age. It declines gradually thereafter.

For the years preceding the Great Recession, having home equity does not significantly affect the retirement rate of husbands (although the first part of the spline has the correct sign), but, at least up to a point, having a greater amount of personal non-housing wealth speeds up retirement.

For the years of the Great Recession, however, having a defined benefit or defined compensation pension plan significantly increases married male retirement rates but personal non-housing wealth does not.

Whether or not married households use the pre-Recession value of their home (equity) as a reference point (see Kahneman and Tversky 1979) is a debatable question. The level of uncertainty about house prices undoubtedly increased during the Great Recession. Many homes

remained in a state of limbo between a homeowner who abandoned it and a bank who did not want to be held liable for the property taxes. The sales of foreclosed homes were treated differently than other sales by municipal governments trying to protect a tax base inflated by housing boom prices. If municipal governments officially acknowledge housing price declines, tax revenues decline. But if these governments maintain that housing prices did not decline locally since the peak of the housing boom, tax revenues remain unaffected. To the extent that assessments in many cases continued at peak or close to peak values during the Great Recession, the argument that the peak values may become reference points seems to be somewhat strengthened. The peak value is the only true value that homeowners know.

The models that we estimate are consistent with the idea that households use peak housing values as a reference point after the Great Recession starts. Households are uncertain about the true current value of their home. Households are certain only about the peak value of their home and the fact that the true current value is substantially lower than the peak. The greater is the peak value, the greater is the amount of wealth possibly lost. So, if households respond to lost wealth by delaying retirement, a possible conclusion to be drawn is that Great-Recession retirement rates are lower, the higher is the peak value of housing. The statistically negative coefficient on the 2006 value of home equity supports the hypothesis that owners of higher-valued home postponed retirement during the Great Recession.

To understand the magnitude of these effects, turn to Figures 2 and 3 for sample average annual retirement probabilities predicted from Model 7 using the mean value of one for the Gamma random effect. For both early and normal age retirement, homeowners and renters have the same retirement probabilities in 2006. For early retirement the gap in retirement probabilities rises to 5.6 percentage points in 2007, 5.0 percentage points in 2008, and 2.2 percentage points in 2009, with renters having the higher probabilities in each year. For normal age retirement the gap is much larger in 2007 and 2008, 13.2 and 9.2 percentage points respectively, but disappears in 2009. The magnitudes of these gaps cannot be completely attributed to home-ownership, since renters are also likely to have smaller pensions and less financial wealth than owners.

To gauge the effect of home equity, we propose a counterfactual (CF in the figures) in which positive home equity value is counted as financial wealth. Under this counterfactual, retirement probabilities for early (normal age) retirement would have risen for home-owners by about 3.0 (4.5) percentage points over the Great Recession. The order of magnitude is 15 to 19

percent. We conclude that home-ownership was an important factor in delaying retirement during the Great Recession.

## 6. CONCLUSIONS

This study uses *Health and Retirement Study* data from waves 1992 through 2010 together with restricted SSA data on geographic location to estimate a model of the age at first self-reported retirement for the subsample of married males. The model covariates include demographic variables, workplace variables, non-housing financial wealth, and housing equity. We estimate proportional hazard models with and without controls for unobserved heterogeneity and find that controlling for unobserved heterogeneity improves the fit. The proportional hazard estimates are, for the most part, significant and of the correct sign. The estimated models suggest that declines in housing wealth during the Great Recession significantly delayed the retirement of married males.

Households are likely to know their peak home value preceding the general fall in home values during the Great Recession, because municipalities had and still have an incentive to keep assessments high. Moreover, many households may have believed that these peak values were the true long-run values. Accordingly, we estimate models in which, over the Great Recession years, we use the 2006 home value reported by households as the basis for the calculation of home equity. In one specification we allow the effect of home equity to remain constant over the Great Recession years and in another we allow it to vary year by year. We compare the results of these specifications with results that do not use a value for home equity during the Great Recession years, but instead use either the county-wide percentage of high-interest rate loans originated from 2004 to 2006 or this percentage interacted with home ownership. The specification for which the effect of home equity remains constant over the Great Recession years is preferred to the one in which it does not; moreover, home equity is a better predictor of married male retirement behavior than the county-specific measures of potentially distressed housing. Using predictions from our preferred model, we concluded that positive home equity lowered retirement probabilities by 15 to 19 percent during the Great Recession.

## References

- Bender, K., Mavromaras, K., Theodossiou, I. and Wei, Z. 2011. "The effect of wealth and earned income on the decision to retire: a dynamic probit examination of retirement," Flinders University Working Paper. Presented at the 25th Annual Conference of the European Society for Population Economics.
- Blau, D. M. 1997. "Social Security and the Labor Supply of Older Married Couples," *Labour Economics* 4: 373-418.
- . 1998. "Labor Force Dynamics of Older Married Couples," *Journal of Labor Economics* 16: 595-629.
- Blau, D. M., and R. T. Riphahn. 1999. "Labor Force Transitions of Older Married Couples in Germany," *Labour Economics* 6: 229-251.
- Burtless, G. 2008. "Stock Market Fluctuations and Retiree Incomes: An Update," Brookings Institution Working Paper.
- Cox, D. R. 1972. "Regression Models and Life-Tables," *Journal of the Royal Statistical Society, Series B* 34(2): 187-220.
- Cox, D. R. 1975. "Partial Likelihood," *Biometrika* 62: 269-276.
- Cooper, J. C. 2008. "Jobs May Take a Smaller Hit This Time," *Business Week*, April 21.
- Copeland, C. 2010. "Employment Status of Workers Ages 55 or Older, 1987-2008," *Employment Benefit Research Institute Notes* 31.
- Farnham, M. and P. Sevak. 2007. "Housing Wealth and Retirement Timing," University of Michigan Retirement Research Center, Working Paper WP-2007-172.
- Goda, G. S., J. B. Shoven, and S. N. Slavov. 2010. "Does Stock Market Performance Influence Retirement Expectations?" National Bureau of Economic Research, NBER Working Paper No. w16211.
- Goodman, A.C. 2013. "Is there an *S* in urban housing supply? Or What on earth happened in Detroit?" *Journal of Housing Economics*, (forthcoming).
- Gustman, A. L., and T. L. Steinmeier. 2000. "Retirement in Dual-Career Families: A Structural Model," *Journal of Labor Economics* 18:503-545.
- . 2003. "Retirement and the Stock Bubble," *Working Paper*, Dartmouth College and Texas Tech University.
- Gustman, A.L., T.L. Steinmeier, and Nahid Tabatabai. 2011. "How Did the Recession of 2007-2009 Affect the Wealth and Retirement of the Near Retirement Age Population in the Health and Retirement Study?" University of Michigan Retirement Research Center Working Paper 2011-253, University of Michigan.

- Honoré, B. and Á. de Paula. 2011. "Interdependent Durations in Joint Retirement," Center for Retirement Research at Boston College Working Paper No. 2011-5.
- Hurd, M. 1990. "The Joint Retirement Decision of Husbands and Wives," in D.A. Wise (ed.), *Issues in the Economics of Aging*, pp. 231-58. Chicago: University of Chicago Press.
- Kahneman, D. and A. Tversky. 1979. "Prospect Theory: An Analysis of Decision under Risk," *Econometrica* 47:263-292.
- Levitz, J. 2008. "Americans Delay Retirement as Housing, Stocks Swoon," *Wall Street Journal*, April 1.
- Meyer, B. 1990. "Unemployment Insurance and Unemployment Spells," *Econometrica* 58:757-82.
- Munnell, A. H., S. Sass, M. Soto, and N. Zhivan. 2006. "Has the Displacement of Older Workers Increased?" Center for Retirement Research at Boston College, Working Paper WP-2006-17.
- Prentice, R. and L. Gloeckler. 1978. "Regression Analysis with Grouped Survival Data with Application to Breast Cancer Data," *Biometrics* 34:57-67.
- Reinhart, C. and K. Rogoff. 2009. "The Aftermath of Financial Crises," *American Economic Review* 99(2):466-72.
- Urban Institute. 2010. "The Future of Social Security: Solvency, Work, Adequacy and Equity," Urban Institute Program on Retirement Policy Brief No. 31, November.

**Table 1**  
**Variable Definitions**

<b>Variable</b>	<b>Definition</b>
<b>Demographic Variables</b>	
Black	African-American indicator for male spouse (1=yes).
Other Race	Non-White, Non- African-American indicator for male spouse (1=yes).
College	College degree indicator for male spouse (1=yes).
Health Very Good	Indicator for report of very good health for male spouse (1=yes).
Spouse Disabled	Indicator for disabled female spouse (1=yes).
Spouse Retired	Indicator for retired female spouse (1=yes).
Spouse Homemaker	Indicator for female spouse always non-working homemaker (1=yes).
Spouse Homemaker x Years Off	Number of years until normal retirement age of male spouse if female spouse always non-working homemaker and zero otherwise.
<b>Workplace Variables</b>	
Log Spouse Income	Log of female spouse's real annual earnings (\$) in year.
Log Own Income	Log of male spouse's real annual earnings (\$) in year.
Defined Benefit Plan	Indicator for whether male spouse has defined benefit plan (1=yes).
Defined Contribution Plan	Indicator for whether male spouse has no defined benefit plan but has defined contribution plan (1=yes).
Both Types of Plan	Indicator for whether male spouse has both defined benefit plan and defined contribution plan (1=yes).
<b>Housing Variables</b>	
Home Equity Spline Part 1	Part 1 of spline for real value of home equity (\$ million). Variable equals zero if not homeowner.
Home Equity Spline Part 2	Part 2 of spline for real value of home equity (\$ million). Variable equals zero if not homeowner.
Log Mortgage	Real value of total home loans.
<b>Financial Variables</b>	
Financial Assets Spline Part 1	Part 1 of spline for real value of non-housing wealth (\$ million).
Financial Assets Spline Part 2.	Part 2 of spline for real value of non-housing wealth (\$ million)..
Post – 1999 Indicator	Indicator for whether the year is after 1999 (1=yes).

**Table 1**  
**Variable Definitions**  
**(cont'd)**

<b>Variable</b>	<b>Definition</b>
<b>Great Recession Variables</b>	
Home Equity 2006	Real value of home equity (\$ million) interacted with Great Recession.
Home Equity 2006 x Year 2007	Real value of home equity (\$ million) interacted with Year 2007.
Home Equity 2006 x Year 2008	Real value of home equity (\$ million) interacted with Year 2008.
Home Equity 2006 x Year 2009	Real value of home equity (\$ million) interacted with Year 2009.
County High Interest Rate Percentage	Percentage high interest rate loans in county as of 2007.
County High Interest Rate Percentage x Year 2007	Percentage high interest rate loans in county interacted with Year 2007.
County High Interest Rate Percentage x Year 2008	Percentage high interest rate loans in county interacted with Year 2008.
County High Interest Rate Percentage x Year 2009	Percentage high interest rate loans in county interacted with Year 2009.
Owner x County High Interest Rate Percentage	Percentage high interest rate loans in county as of 2007 interacted with homeowner indicator.
Owner x County High Interest Rate Percentage x Year 2007	Percentage high interest rate loans in county interacted with homeowner and Year 2007.
Owner x County High Interest Rate Percentage x Year 2008	Percentage high interest rate loans in county interacted with homeowner and Year 2008.
Owner x County High Interest Rate Percentage x Year 2009	Percentage high interest rate loans in county interacted with homeowner and Year 2009.

Defined Benefit Plan x Great Recession	Indicator for whether male spouse has defined benefit plan (1=yes) ) interacted with Great Recession.
Defined Contribution Plan x Great Recession	Indicator for whether male spouse has no defined benefit plan but has defined contribution plan (1=yes) interacted with Great Recession.
Both Types of Plan x Great Recession	Indicator for whether male spouse has both defined benefit plan and defined contribution plan (1=yes). ) interacted with Great Recession.
<b>Age Indicators</b>	
Age xx	Indicator for whether male spouse is age xx in year (1=yes). The values for xx run from 59 through to 70.
Age 71-78	Indicator for whether male spouse is between the ages of 71 and 78 in year (1=yes).

---



**Table 2. Variable Means**

<b>Variable</b>	<b>All Years</b>		<b>First Year</b>	
	<b>Mean</b>	<b>Std Dev</b>	<b>Mean</b>	<b>Std Dev</b>
<b>Demographic Variables</b>				
Black	0.0952	0.2935	0.1050	0.3066
Other Race	0.0321	0.1764	0.0349	0.1835
College	0.2988	0.4577	0.2742	0.4462
Health Very Good	0.5232	0.4995	0.5310	0.4991
Spouse Disabled	0.0704	0.2559	0.0596	0.2369
Spouse Retired	0.2475	0.4316	0.2545	0.4356
Spouse Homemaker	0.1124	0.3158	0.0364	0.1873
Spouse Homemaker x Years Off	0.1580	0.8738	0.2761	1.2947
<b>Workplace Variables</b>				
Log Spouse Income	2.6449	4.4068	3.2291	4.6643
Log Own Income	8.6411	4.0895	9.2365	3.6202
Defined Benefit Plan	0.1602	0.3668	0.2289	0.4202
Defined Contribution Plan	0.4010	0.4901	0.3118	0.4633
Both Types of Plan	0.0734	0.2608	0.0395	0.1948
<b>Housing Variables</b>				
Home Equity	0.1495	0.3925	0.1239	0.2613
<b>Financial Variables</b>				
Financial Assets	0.4519	2.3705	0.2973	0.8181
Post – 1999 Indicator	0.1502	0.3573	0.0000	0.0000
<b>Age Indicators</b>				
Age 59	0.2059	0.4044	1.0000	0.0000
Age 60	0.1772	0.3819	0.0000	0.0000
Age 61	0.1476	0.3547	0.0000	0.0000
Age 62	0.1248	0.3305	0.0000	0.0000
Age 63	0.0888	0.2845	0.0000	0.0000
Age 64	0.0678	0.2514	0.0000	0.0000
Age 65	0.0530	0.2241	0.0000	0.0000
Age 66	0.0388	0.1930	0.0000	0.0000
Age 67	0.0274	0.1634	0.0000	0.0000
Age 68	0.0209	0.1430	0.0000	0.0000
Age 69	0.0146	0.1199	0.0000	0.0000
Age 70	0.0108	0.1036	0.0000	0.0000
Age 71-78	0.0222	0.1475	0.0000	0.0000

**TABLE 3**  
**COMPLEMENTARY LOG-LOG REGRESSION**  
**COVARIATES CONSTANT DURING GREAT RECESSION**

<b>Variable Name</b>	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>
<b>Demographic Variables</b>			
Black	-0.0532 (0.0981)	-0.0425 (0.0982)	-0.0403 (0.0983)
Other Race	-0.1158 (0.1758)	-0.0978 (0.1757)	-0.0924 (0.1758)
College	-0.3185 (0.0692)	-0.3312 (0.0690)	-0.3315 (0.0690)
Very Good Health	-0.2173 (0.0572)	-0.2231 (0.0570)	-0.2231 (0.0570)
Spouse Disabled	0.1100 (0.1013)	0.1187 (0.1012)	0.1195 (0.1012)
Spouse Retired	-0.1148 (0.0817)	-0.1131 (0.0817)	-0.1134 (0.0817)
Spouse Homemaker	0.1343 (0.0882)	0.1358 (0.0882)	0.1348 (0.0882)
Spouse Homemaker x Years Off	-0.0645 (0.0467)	-0.0630 (0.0466)	-0.0629 (0.0466)
<b>Workplace Variables</b>			
Log Spouse Income	-0.0245 (0.0073)	-0.0242 (0.0073)	-0.0242 (0.0073)
Log Own Income	-0.0790 (0.0069)	-0.0780 (0.0069)	-0.0781 (0.0069)
Defined Benefit Plan	1.1793 (0.0901)	1.1907 (0.0911)	1.1942 (0.091)
Defined Contribution Plan	0.5685 (0.0795)	0.5806 (0.0806)	0.5841 (0.0805)
Both Types of Plan	0.9316 (0.1145)	0.9407 (0.1151)	0.9440 (0.1151)

**TABLE 3 (cont'd)**  
**COMPLEMENTARY LOG-LOG REGRESSION**  
**COVARIATES CONSTANT DURING GREAT RECESSION**

<b>Variable Name</b>	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>
<b>Housing Variables</b>			
Home Equity Spline Part 1	1.7292 (1.0093)	1.9648 (1.0322)	2.0186 (1.031)
Home Equity Spline Part 2	-0.2994 (0.2437)	-0.2967 (0.2436)	-0.2973 (0.2437)
Log Mortgage	-0.0148 (0.0053)	-0.0151 (0.0053)	-0.0152 (0.0053)
<b>Other Wealth Variables</b>			
Non-Housing Wealth Spline Part 1	2.9554 (0.8615)	3.1447 (0.871)	3.1786 (0.8706)
Non-Housing Wealth Spline Part 2	-0.1696 (0.0554)	-0.1675 (0.0552)	-0.1676 (0.0552)
<b>Great Recession Variables</b>			
Equity 2006	-0.6424 (0.3181)		
County High Interest Rate Percentage		0.0023 (0.0048)	
Owner x County High Interest Rate Percentage			0.0038 (0.0046)
Non-Housing Wealth x Great Recession	0.0091 (0.0119)	0.0037 (0.0129)	0.0036 (0.0130)
Defined Benefit Plan x Great Recession	1.1837 (0.2244)	1.0863 (0.2353)	1.0765 (0.2297)
Defined Compensation x Great Recession	0.6810 (0.1539)	0.5401 (0.1601)	0.5249 (0.1567)
Both Types of Plan x Great Recession	1.5208 (0.2151)	1.4192 (0.2228)	1.3967 (0.2215)
Post 1999	-0.2057 (0.0633)	-0.2123 (0.0638)	-0.2142 (0.0637)

**TABLE 3 (cont'd)**  
**COMPLEMENTARY LOG-LOG REGRESSION**  
**COVARIATES CONSTANT DURING GREAT RECESSION**

<b>Variable Name</b>	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>
<b>Age Indicators</b>			
Age 59	-2.7649 (0.1500)	-2.8094 (0.1537)	-2.817 (0.1527)
Age 60	-2.3840 (0.1422)	-2.4276 (0.1460)	-2.4354 (0.1450)
Age 61	-2.2197 (0.1422)	-2.2648 (0.1459)	-2.2727 (0.1449)
Age 62	-1.0472 (0.1239)	-1.0920 (0.1280)	-1.0994 (0.1269)
Age 63	-1.3210 (0.1341)	-1.3640 (0.1378)	-1.3709 (0.1366)
Age 64	-1.5241 (0.1467)	-1.5707 (0.1506)	-1.5783 (0.1494)
Age 65	-1.0706 (0.1431)	-1.1157 (0.1467)	-1.1235 (0.1457)
Age 66	-0.9764 (0.1526)	-1.0243 (0.1565)	-1.0322 (0.1552)
Age 67	-1.4594 (0.1907)	-1.5116 (0.1934)	-1.5194 (0.1926)
Age 68	-1.6781 (0.2248)	-1.7352 (0.2272)	-1.7424 (0.2261)
Age 69	-1.7031 (0.2567)	-1.7627 (0.2593)	-1.7711 (0.2584)
Age 70	-1.6422 (0.2836)	-1.7120 (0.2875)	-1.7227 (0.2864)
Age 71-78	-2.1827 (0.2646)	-2.2632 (0.2696)	-2.2778 (0.2685)
-2 Log L	7516.472	7521.48	7521.05

**TABLE 4**  
**COMPLEMENTARY LOG-LOG REGRESSION**  
**COVARIATES VARY DURING GREAT RECESSION**

<b>Variable Name</b>	<b>Model 4</b>	<b>Model 5</b>	<b>Model 6</b>
<b>Demographic Variables</b>			
Black	-0.0532 (0.0981)	-0.0425 (0.0983)	-0.0402 (0.0983)
Other Race	-0.1127 (0.1758)	-0.0965 (0.1758)	-0.0911 (0.1759)
College	-0.3197 (0.0691)	-0.3310 (0.0690)	-0.3314 (0.0690)
Very Good Health	-0.2168 (0.0571)	-0.2228 (0.0570)	-0.2230 (0.0570)
Spouse Disabled	0.1101 (0.1012)	0.1190 (0.1012)	0.1193 (0.1012)
Spouse Retired	-0.1148 (0.0817)	-0.1124 (0.0817)	-0.1124 (0.0817)
Spouse Homemaker	0.1338 (0.0882)	0.1356 (0.0882)	0.1351 (0.0882)
Spouse Homemaker x Years Off	-0.0644 (0.0467)	-0.0629 (0.0466)	-0.0629 (0.0466)
<b>Workplace Variables</b>			
Log Spouse Income	-0.0245 (0.0073)	-0.0239 (0.0073)	-0.0240 (0.0073)
Log Own Income	-0.0787 (0.0069)	-0.0777 (0.0069)	-0.0778 (0.0069)
Defined Benefit Plan	1.1783 (0.0901)	1.1886 (0.0911)	1.1924 (0.0910)
Defined Contribution Plan	0.5675 (0.0795)	0.5787 (0.0806)	0.5824 (0.0805)
Both Types of Plan	0.9303 (0.1145)	0.9388 (0.1151)	0.9422 (0.1151)

**TABLE 4 (cont'd)**  
**COMPLEMENTARY LOG-LOG REGRESSION**  
**COVARIATES VARY DURING GREAT RECESSION**

<b>Variable Name</b>	<b>Model 4</b>	<b>Model 5</b>	<b>Model 6</b>
<b>Housing Variables</b>			
Home Equity Spline Part 1	1.7360 (1.0084)	1.9614 (1.032)	2.0156 (1.0308)
Home Equity Spline Part 2	-0.2989 (0.2437)	-0.2964 (0.2436)	-0.2970 (0.2437)
Log Mortgage	-0.0149 (0.0053)	-0.0151 (0.0053)	-0.0153 (0.0053)
<b>Other Wealth Variables</b>			
Non-Housing Wealth Spline Part 1	2.9608 (0.8607)	3.1420 (0.8709)	3.1759 (0.8705)
Non-Housing Wealth Spline Part 2	-0.1692 (0.0554)	-0.1671 (0.0552)	-0.1673 (0.0552)
<b>Great Recession Variables</b>			
Equity 2006 x Year 2007	-0.1620 (0.3058)		
Equity 2006 x Year 2008	-1.0789 (0.4731)		
Equity 2006 x Year 2009	-0.8732 (0.4779)		
County High Interest Rate Percentage x Year 2007		0.0058 (0.0059)	
County High Interest Rate Percentage x Year 2008		-0.0037 (0.0068)	
County High Interest Rate Percentage x Year 2009		0.0034 (0.0065)	
Owner x County High Interest Rate Percentage x Year 2007			0.0070 (0.0058)
Owner x County High Interest Rate Percentage x Year 2008			-0.0019 (0.0067)
Owner x County High Interest Rate Percentage x Year 2009			0.0052

**TABLE 4 (cont'd)**  
**COMPLEMENTARY LOG-LOG REGRESSION**  
**COVARIATES VARY DURING GREAT RECESSION**

<b>Variable Name</b>	<b>Model 4</b>	<b>Model 5</b>	<b>Model 6</b>
<b>Great Recession Variables (cont'd)</b>			
Non-Housing Wealth x Great Recession	0.00792 (0.0122)	0.00346 (0.0131)	0.00335 (0.0131)
Defined Benefit Plan x Great Recession	1.1815 (0.2239)	1.0830 (0.2358)	1.0728 (0.2301)
Defined Compensation Plan x Great Recession	0.6846 (0.1518)	0.5440 (0.1602)	0.5270 (0.1568)
Both Types of Plan x Great Recession	1.5278 (0.2138)	1.4229 (0.2228)	1.4001 (0.2216)
Post 1999	-1.0737 (0.1464)	-0.2119 (0.0638)	-0.2138 (0.0637)
<b>Age Indicators</b>			
Age 59	-2.7693 (0.1497)	-2.8108 (0.1537)	-2.8198 (0.1528)
Age 60	-2.3871 (0.1419)	-2.4292 (0.146)	-2.4383 (0.1451)
Age 61	-2.2231 (0.1419)	-2.2671 (0.1459)	-2.2759 (0.145)
Age 62	-1.0481 (0.1237)	-1.0937 (0.1281)	-1.1024 (0.1269)
Age 63	-1.3233 (0.1338)	-1.3662 (0.1378)	-1.3744 (0.1367)
Age 64	-1.5284 (0.1464)	-1.5724 (0.1505)	-1.5817 (0.1494)
Age 65	-1.0737 (0.1429)	-1.1157 (0.1467)	-1.1250 (0.1458)
Age 66	-0.9824 (0.1523)	-1.0309 (0.1566)	-1.0399 (0.1554)
Age 67	-1.4624 (0.1905)	-1.5064 (0.1934)	-1.5169 (0.1926)
Age 68	-1.6719 (0.2245)	-1.7352 (0.2273)	-1.7784 (0.2292)

**TABLE 4 (cont'd)**  
**COMPLEMENTARY LOG-LOG REGRESSION**  
**COVARIATES VARY DURING GREAT RECESSION**

<b>Variable Name</b>	<b>Model 4</b>	<b>Model 5</b>	<b>Model 6</b>
<b>Age Indicators (cont'd)</b>			
Age 69	-1.7071 (0.2567)	-1.7732 (0.2595)	-1.7825 (0.2587)
Age 70	-1.6422 (0.2839)	-1.7131 (0.2877)	-1.7214 (0.2866)
Age 71-78	-2.1788 (0.264)	-2.2630 (0.2696)	-2.2789 (0.2685)
-2 Log L	7513.465	7519.562	7519.464



**TABLE 5**  
**PRENTICE-GLOECKLER-MEYER REGRESSION**  
**COVARIATES CONSTANT DURING GREAT RECESSION**

<b>Variable Name</b>	<b>Model 7</b>	<b>Model 8</b>	<b>Model 9</b>
<b>Demographic Variables</b>			
Black	-0.0832 (0.1316)	-0.0662 (0.1300)	-0.0630 (0.1299)
Other Race	-0.1677 (0.2356)	-0.1476 (0.2318)	-0.1432 (0.2315)
College	-0.4159 (0.0951)	-0.4361 (0.0942)	-0.4361 (0.0941)
Very Good Health	-0.1668 (0.0701)	-0.1788 (0.0694)	-0.1794 (0.0693)
Spouse Disabled	0.1378 (0.1363)	0.1509 (0.1345)	0.1518 (0.1343)
Spouse Retired	-0.1857 (0.1091)	-0.1810 (0.1079)	-0.1800 (0.1077)
Spouse Homemaker	0.1668 (0.1157)	0.1666 (0.1142)	0.1665 (0.1140)
Spouse Homemaker x Years Off	-0.0778 (0.0541)	-0.0749 (0.0536)	-0.0745 (0.0536)
<b>Workplace Variables</b>			
Log Spouse Income	-0.0347 (0.0093)	-0.0338 (0.0093)	-0.0336 (0.0093)
Log Own Income	-0.1133 (0.0119)	-0.1105 (0.0121)	-0.1102 (0.0120)
Defined Benefit Plan	1.4167 (0.1223)	1.4167 (0.1225)	1.4186 (0.1222)
Defined Contribution Plan	0.6536 (0.1032)	0.6597 (0.1030)	0.6624 (0.1027)
Both Types of Plan	1.0184 (0.1496)	1.0245 (0.1483)	1.0269 (0.1481)

**TABLE 5 (cont'd)**  
**PRENTICE-GLOECKLER-MEYER REGRESSION**  
**COVARIATES CONSTANT DURING GREAT RECESSION**

	<b>Model 7</b>	<b>Model 8</b>	<b>Model 9</b>
<b>Variable Name</b>			
<b>Housing Variables</b>			
Home Equity Spline Part 1	2.0706 (1.2194)	2.3506 (1.2390)	2.4280 (1.2411)
Home Equity Spline Part 2	-0.4210 (0.2939)	-0.3336 (0.2850)	-0.3356 (0.2848)
Log Mortgage	-0.0245 (0.0072)	-0.0240 (0.0071)	-0.0241 (0.0071)
<b>Other Wealth Variables</b>			
Non-Housing Wealth Spline Part 1	3.9186 (1.0856)	4.0789 (1.0894)	4.1150 (1.0879)
Non-Housing Wealth Spline Part 2	-0.1865 (0.0644)	-0.1804 (0.0636)	-0.1801 (0.0635)
<b>Great Recession Variables</b>			
Equity 2006	-0.8449 (0.3524)		
County High Interest Rate Percentage		0.0009 (0.0054)	
Owner x County High Interest Rate Percentage			0.0024 (0.0053)
Non-Housing Wealth x Great Recession	-0.0009 (0.0154)	-0.0081 (0.0164)	-0.0081 (0.0164)
Defined Benefit Plan x Great Recession	1.5887 (0.2703)	1.4811 (0.2808)	1.4608 (0.2765)
Defined Compensation x Great Recession	0.8131 (0.1787)	0.6684 (0.1843)	0.6521 (0.1806)
Both Types of Plan x Great Recession	1.8517 (0.2746)	1.7441 (0.2793)	1.7215 (0.2782)
Post 1999	-0.1864 (0.0762)	-0.1922 (0.0759)	-0.1939 (0.0758)

**TABLE 5 (cont'd)**  
**PRENTICE-GLOECKLER-MEYER REGRESSION**  
**COVARIATES CONSTANT DURING GREAT RECESSION**

<b>Variable Name</b>	<b>Model 7</b>	<b>Model 8</b>	<b>Model 9</b>
<b>Age Indicators</b>			
Age 59	-2.5141 (0.1874)	-2.5789 (0.1911)	-2.5920 (0.1901)
Age 60	-2.0888 (0.187)	-2.1551 (0.1907)	-2.1685 (0.1897)
Age 61	-1.8732 (0.1944)	-1.9439 (0.1980)	-1.9579 (0.1970)
Age 62	-0.5685 (0.2066)	-0.6472 (0.2098)	-0.6620 (0.2086)
Age 63	-0.6978 (0.2435)	-0.7834 (0.2460)	-0.7989 (0.2447)
Age 64	-0.7735 (0.2777)	-0.8721 (0.2798)	-0.8892 (0.2785)
Age 65	-0.1943 (0.3076)	-0.2983 (0.3093)	-0.3166 (0.3080)
Age 66	0.0537 (0.3511)	-0.0641 (0.3522)	-0.0842 (0.3507)
Age 67	-0.2950 (0.4035)	-0.4277 (0.4038)	-0.4487 (0.4022)
Age 68	-0.4132 (0.4472)	-0.5615 (0.4466)	-0.5839 (0.4447)
Age 69	-0.3751 (0.4871)	-0.5332 (0.4850)	-0.5572 (0.4831)
Age 70	-0.2474 (0.5198)	-0.4231 (0.5176)	-0.4492 (0.5155)
Age 71-78	-0.6641 (0.5484)	-0.8624 (0.5460)	-0.8929 (0.5438)
Gamma Variance	0.7478 (0.2301)	0.7056 (0.2304)	0.6997 (0.2299)
-2 Log L	7496.482	7503.939	7503.762

**TABLE 6**  
**PRENTICE-GLOECKLER-MEYER REGRESSION**  
**COVARIATES VARY DURING GREAT RECESSION**

<b>Variable Name</b>	<b>Model 10</b>	<b>Model 11</b>	<b>Model 12</b>
<b>Demographic Variables</b>			
Black	-0.0834 (0.1317)	-0.0657 (0.1298)	-0.0624 (0.1297)
Other Race	-0.1615 (0.2359)	-0.1443 (0.2315)	-0.1401 (0.2312)
College	-0.4178 (0.0951)	-0.4351 (0.0941)	-0.4353 (0.0939)
Very Good Health	-0.1655 (0.0702)	-0.1788 (0.0693)	-0.1796 (0.0692)
Spouse Disabled	0.1387 (0.1364)	0.1513 (0.1343)	0.1518 (0.1341)
Spouse Retired	-0.1852 (0.1093)	-0.1791 (0.1077)	-0.1780 (0.1076)
Spouse Homemaker	0.1665 (0.1159)	0.1665 (0.1141)	0.1668 (0.1139)
Spouse Homemaker x Years Off	-0.0778 (0.0541)	-0.0746 (0.0536)	-0.0744 (0.0535)
<b>Workplace Variables</b>			
Log Spouse Income	-0.0346 (0.0093)	-0.0334 (0.0093)	-0.0333 (0.0093)
Log Own Income	-0.1130 (0.012)	-0.1098 (0.0120)	-0.1096 (0.0120)
Defined Benefit Plan	1.4164 (0.1225)	1.4133 (0.1224)	1.4154 (0.1221)
Defined Contribution Plan	0.6528 (0.1033)	0.6572 (0.1028)	0.6601 (0.1025)
Both Types of Plan	1.0183 (0.1497)	1.0225 (0.1481)	1.0250 (0.1478)

**TABLE 6 (cont'd)**  
**PRENTICE-GLOECKLER-MEYER REGRESSION**  
**COVARIATES VARY DURING GREAT RECESSION**

<b>Variable Name</b>	<b>Model 10</b>	<b>Model 11</b>	<b>Model 12</b>
<b>Housing Variables</b>			
Home Equity Spline Part 1	2.0778 (1.2188)	2.3413 (1.2371)	2.4241 (1.2395)
Home Equity Spline Part 2	-0.4109 (0.2934)	-0.3334 (0.2846)	-0.3355 (0.2845)
Log Mortgage	-0.0245 (0.0072)	-0.0241 (0.0071)	-0.0241 (0.0071)
<b>Other Wealth Variables</b>			
Non-Housing Wealth Spline Part 1	3.9244 (1.0852)	4.0696 (1.0881)	4.1067 (1.0868)
Non-Housing Wealth Spline Part 2	-0.1859 (0.0644)	-0.1800 (0.0635)	-0.1797 (0.0634)
<b>Great Recession Variables</b>			
Equity 2006 x Year 2007	-0.3223 (0.3751)		
Equity 2006 x Year 2008	-1.2485 (0.5191)		
Equity 2006 x Year 2009	-1.1460 (0.5138)		
County High Interest Rate Percentage x Year 2007		0.0048 (0.0064)	
County High Interest Rate Percentage x Year 2008		-0.0044 (0.0072)	
County High Interest Rate Percentage x Year 2009		0.0009 (0.0072)	
Owner x County High Interest Rate Percentage x Year 2007			0.0059  (0.0064)
Owner x County High Interest Rate Percentage x Year 2008			-0.0025  (0.0072)
Owner x County High Interest Rate Percentage x Year 2009			0.0029  (0.0070)

**TABLE 6 (cont'd)**  
**PRENTICE-GLOECKLER-MEYER REGRESSION**  
**COVARIATES VARY DURING GREAT RECESSION**

<b>Variable Name</b>	<b>Model 10</b>	<b>Model 11</b>	<b>Model 12</b>
<b>Great Recession Variables (cont'd)</b>			
Non-Housing Wealth x Great Recession	-0.0020 (0.0153)	-0.0083 (0.0163)	-0.0083 (0.0163)
Defined Benefit Plan x Great Recession	1.5869 (0.2707)	1.4761 (0.2809)	1.4554 (0.2767)
Defined Compensation Plan x Great Recession	0.8153 (0.1777)	0.6694 (0.1841)	0.6514 (0.1805)
Both Types of Plan x Great Recession	1.8520 (0.2735)	1.7403 (0.2783)	1.7184 (0.2774)
Post 1999	-0.1957 (0.2791)	-0.1918 (0.0758)	-0.1937 (0.0757)
<b>Age Indicators</b>			
Age 59	-2.5196 (0.1875)	-2.5842 (0.1908)	-2.5973 (0.1897)
Age 60	-2.0931 (0.1873)	-2.1606 (0.1904)	-2.1740 (0.1893)
Age 61	-1.8779 (0.1947)	-1.9511 (0.1975)	-1.9650 (0.1965)
Age 62	-0.5700 (0.2074)	-0.6540 (0.2094)	-0.6684 (0.2082)
Age 63	-0.7002 (0.2447)	-0.7923 (0.2455)	-0.8074 (0.2442)
Age 64	-0.7776 (0.2791)	-0.8803 (0.2794)	-0.8975 (0.2781)
Age 65	-0.1957 (0.3098)	-0.3061 (0.3088)	-0.3241 (0.3075)
Age 66	0.0503 (0.354)	-0.0793 (0.3519)	-0.0986 (0.3504)
Age 67	-0.2939 (0.407)	-0.4332 (0.4032)	-0.4555 (0.4016)
Age 68	-0.4021 (0.4511)	-0.5703 (0.4467)	-0.5928 (0.4445)

**TABLE 6 (cont'd)**  
**PRENTICE-GLOECKLER-MEYER REGRESSION**  
**COVARIATES VARY DURING GREAT RECESSION**

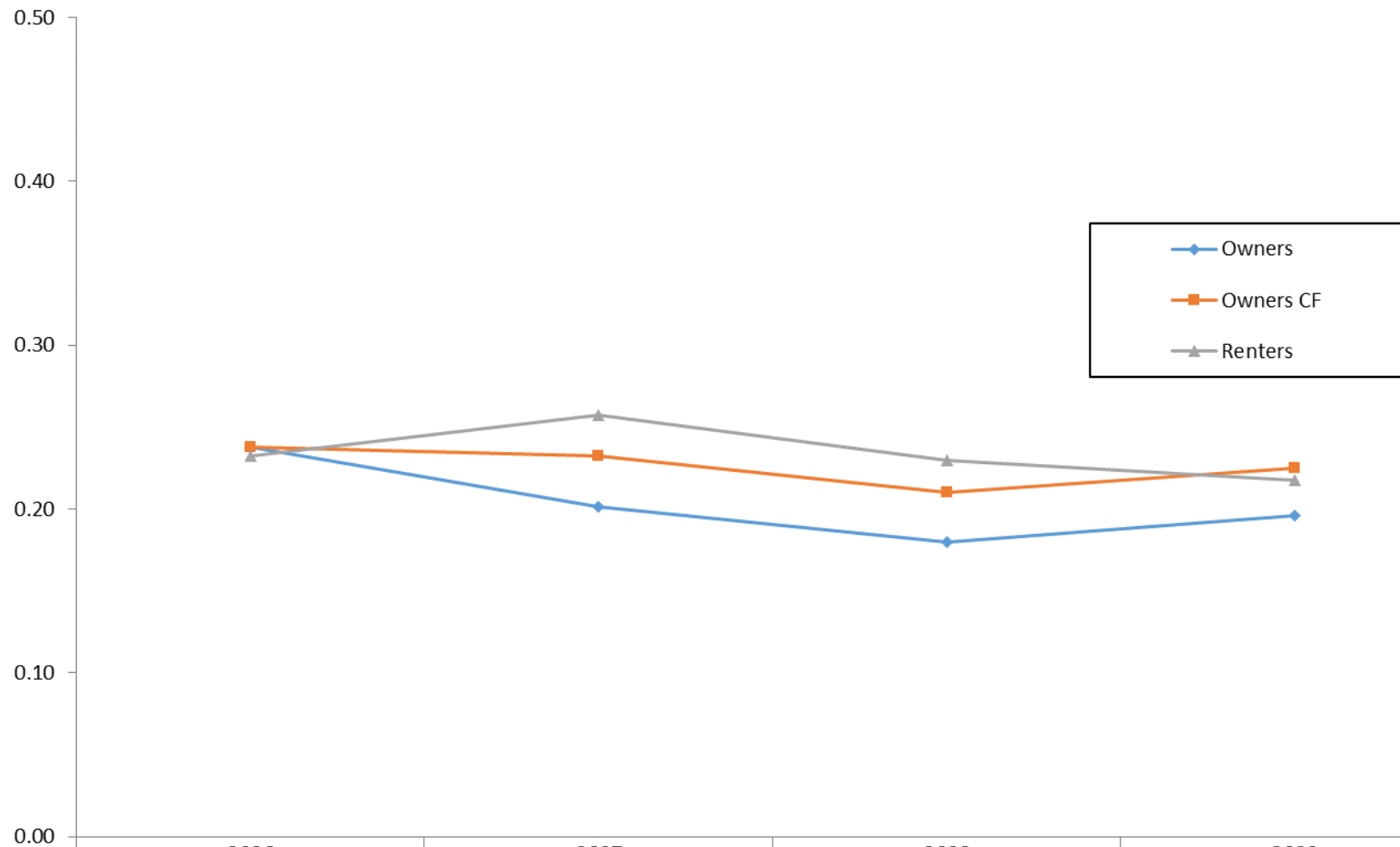
<b>Variable Name</b>	<b>Model 10</b>	<b>Model 11</b>	<b>Model 12</b>
<b>Age Indicators (cont'd)</b>			
Age 69	-0.3712 (0.4918)	-0.5485 (0.4855)	-0.5730 (0.4836)
Age 70	-0.2390 (0.5251)	-0.4303 (0.5178)	-0.4556 (0.5154)
Age 71-78	-0.6538 (0.5536)	-0.8690 (0.5463)	-0.9018 (0.5438)
Gamma Variance	0.7510 (0.2327)	0.6994 (0.2300)	0.6939 (0.2297)
-2 Log L	7493.580	7502.290	7502.450

**Figure 1**  
**Married Male Retirement Rates**  
**1994 - 2009**

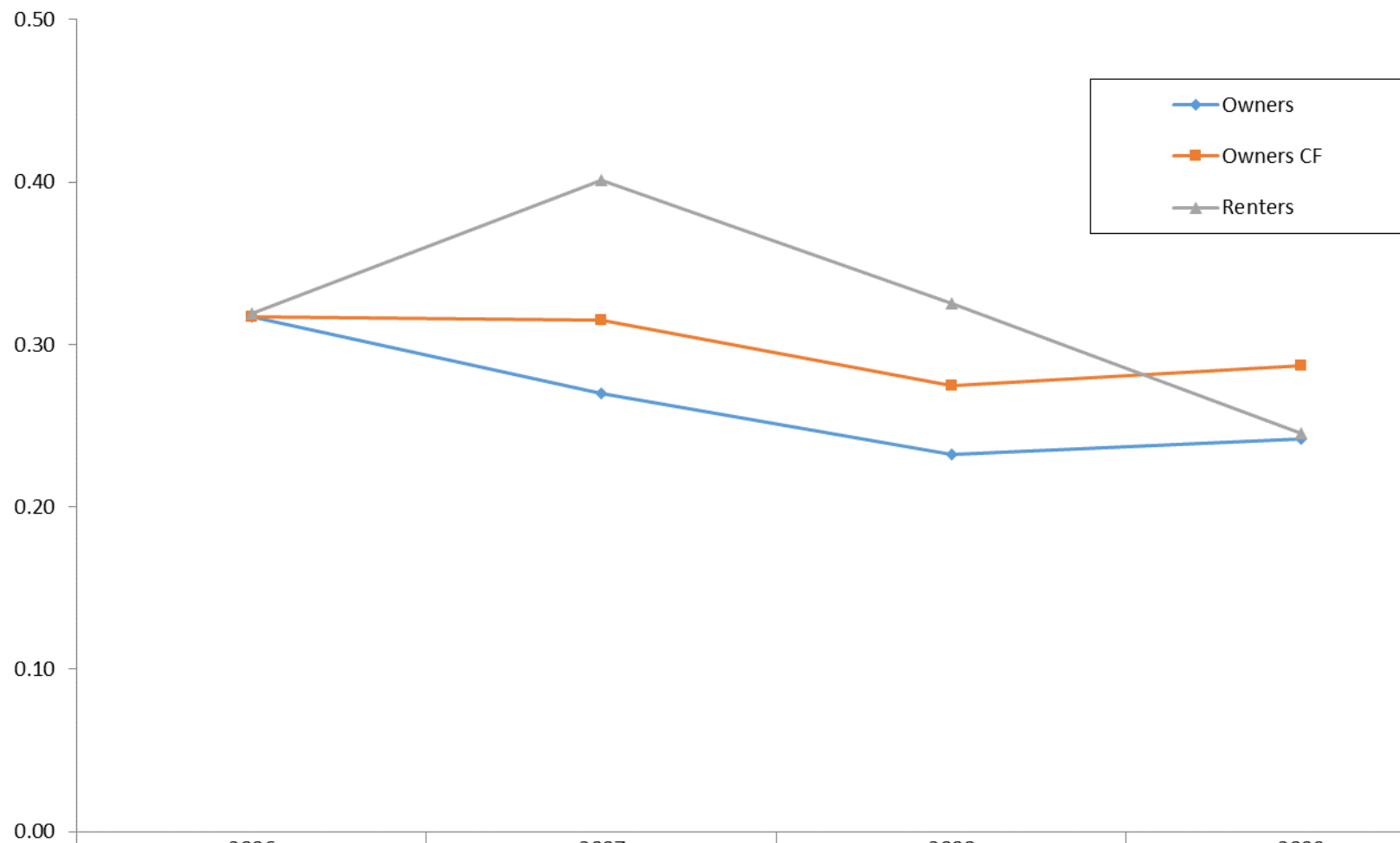




**Figure 2**  
**Early Retirement Rates**  
**2006-2009**



**Figure 3**  
**Normal Retirement Rates**  
**2006-2009**



	2006	2007	2008	2009
Owners	0.3168	0.2695	0.2325	0.2419
Owners CF	0.3168	0.3148	0.2743	0.2866
Renters	0.3194	0.4014	0.3250	0.2454

RECENT WORKING PAPERS FROM THE  
CENTER FOR RETIREMENT RESEARCH AT BOSTON COLLEGE

**Impact of the Great Recession on Retirement Trends in Industrialized Countries**

*Gary Burtless and Barry P. Bosworth, December 2013*

**Does Household Debt Influence the Labor Supply and Benefit Claiming Decisions of Older Americans?**

*Barbara A. Butrica and Nadia S. Karamcheva, December 2013*

**Point of No Return: How Do Financial Resources Affect the Timing of Retirement After a Job Separation?**

*Matthew S. Rutledge, December 2013*

**The Medicaid Buy-In and Social Security Disability Insurance (DI) Beneficiaries: Lessons for the 2014 Medicaid Expansion and Proposals to Reform DI**

*Melissa McInerney, December 2013*

**Validating Longitudinal Earnings in Dynamic Microsimulation Models: The Role of Outliers**

*Melissa M. Favreault and Owen Haaga, September 2013*

**Housing in Retirement Across Countries**

*Makoto Nakajima and Irina A. Telyukova, August 2013*

**Can Benefits and Work Incentives Counseling Be a Path to Future Economic Self-Sufficiency for SSI/SSDI Beneficiaries?**

*Zafar E. Nazarov, August 2013*

**How Do the Changing Labor Supply Behavior and Marriage Patterns of Women Affect Social Security Replacement Rates?**

*April Yanyuan Wu, Nadia S. Karamcheva, Alicia H. Munnell, Patrick Purcell, July 2013*

**Social Security and the 2001 Reform of the Railroad Retirement Program**

*Steven A. Sass, June 2013*

**An Assessment of the 2001 Reform of the Railroad Retirement Program**

*Steven A. Sass, June 2013*

**Reforming the Railroad Retirement System**

*Steven A. Sass, June 2013*

*All working papers are available on the Center for Retirement Research website (<http://crr.bc.edu>) and can be requested by e-mail ([crr@bc.edu](mailto:crr@bc.edu)) or phone (617-552-1762).*