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Retirement Replacement Rates and Saving Behavior

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Retirement replacement rates and saving behavior

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Abstract

We study whether the retirement replacement rate influences households' saving behavior by using the RAND Health and Retirement Study data file. We estimate quantile regressions with the ratio of wealth to permanent income as dependent variable, and age dummies and the retirement replacement rate as main independent variables. Our paper is the first to explicitly link retirement replacement rates to age-wealth profiles. We are unable to conclude that the amount of financial wealth that households have accumulated around the age of 65, relative to permanent income, is decreasing in the replacement rate. However, the age-wealth profile of households in the highest quartile of the replacement rate-distribution is very flat. Finally, households hardly decumulate wealth after retirement and some groups even keep saving after retirement.

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1 Introduction

Several studies (Mitchell and Moore, 1998; Wolff, 2002; Skinner, 2007) claim that U.S. households are not saving enough for retirement. Madrian and Shea (2001) show that behavioral explanations might be at the root of so-called ”default” behavior with respect to saving for retirement, which could lead to the inadequacy of retirement savings. However, other studies (Engen et al., 1999; Scholz et al., 2006) suggest that the problem is less severe. In light of these issues it is useful to examine the saving response of households to differences in the generosity of their pension schemes.

A simple version of the life cycle model (Modigliani and Brumberg, 1954; Friedman, 1957) implies that, if income follows a hump-shaped profile over the life cycle, households will save when they are young and dissave when they are old. The larger the gap between income before and after retirement, the more households need to save in order to maintain a reasonable standard of living when retired. The retirement replacement rate[1] provides a measure of this gap; it is the ratio between income after retirement and income before retirement.

There is a large amount of studies about the displacement effect of pensions on nonpension wealth. Among them are the seminal contributions by Feldstein (1974, 1996) and Gale (1998). The main question in this literature is whether pension wealth crowds out nonpension wealth. Estimates of this displacement effect range from close to zero (no crowding out) to close to minus one (full crowding out).

Related to this, we study whether the replacement rate affects households' saving behavior, and in particular whether age-wealth profiles are affected by the replace-

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[1] For the sake of brevity we will refer to the replacement rate instead of the retirement replacement rate throughout the rest of this paper.

ment rate of households. So, unlike the displacement literature, we do not use pension wealth but replacement rates. One of the main differences between the displacement literature and our approach is that we follow households over time, whereas most studies that estimate the displacement effect rely on cross-sectional household data.

Although some recent papers (see, for example, Engelhardt and Kumar (2011)) use administrative data to calculate pension wealth, most papers in the displacement literature use survey data. To calculate pension wealth from survey data requires many assumptions. To calculate replacement rates we only need to observe income before retirement, and income after retirement. The drawback, on the other hand, of our approach is that we are not able to accurately calculate a displacement effect between -1 and 1. Nonetheless, we are able to test the most important implications of the life cycle model.

Somewhat related to the subject of our study is the work by Bernheim et al. (2001), who are unable to find an effect of differences in replacement rates on wealth accumulation, although they do not use direct wealth data but instead derive it from income and consumption data. They argue that saving behavior of households is more consistent with "rule of thumb", "mental accounting", or hyperbolic discounting theories of wealth accumulation (see, for example, Laibson (1997)), than with the life cycle model[2]. As there have been many adaptations, extensions, and alternatives proposed to the life cycle model (for an overview, see Attanasio and Weber (2010)), it is interesting to study whether this particular implication of the model holds up in the raw data.

Hurd et al. (2012) construct replacement rates by education level and marital status for groups of households in several OECD countries and use these to estimate the effect of the generosity of public pensions on saving rates. Note that they do not calculate replacement rates for individual households and only consider public

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[2] See Akerlof (1991), Thaler (1994), and Lusardi (1999) for other behavioral explanations of saving behavior.

pensions. Our primary innovation is to calculate replacement rates for public and private pensions of individual households from the Health and Retirement Study (HRS) cohort of the RAND HRS data file, and use these to test the effect of the replacement rate on households' saving behavior. We exploit the panel structure of the data to observe labor income as well as pension income for a group of households, which allows us to calculate (before-tax) replacement rates.

The replacement rate suffers from the same endogeneity problems as pension wealth (see, for example, Engelhardt and Kumar (2011)). Most notably, measurement error and unobserved heterogeneity in household saving behavior might cause correlation between the replacement rate and the error term in a regression of wealth on the replacement rate. Also, the level of nonpension wealth could influence the replacement rate if the timing of retirement depends on the amount of wealth accumulated, in which case correlation between the replacement rate and the error term is caused by simultaneity.

To overcome the endogeneity problem we use an instrumental variables approach. In addition, as the distribution of wealth is heavily skewed to the right and influential outliers might be present, we estimate quantile regressions. To combine an instrumental variables approach with quantile regressions we use the Instrumental Variable Quantile Regressions (IVQR) estimator, proposed by Chernozhukov and Hansen (2008). This estimator has been used before by, among others, Engelhardt and Kumar (2011) and Alessie et al. (2011). In addition, we split our sample in four subsamples, defined by the four quartiles of the replacement rate distribution, to investigate whether there are differences in age-wealth profiles between groups with different replacement rates.

We construct an instrument for the replacement rate based on the census region of the household, and the employment sector in which the particular household head has had his or her job with longest job tenure. For example, for a household from census region Midwest, where the household head worked for most of his or her career in the public sector, the value of the instrument is the average replacement rate for households from the Midwest who worked in the public sector. As long as workers do not sort across sectors or move to another census region in response to differences in replacement rates, an assumption which is quite common (Attanasio and Brugiavini, 2003; Engelhardt and Kumar, 2011), our instrument exploits exogenous variation in the replacement rate.

To examine the effects of the replacement rate on saving behavior we estimate a regression model with the ratio of wealth to permanent income as dependent variable, and age dummies and the replacement rate as main independent variables. Our hypothesis is that the lower their replacement rate the more households will save for retirement, relative to permanent income. In addition, households with a relatively low replacement rate will dissave more after retirement. In other words, the lower the replacement rate the steeper the age-wealth profile of households. We assume that households have full certainty about their replacement rate at the time of making saving decisions, as they are at most 15 years from retirement[3]. Note that this hypothesis is in line with the life cycle model as well as with mental accounting models.

We have three main findings. First, based on IV regressions we are unable to conclude that the amount of financial wealth that households have accumulated around the age of 65, relative to permanent income, is decreasing in the replacement rate. Second, the age-wealth profile of households in the highest quartile of the replacement rate-distribution is very flat. Their saving rate is very low and constant over the lifecycle. Finally, households hardly decumulate wealth after retirement and some groups even keep saving after retirement.

The remainder of this paper is organized as follows. Section 2 describes the data that we use. Section 3 discusses our method of identification and presents the empirical model. Section 4 presents results, and finally, Section 5 concludes.

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[3] The HRS cohort consists of households with at least one person in the household born between 1931 and 1941, who is between 51 and 79 years old during the sample period.

2 Data

In this section we describe the data that we use. First, we discuss the replacement rate. Second, we present the other variables that we use in our analysis. We use the RAND HRS data file, which contains cleaned and processed variables, model-based imputations, and spousal counterparts of most individual-level variables. The RAND HRS data file is derived from the HRS, a longitudinal household survey data set for the study of health and retirement of the elderly in the United States. We use all ten waves (1992-2010) of the RAND HRS data file. The data file contains data on demographics and family structure, health, income, social security and pensions, wealth, and employment history. Almost all variables are defined at the level of the individual. The only exception are the wealth variables, which are defined at the level of the household. As it is impossible to assign wealth to individual household members, the household will be our unit of analysis throughout this whole study.

Descriptive statistics of the replacement rate are shown in table 1. Chapter 3 of this thesis contains a detailed description of the calculation method of two replacement rate measures. It also presents a table that clarifies our data selections. We present summary statistics for the first pillar replacement rate RR_{FP} and the overall replacement rate RR_O. The first pillar contains Social Security and the second pillar consists of employer-provided pensions and 401(k). Note that the replacement rate is time-invariant, which explains the number of 1,204 observations (one for each household).

–table 1 here–

The median RR_{FP} is 0.333, and the median RR_O is 0.485. The mean replacement rates are higher than the median replacement rates. The percentile measures also indicate that both replacement rate-distributions are right skewed.

Table 2 provides the number of observations, number of households, mean, standard deviation, first quartile, median, and third quartile of the other variables. The following wealth categories from the HRS together consitute total wealth: Net value of real estate (not primary residence), net value of vehicles, net value of businesses, net value of IRA and Keogh accounts, net value of stocks, mutual funds, and investment trusts, value of checking, savings, or money market accounts, value of CD, government savings bonds, and T-bills, net value of bonds and bond funds, net value of all other savings minus the net value of all other debt, and the value of housing wealth. Housing wealth consists of the value of primary and secondary residence minus the value of all mortgages/land contracts and the value of other home loans for primary and secondary residence. Financial wealth is simply the difference between total wealth and housing wealth. Note that the value of 401(k) accounts is not included in any wealth measure, but is considered as part of the second pillar pension. Furthermore, because we drop all self-employed business equity is irrelevant in our analysis.

All wealth measures are net wealth measures, so the level of debt is subtracted from gross wealth. Median net financial wealth in the sample is around $34,000 (constant 1992 dollars), and median net total wealth is around $100,000.

–table 2 here–

For both wealth measures the mean is much higher than the median, even after normalizing by permanent income, and the distance between the third quartile and the median is much larger than the distance between the first quartile and the median. This implies that the wealth distribution is right skewed. All household heads in our sample are, by definition, between 51 and 79 years old, although the number of households in the upper part of the age distribution is a bit lower than would be expected. The average and median age of all households is 64 years old.

Median total income[4] is around \$28,000, and median permanent income is around \$33,000. All income measures, before and after retirement, are before-tax.

We determine permanent income by estimating income regressions for four different educational groups, and using the coefficient estimates to predict future household income. We then calculate permanent income as a weighted average of the present values of all past, current, and future incomes, where the discount factors form the weights. A simplification we make is that we set initial wealth (at the age of 20) equal to zero in the calculation. The appendix of Zandberg (2014) contains a detailed description of the construction of permanent income.

Our sample only spans households where the household head is born between 1931 and 1941. Figures 1 and 2 present cohort-time plots of the median financial wealth/permanent income and median total wealth/permanent income ratios. Note that productivity-related cohort effects are not present anymore in these pictures, as wealth is divided by permanent income. Cohort_{1930} consists of households born before 1933, cohort_{1934} of households born in 1933, 1934, 1935, or 1936, cohort_{1938} of households born in 1937, 1938, 1939, or 1940, and cohort_{1942} of households born after 1940. Only households from this last cohort clearly have higher levels of wealth than households from the other three cohorts.

–figures 1 and 2 here–

Less than half of all households in the sample are couple households. This seems to be much lower than for the overall population between 50 and 80 years old. The most obvious explanation is that it is easier to calculate a replacement rate for single households; we just dropped a larger fraction of couple households from the sample, as we were not able to calculate a replacement rate for them (see Zandberg (2014)

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[4] Total income consists of earnings, income from employer pensions and/or annuities, Social Security income, unemployment compensation, and other government transfers. Capital income is not included in total income.

for details).

3 Identification and Empirical Model

Our econometric specification to test the effect of the replacement rate on wealth holdings is as follows:

$$\frac{W_{ht}}{Y_h^P} = \gamma_0 + \gamma_a + \gamma_t + \gamma_1 \log(RR_h) + X_{ht}' \beta + \epsilon_{ht}, \quad (1)$$

where W_{ht} is net wealth of household h in year t, Y^P is permanent income, γ_0 is a constant, γ_a captures the age effect, γ_t captures the time effect, RR_h is the replacement rate of household h, and X is a vector of control variables, consisting of education dummies, a dummy for couple households, sector dummies, and region dummies. Finally, ϵ_{ht} is an error term, where we allow for intra-household correlation, so all standard errors that we calculate are clustered at the level of the household.

In a life cycle model with quadratic utility, all productivity-related cohort effects are captured in the dependent variable, through their effect on permanent income (see e.g. Kapteyn et al. (2005)). However, the above specification does not control for other causes of cohort differences in wealth. For example, generations raised during the Great Depression might be thriftier than other generations, and therefore have higher levels of wealth. As the coefficients of a model with age-, time-, and cohort dummies are unidentified, we choose to only include age- and time dummies in the main specification.

There are three sources of endogeneity in equation 1. First, unobservable tastes for saving might influence both the replacement rate and the level of wealth. This is an example of omitted variable bias. Second, Coile and Gruber (2007) find that retirement decisions are sensitive to the level of retirement wealth already accrued.

Thus, the level of wealth could affect the timing of retirement, which in turn determines the replacement rate. In that case, correlation between the error term and the replacement rate is caused by simultaneity. Finally, pension income as well as earnings are most likely measured with error. The replacement rate is obtained by taking the ratio of these two variables, so the replacement rate will suffer from measurement error.

If thrifty individuals choose jobs based on generous pension arrangements, the effect of the replacement rate on wealth levels would be biased upwards. On the other hand, if wealthy individuals decide to retire earlier, because they can afford so, the effect would be biased downwards. In the displacement literature, measurement error causes a negative correlation between the wealth/permanent income ratio and pension wealth, the main independent variable, because measurement error in pension wealth and permanent income are positively related. In our model, however, the replacement rate is a ratio of two variables that together determine permanent income. We thus believe that the correlation between measurement error in permanent income and measurement error in our main independent variable is not as problematic as in the displacement literature. However, general measurement error in the replacement rate might cause attenuation bias, which would drive the coefficient estimate towards zero.

In order to overcome the endogeneity problem we use an instrument for the replacement rate. We construct this instrument from the data itself. By calculating median replacement rates over census regions and job sectors, we are able to assign a so-called ”potential replacement rate” to each household, which can be used as an instrument for the replacement rate. As long as workers do not sort across employment sectors and do not move to a different census region in search of jobs with more generous pension arrangements, the instrument is exogenous. Note that these assumptions are also made by, among others, Attanasio and Brugiavini (2003) and Engelhardt and Kumar (2011).

The first source of variation in our instrument is thus the census region a household is living. This effect runs through the timing of retirement. Munnell et al. (2008) show that there are considerable differences in labor participation rates of men aged 55-64 across states and census regions. Especially in the regions East South Central and South Atlantic the labor participation rate of older men is low, compared to the rest of the country. In the regions West North Central, and New England, on the other hand, the labor participation rate of this group of men is significantly higher than in the rest of the country. Also, Coile and Gruber (2007) report that early retirement is significantly more prevalent in the Pacific region, and significantly less in New England, compared to the other regions of the country. Early retirement will, ceteris paribus, decrease the replacement rate, as workers simply have had less time to accumulate pension savings. Also, Social Security benefits are lower when they are claimed before the official retirement age. Munnell et al. (2008) show that, after controlling for individual worker characteristics, state- or region-specific labor market conditions are important in determining these differences in labor participation rates of individuals around retirement.

The second source of variation is the sector where the household head has had his or her job with longest reported tenure. We divide the economy in four sectors: the primary sector, the secondary sector, the tertiary sector, and the public sector. The generosity of pension schemes differs widely among sectors. For example, it is well known that pension arrangements in the public sector are generally very good compared to the private sector. Although the replacement rate of Social Security (first pillar) is mainly determined by the level of pre-retirement income (it is decreasing in earnings), the extent to which employer-provided pension plans (second pillar, together with 401(k)) meet the need of a reasonable standard of living after retirement depends, among other things, on the sector in which the worker is employed.

The variation in our instrument will thus be independent of individual characteristics that cause the endogeneity of the replacement rate. Table 3 presents median replacement rates for all 9 census regions and 4 employment sectors:

–table 3 here–

The median RR_O is highest in census region West North Central, which is in line with the evidence of Munnell et al. (2008) that labor participation rates of older men are relatively high in this region. The regions West South Central and Mountain have the lowest median RR_O, while New England has the lowest median RR_{FP}. This is most probably due to the relatively high income level in New England. As expected, the employment sector "Public Sector" has the highest median RR_O, and the lowest RR_{FP}. The median tests at the bottom of the table show that there are significant differences between sectors and regions for both RR_{FP} and RR_O.

To account for the endogeneity of the replacement rate in equation 1 we employ the instrumental variable quantile regression (IVQR) estimator of Chernozhukov and Hansen (2008)[5]. The first stage is estimated by OLS, and the second stage by quantile regression. We limit ourselves to the 50^{th} percentile, essentially performing median regressions.

An alternative to quantile regression would be to take the log of wealth, as wealth is more or less lognormally distributed. However, around 11% of observations concern non-positive wealth levels, so they would be lost after a logarithmic transformation of the data. It is hard to maintain that this is a random part of the wealth distribution. The sample would become biased towards households with positive wealth holdings. Furthermore, quantile regression is more robust against influential outliers (Koenker, 2005).

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[5] The Matlab file that we use comes from the website of Christian Hansen: http://faculty.chicagobooth.edu/christian.hansen/research/

4 Results

We show results in this section. First, we present findings of estimating the baseline model. Second, we split our sample into four groups based on the distribution of the replacement rate, and estimate an age-wealth profile for each of the four groups separately. Finally, we perform robustness checks.

4.1 Baseline Specification

Table 4 presents results from estimating equation 1 by quantile regression (QR) and instrumental variable quantile regression (IVQR). The first two columns contain results for RR_{FP}, and the last two columns for RR_O. The quantile regression in the first column shows an estimate of -0.160 for the effect of log RR_{FP} on the financial wealth/permanent income ratio. This would imply that a 10% increase in the replacement rate is associated with a fall in the financial wealth/permanent income ratio of about 0.016. The interpretation is that the difference in average lifetime wealth would be \$640 between two households with a permanent income of \$40,000 that are equal to each other in all other respects, except that the household with the higher level of wealth has a 10% lower replacement rate.

Using the IVQR estimator, we find an insignificant estimate of log RR_{FP} of -0.065. Apparently, endogeneity leads to a downward bias of the estimate because taking it into account gives an estimate very close to (and insignificant from) zero. These results suggest that general measurement error can not be the only cause of the endogeneity, because if that would have been the case the QR estimate would have been closer to zero than the IVQR estimate, which is not the case. The coefficient on the instrument in the first stage equals 0.715 and is strongly significant. Furthermore, the partial F-statistic is 12.6. Note that the life cycle model predicts that the age-wealth profile of households with a high replacement rate lies below the profile of households with a low replacement rate. However, it also predicts that the distance between the two profiles is largest around retirement. We will come back to this in the next subsection.

Using RR_O the estimates are -0.120 and -0.052, but the latter estimate is insignificantly different from zero. However, as Engelhardt and Kumar (2011) and Chernozhukov and Hansen (2008) also note, the IVQR estimator is very inefficient. Although the quantile regression estimates are negative and significant, the IVQR estimates are insignificant, so we cannot conclude that there is a negative correlation between the replacement rate and the financial wealth/permanent income ratio. Note also that the partial F-statistic of 6.3 indicates a weak instrument problem. Finally, the education dummies and the couple household dummy have the expected positive signs and are all strongly significant.

–table 4 here–

Adding housing wealth to financial wealth gives total wealth. It is interesting to examine whether the results for total wealth are comparable to financial wealth as housing wealth is one of the most illiquid forms of wealth. We therefore think that, in the context of the life cycle model, it is appropriate to treat it in a different manner from other forms of wealth.

The results of the regressions for total wealth are in table 5. The IVQR estimate for RR_{FP} is lower than the estimate of the quantile regression, but both are insignificant. The IVQR estimate for RR_O is even positive, but insignificant. So, the evidence concerning an effect of the replacement rate on total wealth is mixed and inconclusive. Note that the number of observations in table 5 is a bit lower than in table 4. This is because there is no reliable housing wealth measure in the 1996 wave. Therefore, all observations for 1996 are dropped in table 5.

–table 5 here–

4.2 Age-Wealth Profiles

As already noted, if households behave according to the life cycle model the age-wealth profile of households with a high replacement rate should lie below the profile of households with a low replacement rate. Furthermore, the distance between the profiles should be at its maximum around retirement. Households with a low replacement rate should save more before retirement, and dissave more after retirement, so their age-wealth profile is expected to be steeper than the profile of households with a high replacement rate.

We divide the sample into four subsamples, based on the distribution of the replacement rate. However, due to the endogeneity of the replacement rate, we cannot simply use the data to define the quartiles. Therefore, we first estimate the first stage and base the quartiles on the distribution of the predicted replacement rate, instead of the actual values of the replacement rate. We then estimate quantile regressions for each of the four subsamples, and examine the resulting age-wealth profiles. The estimation procedure consists thus of two steps:

1. OLS regression of the endogenous variable, the (log) replacement rate, on the exogenous variables and the instrument. Based on the regression estimates, we calculate fitted values and define the four quartiles of the predicted replacement rate.

2. Quantile regressions for each of the four samples, with the ratio of wealth to permanent income regressed on the exogenous variables.

Table 6 presents the estimation results for financial wealth. The first four columns contain results for RR_{FP}, and the last four columns for RR_O. Instead of age dummies, we have defined a linear spline in age such that each spline contains an equal amount of observations. As the sample size of each regression is four times as small as in tables 4 and 5 the model would become overparameterized with age dummies. Furthermore, we have excluded education dummies, region dummies, and sector dummies to limit convergence problems while estimating the model.

–table 6 here–

The coefficient estimate of the couple household dummy is in line with the findings in tables 4 and 5. We also show the coefficient estimates for all age spline variables. Figures 3 and 4 show age-wealth profiles for all four quartiles of the replacement rate distribution, based on these coefficient estimates. The other variables are evaluated at their sample means.

–figures 3 and 4 here–

Figure 3 reveals that the amount of wealth that is accumulated before retirement is decreasing in RR_{FP}. Households from the lowest quartile of the replacement rate-distribution have accumulated six times as much financial wealth, relative to permanent income, around the age of 65 than households in the highest quartile of the distribution. This is in line with the predictions of the life cycle model. The picture of wealth decumulation after retirement is less clear, which is partly caused by the large standard errors of the estimates of age 70-79. However, it seems that households in the highest two quartiles of the distribution, so with the highest RR_{FP}'s, do not dissave after retirement. This is again what the life cycle model predicts.

Households with a lower RR_{FP} keep saving after retirement. Possible explanations might be uncertain life expectancies and the risk of out-of-pocket medical expenses for these households (see De Nardi et al. (2009, 2010)). In addition, several studies have documented that households experience a drop in consumption around retirement (e.g., Banks et al. (1998); Bernheim et al. (2001); Haider and Stephens Jr. (2007)). This could also explain why households do not dissave after retirement, namely that they simply do not need to as their pension income is high enough to satisfy their consumption needs.

The age-wealth profiles in figure 4, where the quartiles of the RR_O-distribution are used, are comparable to the ones in figure 3. Again, in none of the four groups households decumulate wealth after retirement, while the accumulation of wealth before retirement is decreasing in the replacement rate.

–table 7 here–

If we include housing wealth the picture roughly stays the same, as table 7 and figures 5 and 6 reveal. If there is any wealth decumulation at all, it is in the lowest quartiles of the replacement rate distribution. Furthermore, also total wealth is decreasing in the replacement rate.

–figures 5 and 6 here–

4.3 Robustness Checks

To check the influence of accounting for the endogeneity of the replacement rate on our findings, we perform a robustness check. Instead of dividing the sample in four parts based on the distribution of the fitted values of a regression with the replacement rate as left-hand side variable, we divide the sample in four parts based on the actual distribution of the replacement rate. We thus treat the replacement rate as an exogenous variable. Tables 8 and 9 present the regression results for the four groups, and figures 7-10 show the age-wealth profiles that these regression results imply.

The main difference with the baseline results is that when we divide the sample on the basis of actual replacement rates, households in the lowest two quartiles of the RR_{FP} distribution seem to decumulate wealth after retirement, while these groups keep accumulating wealth in the baseline model. Of course, the nature of the robustness check implies that the composition of these groups differs. However, in general we observe the same patterns as in figures 3-6: Wealth accumulation is decreasing in the replacement rate and there is hardly decumulation of wealth after retirement.

–tables 8 and 9 here–

–figures 7-10 here–

5 Conclusions

The finding that large groups of households keep saving after retirement is already well-documented in the literature (see, among others, Alessie et al. (1997); Banks and Rohwedder (2003)). We confirm this finding. However, we do not find support for the hypothesis that the amount of financial wealth is decreasing in the retirement replacement rate. So, we are unable to claim a causal effect of the replacement rate on the amount of accumulated wealth. Whether this effect is simply not there or the IVQR estimator is too inefficient remains an open question. Finally, the age-wealth profile of households in the highest quartile of the replacement rate-distribution is very flat, which is in line with the predictions of the life cycle model.

One of the limitations of our study is that we do not have access to information about the state where households are living. Using this information would make the instrument stronger, as the variation in replacement rates is much larger between states than between census regions. Furthermore, data on the complete income history of households would allow us to improve the caluculation of permanent income and the replacement rate. An interesting avenue for future research would be to examine what the main determinants are of differences in replacement rates. Also, the issues around the calculation of replacement rates deserve some more attention.

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Table 1: *Summary statistics of the first pillar replacement rate (RR_{FP}) and the overall replacement rate (RR_O)*

	RR_{FP}	RR_O
Observations	1,204	1,204
Mean	0.457	0.637
Standard Deviation	1.788	1.802
10^{th} Percentile	0.151	0.259
25^{th} Percentile	0.242	0.357
50^{th} Percentile (Median)	0.333	0.485
75^{th} Percentile	0.448	0.667
90^{th} Percentile	0.632	0.883

Note: *The replacement rate measure is time-invariant, which explains the number of observations of 1,204.*

Table 2: *Summary statistics of the sample that we use to estimate the regression models (1992 dollars)*

Variable	Obs.	No. hh's	Mean	St.dev.	1^{st} Quart.	Median	3^{rd} Quart.
Financial Wealth	10,582	1,204	133,678	320,612	4,486	33,923	134,661
Total Wealth	9,467	1,204	215,449	389,285	27,601	100,496	252,537
Fin. Wealth/Perm. Inc.	10,436	1,204	3.671	15.055	0.159	0.950	3.427
Tot. Wealth/Perm. Inc.	9,342	1,204	5.928	14.806	0.929	2.929	6.578
Age	10,582	1,204	63.71	6.41	59	64	69
Total Income	10,582	1,204	36,531	33,642	15,816	28,416	48,000
Permanent Income	10,436	1,204	36,858	18,639	23,514	33,338	46,002
Couple Household	10,582	1,204	0.461	0.499	0	0	1

Note: *The couple household dummy is time-invariant, as we drop households when one of the members leaves the household (either through divorce or death).*

Table 3: *Median values RR_{FP} and RR_O per census region and per sector*

Census region	Obs.	RR_{FP}	RR_O	Sector	Obs.	RR_{FP}	RR_O
New England	410	0.28	0.45	Primary Sector	336	0.40	0.46
Mid Atlantic	1,576	0.30	0.51	Secondary Sector	3,584	0.37	0.46
East North Central	1,653	0.31	0.49	Tertiary Sector	5,884	0.31	0.51
West North Central	1,058	0.37	0.55	Public Sector	572	0.26	0.54
South Atlantic	2,679	0.35	0.48				
East South Central	744	0.38	0.48				
West South Central	832	0.33	0.41				
Mountain	485	0.31	0.44				
Pacific	1,120	0.30	0.51				
p-value median test		0.000	0.000			0.000	0.000

Table 4: *Quantile Regression (QR) and Instrumental Variable Quantile Regression (IVQR) Estimates*

Dependent variable	Financial Net Wealth/Permanent Income			
Estimation method	**QR**	**IVQR**	**QR**	**IVQR**
Log RR_{FP}	-0.160	-0.065		
	(0.061)***	(0.532)		
Log RR_O			-0.120	-0.052
			(0.066)*	(0.853)
Secondary education	0.425	0.422	0.423	0.410
	(0.082)***	(0.089)***	(0.097)***	(0.426)
College education	0.540	0.562	0.554	0.559
	(0.126)***	(0.153)***	(0.101)***	(0.416)
University education	1.489	1.546	1.498	1.388
	(0.231)***	(0.340)***	(0.205)***	(0.440)***
Couple household	1.686	1.714	1.740	1.502
	(0.141)***	(0.167)***	(0.152)***	(0.163)***
First-stage				
Instrument		0.715		0.526
		(0.201)***		(0.210)**
Partial F-statistic		12.6		6.3
Number of observations	10,049	10,049	10,168	10,168
Number of households	1,163	1,163	1,178	1,178

Notes: *Numbers in parentheses are bootstrapped standard errors, clustered at the household level, based on 100 replications. Standard errors in the first stage are not bootstrapped, but are clustered at the household level as well. *,**,*** denote significance at the 10%, 5% and 1% respectively. All specifications include a full set of age dummies, time dummies, sector dummies, and region dummies. We also estimated the IVQR models without sector and region dummies; the results are comparable to the results we show in this table, although the partial F-statistic becomes more than twice as large.*

Table 5: *Quantile Regression (QR) and Instrumental Variable Quantile Regression (IVQR) Estimates*

Dependent variable	Total Net Wealth/Permanent Income			
Estimation method	**QR**	**IVQR**	**QR**	**IVQR**
Log RR_{FP}	-0.249	-0.483		
	(0.169)	(1.460)		
Log RR_{O}			-0.342	0.431
			(0.195)*	(1.205)
Secondary education	0.916	0.877	0.965	0.991
	(0.185)***	(0.271)***	(0.189)***	(0.498)**
College education	1.094	1.055	1.175	1.242
	(0.238)***	(0.541)*	(0.232)***	(0.496)**
University education	2.400	2.268	2.506	2.609
	(0.431)***	(0.933)**	(0.362)***	(0.759)***
Couple household	3.405	3.358	3.439	3.430
	(0.262)***	(0.323)***	(0.243)***	(0.261)***
First-stage				
Instrument		0.715		0.527
		(0.199)***		(0.211)**
Partial F-statistic		12.9		6.3
Number of observations	8,996	8,996	9,101	9,101
Number of households	1,163	1,163	1,178	1,178

Notes: *Numbers in parentheses are bootstrapped standard errors, clustered at the household level, based on 100 replications. Standard errors in the first stage are not bootstrapped, but are clustered at the household level as well. *,**,*** denote significance at the 10%, 5% and 1% respectively. All specifications include a full set of age dummies, time dummies, sector dummies, and region dummies. We also estimated the IVQR models without sector and region dummies; the results are comparable to the results we show in this table, although the partial F-statistic becomes more than twice as large.*

Table 6: *Quantile Regressions with Subsamples Based on the Replacement Rate-Distribution*

Dependent variable	Financial Net Wealth/Permanent Income							
Replacement rate	RR_{FP}				RR_O			
Quartile replacement rate-distr.	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Age 51-58	0.078	0.085	0.048	0.020	0.103	0.069	0.042	0.030
	(0.038)**	(0.038)**	(0.029)*	(0.011)*	(0.044)**	(0.028)**	(0.030)	(0.018)
Age 58-62	0.159	0.096	0.066	0.039	0.080	0.123	0.119	0.041
	(0.068)**	(0.067)	(0.059)	(0.021)*	(0.068)	(0.048)**	(0.048)**	(0.027)
Age 62-66	0.087	0.199	0.004	0.032	0.082	0.057	0.084	0.036
	(0.085)	(0.064)***	(0.044)	(0.018)*	(0.075)	(0.056)	(0.050)*	(0.030)
Age 66-70	-0.168	0.075	-0.070	0.009	0.019	-0.023	-0.002	0.022
	(0.081)**	(0.055)	(0.043)*	(0.015)	(0.067)	(0.046)	(0.043)	(0.022)
Age 70-79	0.138	0.048	-0.001	0.002	0.086	0.027	0.039	-0.006
	(0.098)	(0.056)	(0.026)	(0.012)	(0.070)	(0.046)	(0.042)	(0.016)
Couple household	2.447	2.110	1.469	0.773	2.156	2.101	1.740	1.513
	(0.358)***	(0.223)***	(0.264)***	(0.182)***	(0.243)***	(0.341)***	(0.262)***	(0.370)***
Number of observations	2,556	2,561	2,569	2,524	2,558	2,556	2,553	2,543
Number of households	321	359	368	326	371	426	416	362

Notes: *Numbers in parentheses are bootstrapped standard errors, clustered at the household level, based on 100 replications.* *,**,*** *denote significance at the 10%, 5% and 1% respectively. In the first step the endogenous variables, (log)* RR_{FP} *and (log)* RR_O *are regressed on the exogenous variables and the instrument. Based on the regression estimates, we calculate fitted values and define the four quartiles of the predicted* RR_{FP} *and* RR_O*. In the second step we perform quantile regressions for each of the four subsamples, with the ratio of wealth to permanent income regressed on the exogenous variables. All specifications include a full set of time dummies. The age effects are captured by a linear spline in age. Education dummies, region dummies, and sector dummies are excluded in the quantile regressions to limit convergence problems, but note that these dummies are included to determine the distribution of the replacement rate in the first step. We also estimated all specifications with a dummy for* cohort_{1942} *included (see section 2). However, the coefficient estimate is insignificant in all specifications and the estimates of the other coefficients are comparable to the ones in this table.*

Table 7: *Quantile Regressions with Subsamples Based on the Replacement Rate-Distribution*

Dependent variable	Total Net Wealth/Permanent Income							
Replacement rate	RR_{FP}				RR_O			
Quartile replacement rate-distr.	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Age 51-58	0.152	0.198	0.202	0.081	0.241	0.181	0.051	0.151
	(0.080)**	(0.063)***	(0.050)***	(0.064)	(0.053)***	(0.067)***	(0.084)	(0.039)***
Age 58-62	0.157	0.052	0.127	0.200	0.138	0.098	0.098	0.204
	(0.113)	(0.089)	(0.090)	(0.054)***	(0.136)	(0.100)	(0.079)	(0.076)***
Age 62-66	0.069	0.196	0.179	0.013	0.161	0.203	0.108	0.133
	(0.120)	(0.119)*	(0.109)	(0.048)	(0.153)	(0.124)	(0.089)	(0.070)*
Age 66-70	-0.065	0.071	-0.171	-0.004	0.087	-0.186	-0.028	0.071
	(0.167)	(0.107)	(0.107)	(0.078)	(0.145)	(0.109)*	(0.105)	(0.075)
Age 70-79	0.186	0.054	0.073	-0.013	0.038	0.045	-0.012	0.120
	(0.190)	(0.117)	(0.072)	(0.062)	(0.148)	(0.139)	(0.078)	(0.086)
Couple household	3.832	3.657	2.919	3.144	3.674	3.684	3.141	3.585
	(0.558)***	(0.420)***	(0.341)***	(0.459)***	(0.447)***	(0.465)***	(0.364)***	(0.489)***
Number of observations	2,278	2,295	2,294	2,271	2,296	2,290	2,279	2,273
Number of households	328	359	368	326	371	424	415	358

Notes: *See table 6*

Table 8: *Quantile Regressions with Subsamples Based on the Replacement Rate-Distribution*

Dependent variable	Financial Net Wealth/Permanent Income							
Replacement rate	RR_{FP}				RR_O			
Quartile replacement rate-distr.	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Age 51-58	0.068	0.079	0.032	0.006	0.067	0.029	0.026	0.035
	(0.038)*	(0.028)***	(0.028)	(0.016)	(0.034)**	(0.026)	(0.024)	(0.026)
Age 58-62	0.102	0.049	0.018	0.055	0.121	0.103	0.049	0.024
	(0.057)*	(0.050)	(0.044)	(0.024)**	(0.058)**	(0.043)**	(0.049)	(0.031)
Age 62-66	-0.097	0.132	-0.003	0.060	0.056	-0.039	0.071	0.088
	(0.085)	(0.066)**	(0.045)	(0.030)**	(0.068)	(0.040)	(0.054)	(0.039)**
Age 66-70	-0.078	-0.053	-0.067	0.004	-0.015	-0.030	-0.080	0.010
	(0.077)	(0.057)	(0.044)	(0.016)	(0.060)	(0.039)	(0.040)**	(0.033)
Age 70-79	-0.078	-0.020	-0.002	0.029	0.083	-0.011	-0.030	0.057
	(0.051)	(0.047)	(0.035)	(0.021)	(0.058)	(0.032)	(0.023)	(0.030)*
Couple household	2.602	2.423	1.092	0.892	3.263	1.792	1.832	1.323
	(0.345)***	(0.312)***	(0.225)***	(0.242)***	(0.425)***	(0.250)***	(0.282)***	(0.267)***
Number of observations	2,580	2,569	2,575	2,551	2,596	2,292	2,275	2,274
Number of households	299	290	293	299	303	298	298	297

Notes: *Numbers in parentheses are bootstrapped standard errors, clustered at the household level, based on 100 replications. *,**,*** denote significance at the 10%, 5% and 1% respectively. We divide the sample into four quartiles, based on the distribution of RR_{FP} and RR_O. We perform quantile regressions for each of the subsamples, with the ratio of wealth to permanent income regressed on the exogenous variables. All specifications include a full set of time dummies. The age effects are captured by a linear spline in age. Education dummies, region dummies, and sector dummies are excluded in the quantile regressions to limit convergence problems. Note that possible endogeneity of the replacement rate is fully ignored in these regressions. We also estimated all specifications with a dummy for cohort$_{1942}$ included (see section 2). However, the coefficient estimate is insignificant in all specifications and the estimates of the other coefficients are comparable to the ones in this table.*

Table 9: *Quantile Regressions with Subsamples Based on the Replacement Rate-Distribution*

Dependent variable	Total Net Wealth/Permanent Income							
Replacement rate	RR_{FP}				RR_O			
Quartile replacement rate-distr.	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Age 51-58	0.044	0.225	0.047	0.129	0.187	0.153	0.099	0.126
	(0.079)	(0.056)***	(0.055)	(0.048)***	(0.060)***	(0.055)***	(0.069)	(0.044)***
Age 58-62	0.110	0.011	0.069	0.155	0.091	0.184	0.048	0.102
	(0.097)	(0.092)	(0.067)	(0.069)**	(0.106)	(0.082)**	(0.084)	(0.074)
Age 62-66	-0.075	0.113	0.068	0.148	0.034	0.020	0.091	0.170
	(0.121)	(0.108)	(0.089)	(0.099)	(0.124)	(0.083)	(0.084)	(0.095)*
Age 66-70	-0.211	-0.107	-0.120	0.016	-0.001	0.025	-0.104	-0.042
	(0.131)	(0.085)	(0.076)	(0.080)	(0.133)	(0.113)	(0.074)	(0.093)
Age 70-79	-0.175	-0.059	0.049	0.164	-0.047	0.044	-0.147	0.148
	(0.071)**	(0.113)	(0.085)	(0.071)**	(0.141)	(0.099)	(0.061)**	(0.060)**
Couple household	4.261	3.392	2.680	3.088	5.004	4.001	3.084	2.712
	(0.582)***	(0.405)***	(0.371)***	(0.359)***	(0.682)***	(0.438)***	(0.423)***	(0.353)***
Number of observations	2,310	2,299	2,302	2,289	2,330	2,323	2,330	2,322
Number of households	299	290	293	299	303	298	298	297

Notes: *See table 8*

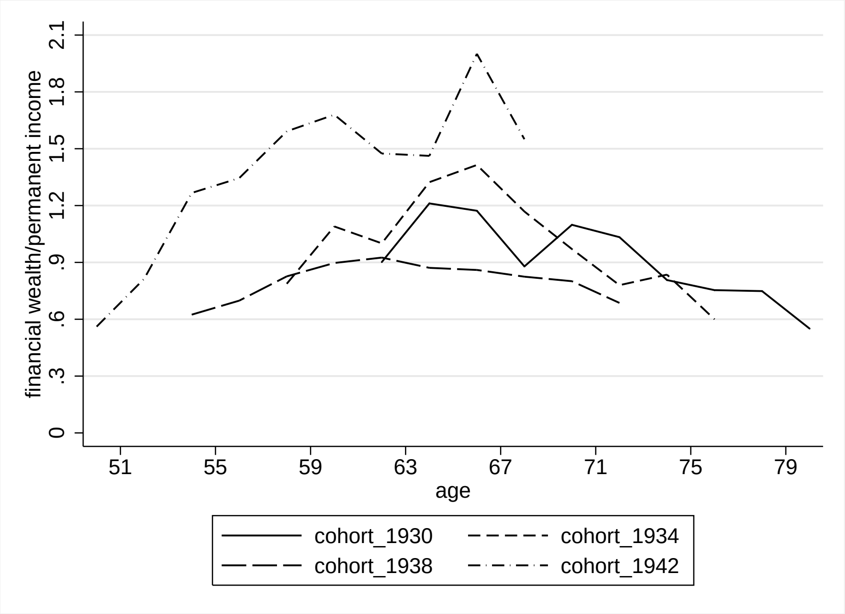

Figure 1: Median financial wealth/permanent income across age and cohorts

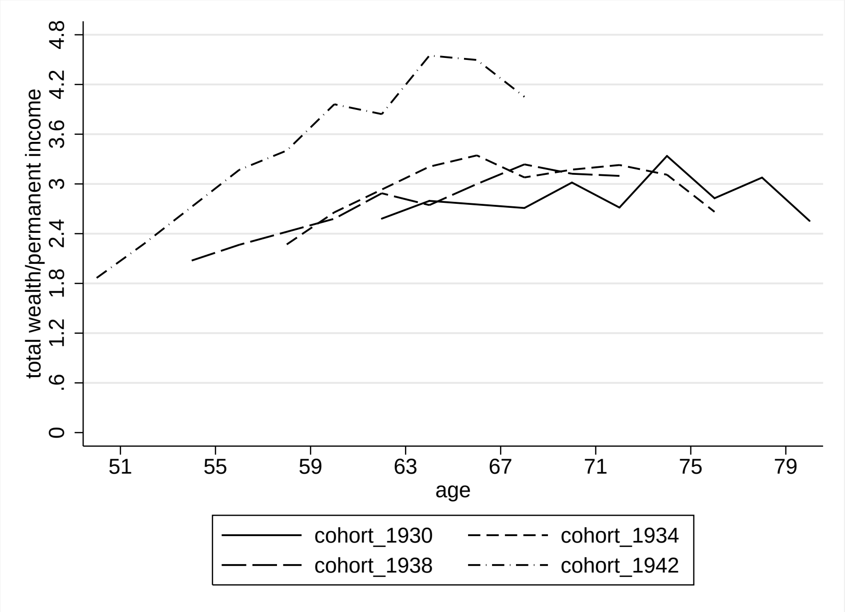

Figure 2: Median total wealth/permanent income across age and cohorts

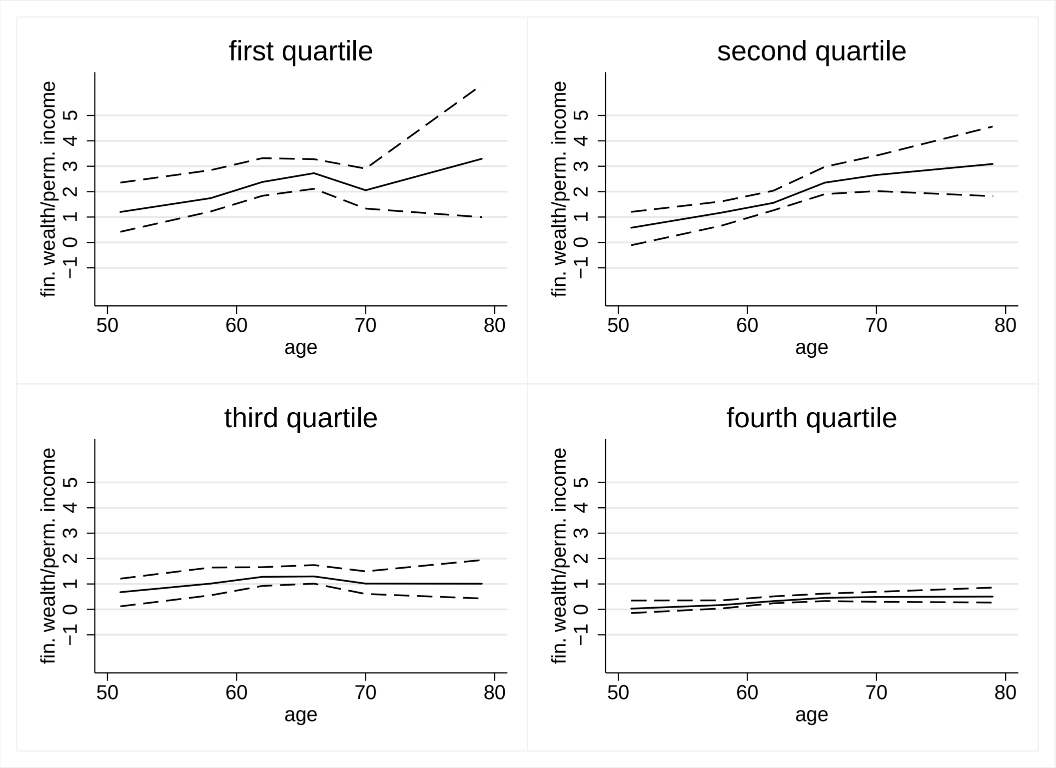

Figure 3: Age-financial wealth profiles (solid lines) for all quartiles of the RR_{FP}-distribution. The dashed lines represent 95% confidence bounds, based on 1000 bootstrap replications (clustered at the household level).

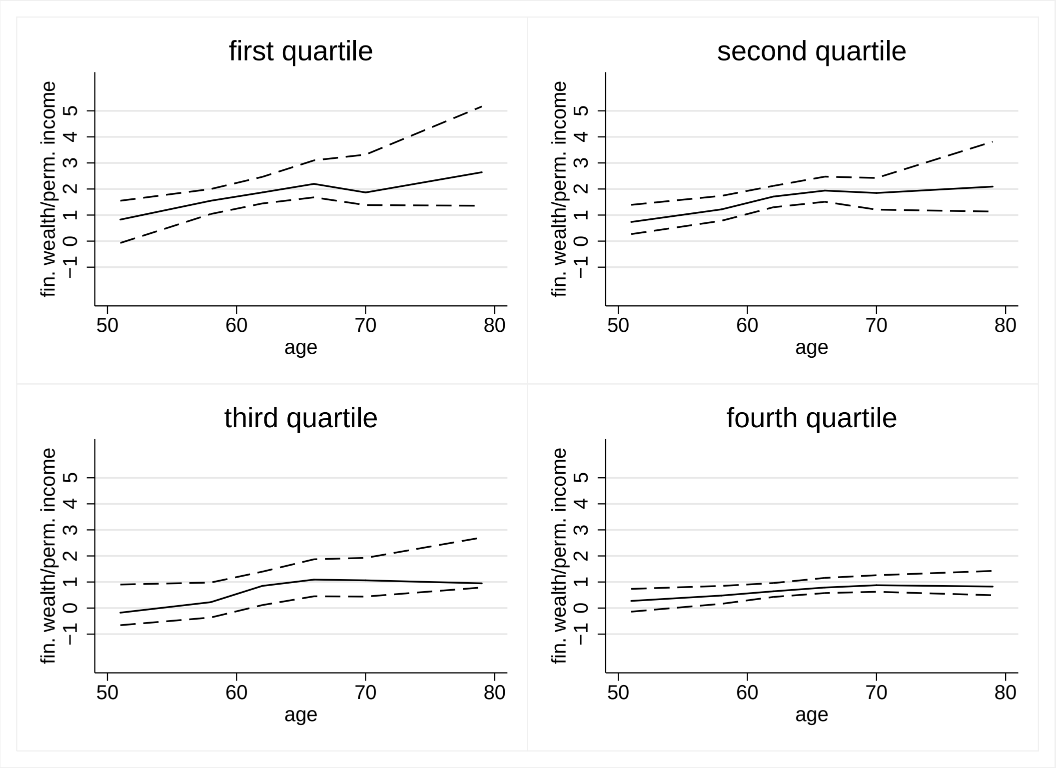

Figure 4: Age-financial wealth profiles (solid lines) for all quartiles of the RR_O-distribution. The dashed lines represent 95% confidence bounds, based on 1000 bootstrap replications (clustered at the household level).

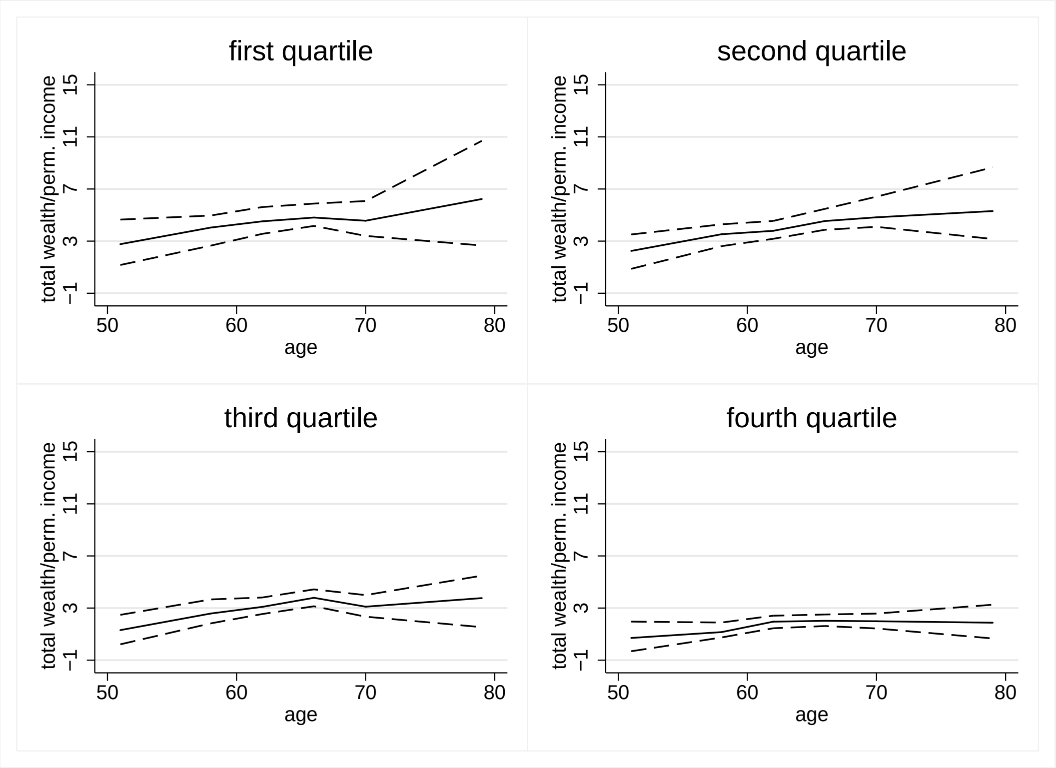

Figure 5: Age-total wealth profiles (solid lines) for all quartiles of the RR_{FP}-distribution. The dashed lines represent 95% confidence bounds, based on 1000 bootstrap replications (clustered at the household level).

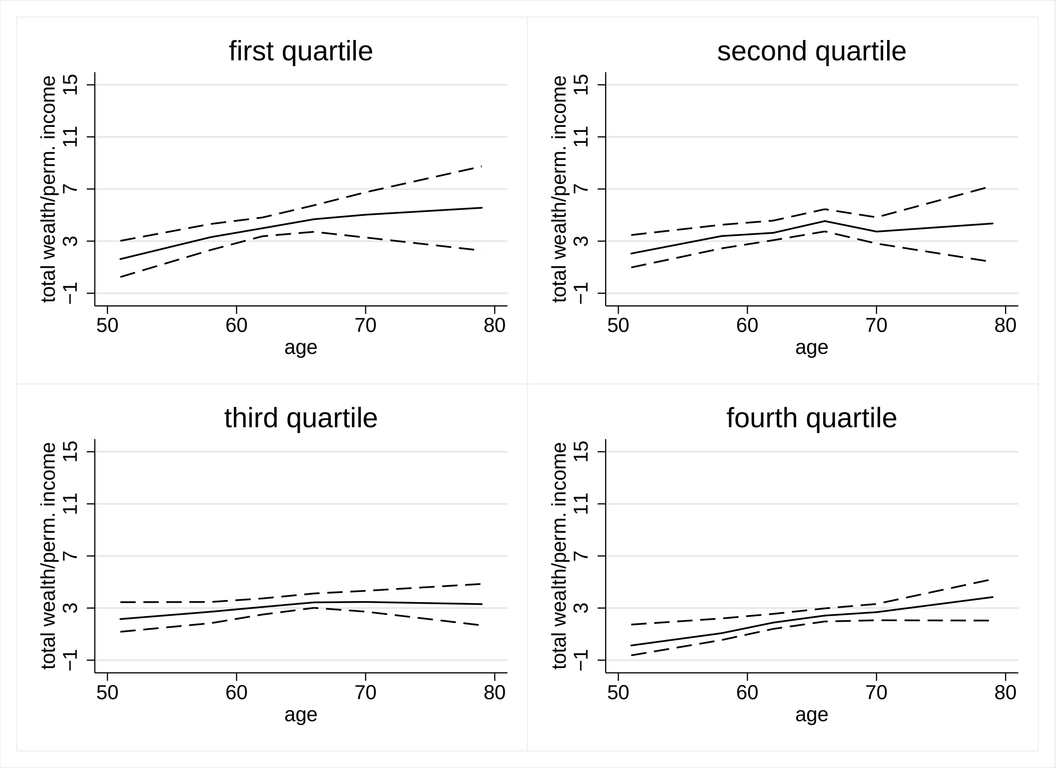

Figure 6: Age-total wealth profiles (solid lines) for all quartiles of the RR_O-distribution. The dashed lines represent 95% confidence bounds, based on 1000 bootstrap replications (clustered at the household level).

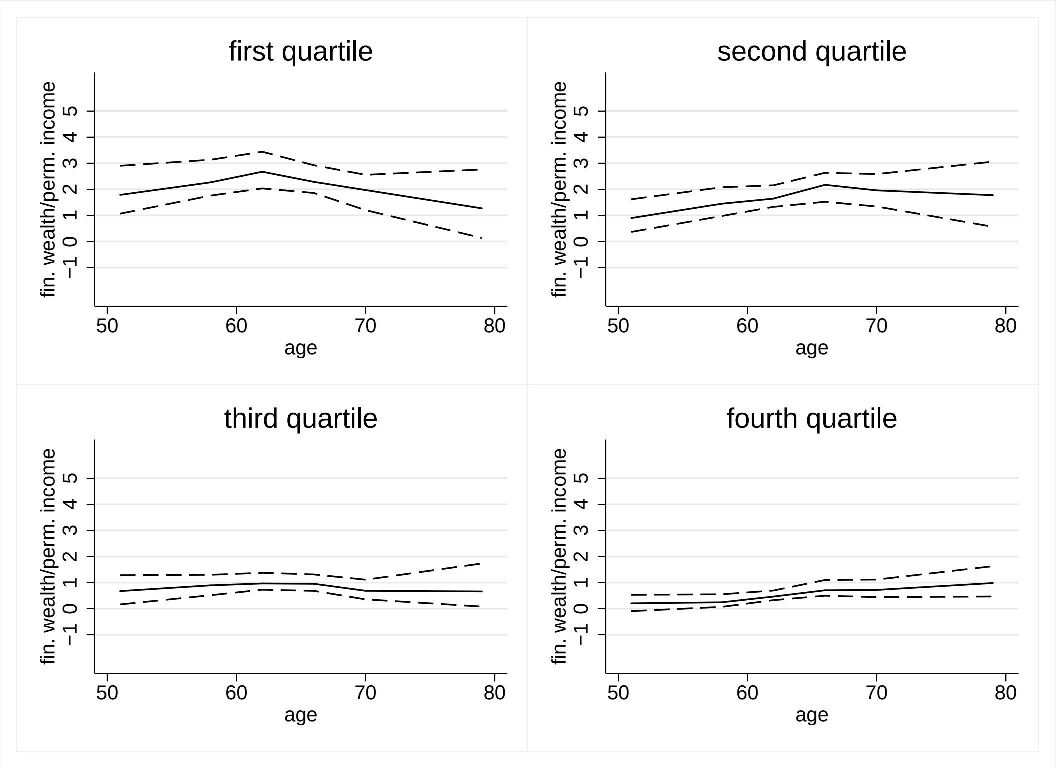

Figure 7: Age-financial wealth profiles (solid lines) for all quartiles of the RR_{FP}-distribution. Note that possible endogeneity is ignored in determining this distribution. The dashed lines represent 95% confidence bounds, based on 1000 bootstrap replications (clustered at the household level).

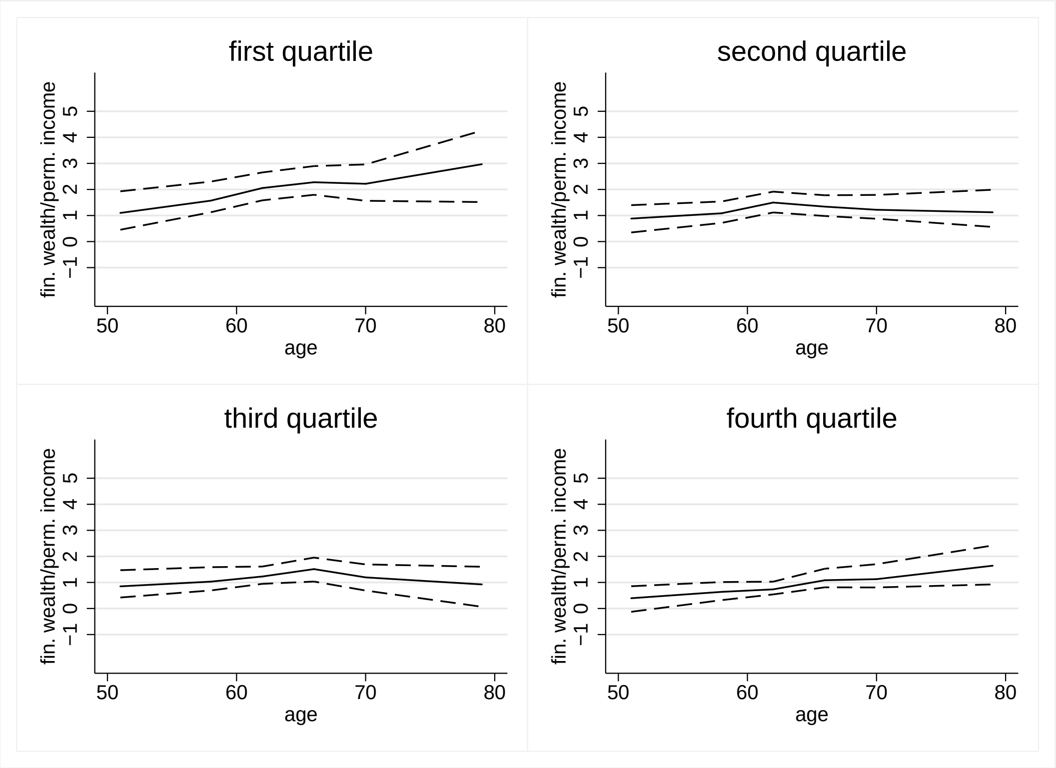

Figure 8: Age-financial wealth profiles (solid lines) for all quartiles of the RR_O-distribution. Note that possible endogeneity is ignored in determining this distribution. The dashed lines represent 95% confidence bounds, based on 1000 bootstrap replications (clustered at the household level).

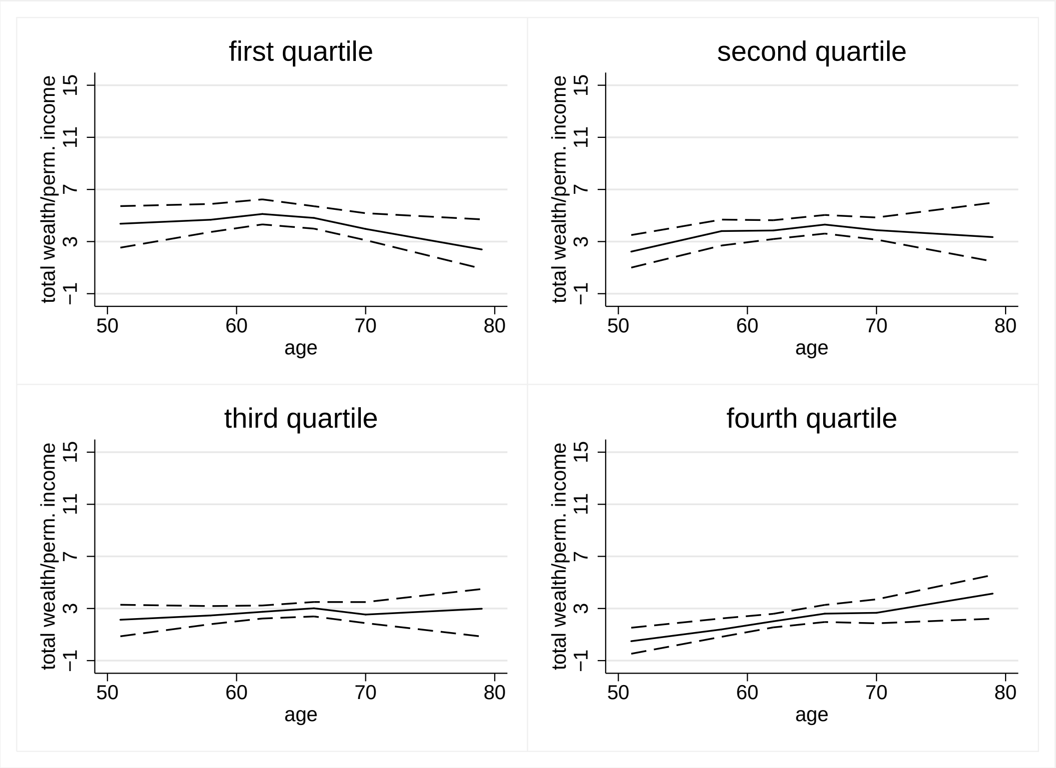

Figure 9: Age-total wealth profiles (solid lines) for all quartiles of the RR_{FP}-distribution. Note that possible endogeneity is ignored in determining this distribution. The dashed lines represent 95% confidence bounds, based on 1000 bootstrap replications (clustered at the household level).

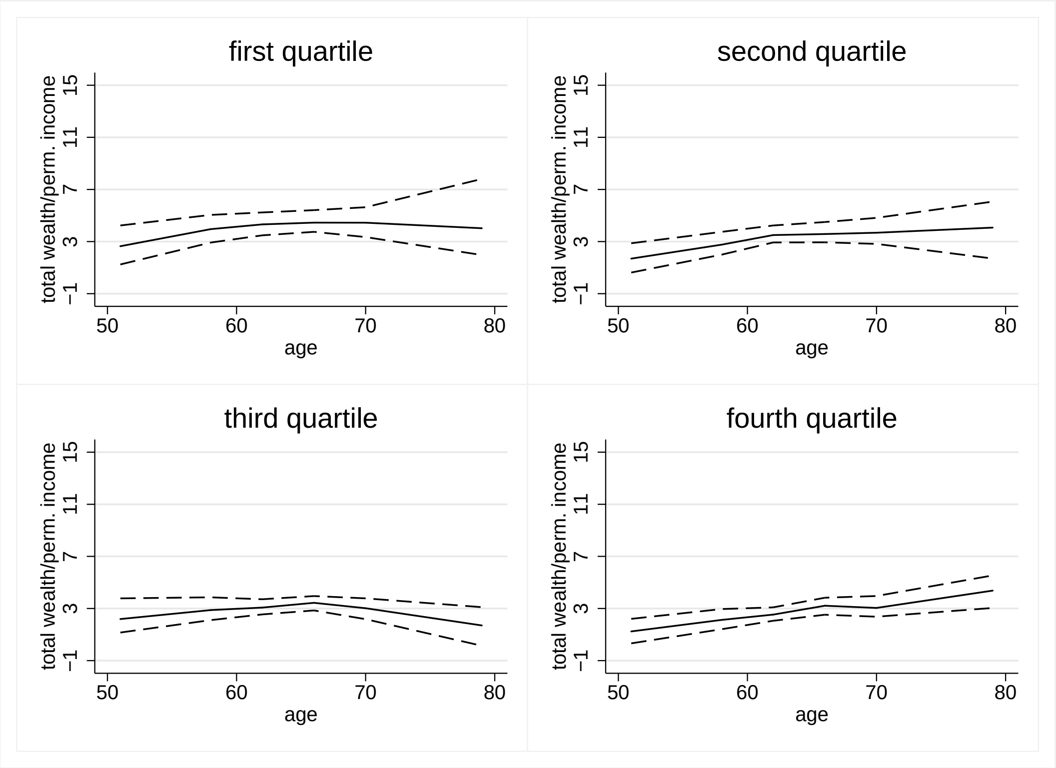

Figure 10: Age-total wealth profiles (solid lines) for all quartiles of the RR_O-distribution. Note that possible endogeneity is ignored in determining this distribution. The dashed lines represent 95% confidence bounds, based on 1000 bootstrap replications (clustered at the household level).