The Effects of Annuities on Longevity

Borja Larrain, Alessandro Previtero, and Felipe Severino*

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Abstract

We investigate the annuitization choices of over 65,000 Chilean retirees. Retirees are less likely to choose an annuity following high recent stock market returns. Using the past-year returns around retirement as an instrument for selecting an annuity, we document that annuities significantly increase longevity. Using the same instrument in independent survey data from Chilean retirees, we confirm that annuitants have better post-retirement health than non-annuitants. We investigate the mechanisms leading to annuitants' better health and longevity after retirement.

Keywords: annuities; retirement income; health and longevity; financial distress; precautionary savings.

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1 Introduction

Defined contribution (DC) plans are the most common retirement plans worldwide. Employees in DC plans have significant autonomy in their elections and, as a result, face the risk of making costly mistakes. Academics and policymakers have focused on accumulation choices to ensure employees create their nest eggs successfully.[1] Conversely, retirees from DC plans have very little guidance in the decumulation phase when they draw down from their retirement wealth.

Nonetheless, these retirees face several key decisions, including how much to withdraw, how to invest their assets, and whether to protect themselves against the longevity risk– the possibility of outliving their retirement savings. While annuities represent the most straightforward way to hedge longevity risk, their direct sales from insurance companies are historically limited, a well-known fact since Modigliani (1986). Moreover, annuities represent the default payout option in disappearing defined benefit (DB) plans. Still, DC plans seldom offer the option to annuitize retirement wealth (only one in six in the US, LIMRA, 2023). As many countries reduce the generosity of annuitized public pensions and nudge citizens to rely more on private retirement plans that do not provide longevity insurance, retirees will become less and less likely to receive lifetime income.[2] How does reducing access to annuitized income affect retirees' health and longevity?

Investigating the effects of annuities on longevity is challenging for several reasons. First, in many countries, retirees are mandated to choose an annuity. Even in countries

[1]For example, nudges endorsed in the Pension Protection Act, such as auto-enrollment, auto-escalation of retirement savings, and default investment options such as target-date funds, have helped millions of employees increase their retirement nest egg (Benartzi and Thaler (2013))

[2]This trend is reverting the postwar increase in mandatory annuity programs such as Social Security. Philipson and Becker (1998) highlight how introducing such programs has been associated with a rapid rise in life expectancy at older ages. The authors posit that annuities could generate incentives to increase longevity.

with a limited role for annuitized public pensions, the prevalence of DC plans is relatively recent, and data might not yet be available to assess the effects of annuities on longevity. Second, due to selection effects, annuities could be associated with high longevity. Retirees expecting to live longer would be more likely to select an annuity. Therefore, identifying the impact of annuities would require variation in the annuitization propensity exogenous from factors associated with life expectancy. Last, receiving a lifetime income stream could affect longevity in different and not mutually exclusive ways. Lifetime income could reduce the likelihood of running out of money and facing financial hardship, mimicking the positive effects of bankruptcy protection on longevity (Dobbie and Song (2015)). Analogously, the constant stream of income provided by annuities can reduce the negative impact on health and longevity of income volatility (Sullivan and von Wachter (2009)) and stock market fluctuations (Engelberg and Parsons (2016)). Furthermore, annuities can provide economic incentives to invest in health, adopt healthier lifestyles, and increase longevity (Philipson and Becker (1998)).

Using a sample of over 65,000 deceased retirees from Chile, we investigate the relationship between annuity and longevity. To address the selection effects and the endogenous nature of the decision to annuitize, we use the recent stock market returns as an instrument, given that individuals are more likely to choose annuities following poor recent stock market returns (Chalmers and Reuter (2012) and Previtero (2014)). In our favorite specifications with birth-cohort fixed effects, choosing an annuity increases longevity between 3.0 and 3.4 years. Additional analyses using the same instrument in survey data confirm that annuitants are less likely to suffer from disability later in life. Why do annuitants have better health and live longer? We investigate potential mechanisms related to the annuity treatment, such as overcoming financial hardship, reducing anxiety about income or stock market volatility, or providing incentives to invest in health and increase

longevity.

Studying the retirement choices in the Chilean population represents an ideal testing ground for several reasons. Chile privatized its pension system in 1980 by creating a defined contribution system. Roughly 85% of workers participate in this pension system. Given the early start of the defined contribution system, we can observe payout choices and life expectancy for many retirees. Moreover, individuals enrolled in the pension system can choose between an annuity or programmed withdrawals at retirement. While programmed withdrawals offer higher payouts in the early retirement years, retirees bear the stock market risk, and payments later in life can become minimal. The annuities offer, instead, constant lifetime payouts in real (inflation-adjusted) terms.

We document four sets of results. First, we find that recent stock market returns affect the decisions to annuitize. Consistent with US evidence from the Oregon State retirement plan (Chalmers and Reuter (2012)) and 112 different large DB plans (Previtero (2014)), Chilean retirees are more likely to choose annuities following recent negative stock market returns. In Figure 3, we plot the fractions of Chilean retirees that take the annuity in a particular month and the previous six-month cumulative returns in the most common retirement fund (Fund C). The correlation is high at -0.51. In our regression specifications with demographic controls and birth-cohort fixed effects, we find that a one-standard-deviation increase in past six-month returns leads to a decrease in the probability of taking an annuity by roughly 1.4 percentage points (pp). This regression helps assess our instrument's relevance (i.e., our first stage).[3]

Second, when we run a 2SLS instrumenting annuitization with the past six-month stock returns, we find that annuities increase longevity by 3.4 years in the standard

[3]The F-test for weak instruments equals 18.53 and 28.93 for the standard retirement and full samples, respectively.

retirement sample and 3.0 years in the full sample. In the standard retirement sample sample, we restrict our analyses to individuals retiring after their standard retirement age (65 for men, 60 for women). The analysis of retirees in this sample is particularly informative, as we can mitigate the concern that individuals might time their retirement based on stock market conditions. Individuals in the standard retirement sample retiring after high vs. low stock market returns are similar among many observable dimensions such as gender, last salary, accumulated retirement balance, and years of contribution.

We investigate if annuities affect retirees' health status using data from a biennial survey (CASEN) of Chilean households. This survey collects detailed disability information based on the difficulty with day-to-day activities such as eating, getting dressed, or communicating. Given that in the CASEN data, we do not observe the actual retirement date, we assume that men and women retire at their standard retirement age (65 and 60, respectively). Accordingly, we instrument the choice to annuitize with stock market returns in the past six months before the standard retirement age. Even if measured with noise, we still find that past stock market returns affect the probability of choosing an annuity (our first stage). In our 2SLS, we confirm that annuities significantly reduce the average disability index reported by retirees by 0.98 on a five-point scale. In Figure 4, we plot the relationship dynamics between the reported disability and our instrument, the stock market conditions at the time of retirement (the reduced form relationship of our IV). The effects of our instrument appear to happen in the later years of retirement. While suggestive, this evidence is consistent with the fact that the payouts of phased withdrawals and annuities significantly diverge only later in life.

Furthermore, we attempt to investigate what drives the annuity treatment. By providing a monthly income stream, annuities can reduce the risk of running out of money and financial hardship, positively affecting health and longevity. To assess this possibil-

ity, we split our sample based on the retirement account balance. The effects of annuities on longevity appear stronger for those retirees in the top quartile of benefits amount, where the differences between the payout of phased withdrawals and an annuity are more pronounced.

Moreover, retirees with phased withdrawals are subject to stock market fluctuations and potentially exposed to stock market downturns that can negatively influence their health (Engelberg and Parsons (2016)) and life expectancy. To check for this possibility, we investigate the effects of stock market returns on longevity in the months following retirement. We document that the returns over three months, six months, or one year post-retirement do not affect retiree longevity. This evidence suggests that short-term stock market trends post-retirement do not significantly affect longevity.

Finally, choosing an annuity offers the incentive to improve one own health, given that annuity payments are life-contingent. In other words, retirees can exhibit moral hazard as annuities incentivize them to live longer. We turn to the Health and Retirement Study (HRS) to investigate this potential channel. Unfortunately, we cannot replicate our instrumental variable approach in the HRS, as there is limited variation in annuitization choices in the US. We show that annuitants differ from non-annuitants along several health-related dimensions, from reporting fewer disabilities, better health status, fewer depression symptoms, and more satisfaction with their retirement to being more likely to practice sports, less likely to smoke, and having lower weight. Although purely correlational, these results are consistent with annuitants taking better care of themselves post-retirement.

Our study contributes to several strands of literature. First, our findings are related to the studies on the effects of individual and aggregate economic conditions on longevity. Sullivan and von Wachter (2009) find evidence that displaced workers experience higher

mortality rates in the short and long term (from one year to twenty years after displacement). Dobbie and Song (2015) document that bankruptcy protection increases annual earnings and reduces five-year mortality. Finkelstein, Notowidigdo, Schilbach, and Zhang (2024) analyze the effect of aggregate economic conditions by documenting that the Great Recession reduces the annual mortality rate, with effects persisting for at least 10 years. Reductions in air pollution due to recessions appear essential to explain this evidence. Similarly, Engelberg and Parsons (2016) document that aggregate stock market downturns can negatively affect investor health. We contribute to this literature by showing that annuities can have long-term effects on retiree health status and longevity.

Second, several studies have investigated subjective beliefs about life expectancy and mortality. Investigating the UK annuity market, Finkelstein and Poterba (2004) find evidence consistent with longer-lived retirees being more likely to buy back-loaded annuities. More recently, using data from ELSA, O'Dea and Sturrock (2023) document that individuals underestimate their longevity and exhibit survival pessimism. Similarly, Heimer, Myrseth, and Schoenle (2019) find that individuals underestimate their life expectancy well in their 60s. How can retirees systematically underestimate their life expectancy yet be able to choose the backloaded annuities when living (ex-post) longer? We can reconcile these contradictory results in the literature by documenting that annuities could positively affect health and life expectancy.

Lastly, many researchers have presented several rational reasons to explain the annuity puzzle, from bequest motives to precautionary savings, from adverse selection and fees to hedging within the family (for a review, see Brown (2007)). Furthermore, researchers have proposed behavioral reasons such as framing, trend-chasing, present-biased preferences, and regret aversion (for a review, see Benartzi, Previtero, and Thaler (2011)). In this paper, we contribute to these studies by documenting the effects of annuities on health

and longevity. A lifetime stream of income can increase retirees' health and longevity. This evidence casts all the considerations about the money-worth of annuities in a different light: insurance companies price annuities based on the average life expectancy of both annuitants and non-annuitants. If annuities positively affect longevity, they are a better deal than previously estimated, making the annuity puzzle even more stark.

2 Data

The Chilean pension system was privatized in 1980 through the creation of a defined-contribution system that replaced the old public pay-as-you-go system. All workers have to contribute 10% of their taxable income (with a cap) per month to individual retirement accounts. In the 2010s, there were close to 10 million participants in the system. On average, 84.5% of individuals between 20 and 65 years contribute to their individual accounts in the pension fund system.

Pension fund administrators (PFAs) charge a fee out of the contributions of the participants. Since 2002, workers are able to choose between five types of funds that each PFA is required to offer. The five types of funds are subject by law to different investment limits. Fund A has the highest share of equities, up to 80% of the portfolio, among the five funds and is considered the riskiest. Fund E is almost entirely invested in domestic fixed-income securities. Funds B, C, and D are designated as age-dependent default investment options. Investors are automatically shifted to the less risky funds, moving from B to D, as they get older, unless they have explicitly expressed their preference for other funds.

In 2010-2020, average assets under management in the system correspond to approximately 175 billion USD, or close to 65% of Chilean GDP. Fund C, which started in 1980

instead of 2002, is the largest, with 65 billion USD in assets under management. At the system level, close to 42% of the assets under management are invested in foreign assets.

Given the start in 1980, there are already many retirees from the system. The legal age of retirement is 65 for men and 60 for women. Most people retire at the legal age or shortly thereafter. We call standard retirement to those men and women who retire after 65 and 60, respectively. There is also the option of retiring before reaching the legal age. The conditions for early retirement are two: (i) having sufficient funds to obtain a pension above 70% of the average wage received by the individual in the last 10 years, and (ii) that the first monthly pension must be at least 12 UF (around 1,050 USD).[4] Disability retirement is a third option besides standard and early retirement. This is an option for anyone who has been declared fully or partially disabled by a medical committee of the pension regulator. [5]

Retirees (under standard, early, or disability retirement) can choose between two payout options: programmed withdrawal (PW) or annuity. After choosing PW, one can go back to an annuity, but the annuity decision is irreversible. Under PW the pension fund pays the retiree from her individual capitalization account throughout retirement. Beneficiaries receive any balance left after death. Retirees under PW are exposed to yearly fluctuations in the returns of their portfolios. Retirees can choose to allocate their money between funds C, D, and E, but they cannot choose the more risky funds A or B. The amount of the payment under PW is reset each year based on the balance of the individual account, the life expectancy of the retiree, the number of beneficiaries, and assumptions

[4]The Chilean UF is an inflation-adjusted unit of account used for most financial contracts in the country. The Chilean peso is the only legal tender though. For our calculations we use a conversion rate of 1 UF = 37015 Chilean pesos, and then adjusting for purchasing power using 1 USD = 426 Chilean pesos (from OECD).

[5]We exclude from the analysis survivorship pensions that are allocated to the spouse or dependents of a deceased retire.

about future fund returns. In particular, the monthly payout under PW is:

$$PW = \frac{AccountBalance}{12 \times NUC},$$

where NUC or Necessary Unit of Capital is given by the following formula (up to a constant):

$$NUC = \sum_{n=age}^{110} \frac{l(n, age, gender, beneficiaries)}{(1 + r_{pw})^{n-age}}$$

The NUC is the present value of one unit of annual pension, taking into account the likelihood of survival ($l(.)$) and future returns (r_{pw}). Survival probabilities are a function of age, gender, and they take into account beneficiaries. The probability of being alive at 110 is assumed to be zero. Since 2014, future returns are assumed to be constant, and they are computed as a combination of current annuity yields and the average returns of the pension funds over the previous 120 months. The pension regulator sets the rules and parameters for computing the NUC. There is no leeway for the individual or PFA in determining the amount of PW.

Annuities can be of two types. The first is an immediate annuity, where the retiree takes her accumulated pension balance and buys an annuity from an insurance company. The insurance company must pay the retiree an inflation-adjusted (otherwise fixed) amount per month until death. Hence, longevity risk is passed on to the insurance company. A retiree can also choose a deferred annuity where the monthly annuity starts from a future date (e.g., three years after retirement), leaving a balance in her individual

account to draw a temporary income between retirement and the beginning of the annuity. The monthly temporary income cannot be more than twice the future monthly annuity. Both types of annuities can have a guaranteed period, during which, if the person dies, her beneficiaries continue receiving payments (e.g., 20 or 30 years). A final possibility is a combination of PW and annuity. The annuity amount, in this case, must be larger than the state-funded basic pension. We exclude retirees with a mix of PW and annuity, although they are extremely few (less than 2,500 observations in the sample). We group together retirees with immediate and deferred annuities for most of our analysis.

Since 2004, the choice of pension type has been implemented through an exchange called SCOMP.[6] Retirees receive offers from insurance companies regarding the type of annuity contracts they have selected. Sales agents from insurance companies and financial advisors help retirees access SCOMP, and charge fees for their services that are tilted towards recommending annuities (Boehm, 2024). Retirees can also approach insurance companies independently to renegotiate offers. Retirees receive different annuity offers and a simulation of PW. Figure 1 shows the different offers for PW. The table at the top shows the first-year monthly payment offered by different PFAs (one can move to a different administrator at retirement). Fees are the only difference between offers. The graph at the middle of the page shows a simulation of future payments associated with PW under the parameters set by the regulator.

Our main database corresponds to all retirees who have taken an offer (annuity or PW) from the SCOMP system in 2004-2022. Table 1 shows averages of different variables according to the choice of pension. Retirees with annuities represent close to 60% of our

[6]Only people that can get a monthly annuity payment equal or greater than 3 UF (about 250 USD) can access SCOMP. For those above 3 UF it is compulsory to use SCOMP. Thus, very poor people, or people without a long history in the labor market, will not access SCOMP. The default for those without access to SCOMP is getting programmed withdrawal. They also get pension supplements from the government.

sample. The average value of the annuity or the initial balance under PW is around 2500 Chilean UF or about 217,000 USD. The annual payment for the first year corresponds to 5.59%-5.79% of the value of the annuity, but 7.79% of the PW balance. The monthly payments during the first year of an annuity correspond to 49%-59% of the previous average income of the individual, and 68% under programmed withdrawal. More than 75% of annuities have a guaranteed period. Around 17% of retirees choosing an annuity are moving from PW (the annuity decision is irreversible). Men are more likely to choose PW than women. Figure 2 reports the distribution of retirees by gender and type of retirement. Consistent with the regulation, the distribution of men (women) retirees is concentrated around 65 (60). Figure 3 shows the fraction of retirees by month who choose an annuity and the previous six-month returns of Fund C.

Table 2 shows summary statistics for a sample of retirees who have died, or what we label the longevity sample. On average, the age of death is 67.5 years, 81 % are men, and the average last salary is 21.6 Chilean UF, or about 1,900 USD. This longevity is in line with the life expectancy of those born in Chile around the 1950s.[7] The average accumulated balance is 2410 Chilean UF, or about 200,000 USD. Households in Chile in our longevity sample, on average, contribute for 22.4 years to their defined contribution plan. Table 3 reports similar estimates for the sample of the households that retired at or after the legal age (standard retirement sample). Retirees in this sample live longer, on average 71.6 years, and have higher last salaries, but lower accumulated balances than the full sample of retirees in the longevity sample.

We also get data from a survey (CASEN) that describes the socioeconomic conditions of Chilean households. The Ministry of Development conducts this survey every two

[7]According to the Chilean Statistical Office (INE) life expectancy was 53 years for men and 57 for women for those born in 1950-1955. Life expectancy has increased by about 25 years for those born in 2015-2020.

years. The survey reports information about income, work, education, health, household composition, and living standards for a representative sample of thousands of households across the country. The sample is different each year, so it is a repeated cross-sectional survey. Questions regarding sources of retirement income (e.g., PW or annuity) start with the 2011 survey. We focus on retired men (women) who are older than 65 (60), and who are receiving non-disability pension income from either PW or an annuity.

3 Empirical strategy and main results

We are interested in estimating the effect of annuity on longevity. A naïve empirical design would use OLS to estimate equations of the form:

$$y_{ict} = \beta_c + \beta_A \; Annuity_i + \Gamma' \; X_{ict} + \epsilon_{ict} \quad (1)$$

Where y_{ict} is the difference between the year of death and the year of birth (i.e., longevity) for retiree i in cohort c, and calendar time t; β_c is a set of birth-year cohort fixed effects, and X_{ict} is a set of observable controls at retirement such as gender, last salary, accumulated retirement balance, years contributed to the pension fund, dummies for PFA, dummies for retirement type (standard, early, and disability), plus the interaction of gender with the birth-year and acceptance-year cohort fixed effects. Finally, $Annuity_i$ is an indicator equal to one if the retiree i chooses an annuity at the moment of retirement. Therefore, our coefficient of interest is β_A representing the correlation between the retirement choice and our longevity measure.

Despite the extensive set of control variables, the error term ϵ_{ic} in equation 1 likely contains unobserved variation, such as subjective life expectancy. If individuals who

expect to live longer are more likely to select an annuity—that is, if there is adverse selection—then the effect of annuities on longevity can be overstated in a standard OLS regression. Conversely, if individuals systematically underestimate their longevity (as in O'Dea and Sturrock 2023), then longevity pessimism can lead to an underestimation of the effects of annuities. Furthermore, a compositional effect within the population of retirees could lead to a null effect of annuities on longevity that will mask the treatment effect of annuities on longevity.

To overcome this identification challenge, we exploit plausibly exogenous variation in the choice of annuity. We use the average return on the pension fund portfolios of the Chilean pension system just before, six months before the retirement date t, as an instrument for the annuity choice; there is a significant correlation between these returns and local and international stock market return, this strategy is similar to Previtero (2014).

Specifically, the first-stage equation is:

$$Annuity_i = \alpha_c + \alpha_r \; Return_{it} + \Gamma' \; X_{ict} + \upsilon_{ict} \quad (2)$$

Where $Returns_{it}$ are the cumulative returns in the pension fund C of the Chilean pension system between $t-6$ months and t, and the reminder variables are defined as in equation 1. The second stage equation is equation 1, where we estimate the parameters using standard instrumental variables techniques. such that:

$$y_{ict} = \beta_c + \beta_A \; \widehat{Annuity}_i + \Gamma' \; X_{ict} + \epsilon_{ict} \quad (3)$$

Where $\widehat{Annuity_i}$ is the predicted value in equation 2, we cluster standard errors at the birth year cohort to account for across-time correlations between birth year cohorts.

Our identifying assumption is that previous returns to the pension systems generate variation in the choice of annuity that is orthogonal to the household heterogeneity, after removing observables variation: E[$Return_{it} \times \epsilon_{ict} \mid X_{ict}$,$\beta_c$]=0, the exclusion restriction.

Under this assumption, the second stage coefficient β_A on an annuity is the causal effect of the annuity choice on longevity. If the identification assumption holds, individuals who retired when previous returns were low have similar observable and unobservable characteristics as individuals who retired when returns were high. Yet, they are more likely to choose an annuity. In reduced form, our empirical strategy compares the longevity of these two groups of retirees.

One concern is that the timing of when to retire is also a choice that will affect the validity of our instrument; motivated by this, we estimate the same specification in the group of retirees that follow standard retirement timing in Chile (65 for men, 60 for women). Figure 1 shows that there is a left tail of retirees that retiree before the legal age due to advance or disability reasons; the standard retirement distribution is truncated at the retirement age and allows us to alleviate concerns about the timing of the decision that will interact with our measure of returns.

While our identifying assumption is untestable, we nonetheless can test whether $Return_{it}$ is correlated with observable characteristics. We sort our sample of retirees by whether $Return_{it}$ is above or below the sample median and report the average characteristic of retirees at the moment of retirement t controlling for birth year cohort. Tables Table 2 and Table 3, columns 5-6, for the entire sample of retirees and the standard retirement, respectively. In the case of Table 2, all retirees' differences between low and high returns still exist, but the magnitude of the differences is smaller than in the endogenous

annuity choice reported in columns 2-3. Importantly, in Table 3, standard retirement sample, differences in observables characteristics show no economic or statistical differences in columns 5-6, in contrast to columns 2-3 that report statistics by the endogenous annuity choice, consistent with random assignment, and with the notion that focusing on standard retirement sample, removes unobservable variation related to the timing of the choice.

3.1 Main Results

Table 4 reports the results described above, columns 1 and 5 report the estimates of the OLS estimates described in equation 1 for all retirees and the standard retirement sample, respectively, it shows that after controlling for a vast set of observable characteristics the annuity choice is correlated with retirees' longevity, the estimates are significant but economically small, which is consistent with a regulatory environment which establishes a regulated exchange SCOMP as described in the Data Description section.

Table 4 columns 2 and 6 show the reduced form effect of previous returns on annuities; it shows that individuals who retire following high return on the pension funds (and the market overall) live between 0.70 to 0.96 years less than individuals who retire following low return on the pension funds (and the market overall).

Having established that relationship, we look into the first stage regression described in equation 2, Table 4 columns 3 and 7 show that following high return individuals are less likely to choose an annuity, the coefficients 0.24 and 0.28 implied that a one-standard-deviation increase in stock market returns leads to a decrease in the probability of taking an annuity by roughly between 1.2 to 1.4 percentage points.[8]

[8]Table 2 and 2 show that the standard deviation of previous six months returns is 0.049 for the all retiree sample and 0.051 for the standard retirement sample, thus 0.24*0.049=1.2% and 0.28*0.051=1.4%

Finally, Table 4 columns 4 and 8 document our 2SLS specification described in equation 3. We find that annuities increase longevity between 3 and 3.4 years. These results are statistically significant, with p-values of 0.025 and 0.0029, respectively, and economically important.

A main concern in interpreting these results is that previous stock market performance could be correlated with other unobservable characteristics that could affect longevity but are different from the annuity per se. An obvious candidate is the overall wealth of the retiree; it is plausible to think that wealth will positively affect longevity as it provides better access to health and wellness for the elderly. Although a plausible story, considering our current findings that high returns predict lower longevity if good stock market performance increases individuals' overall wealth, our 2SLS estimates will be a lower bound of the true effect of annuities on longevity, making the documented effects still relevant.

3.2 Robustness

Following up on the previous discussion, the timing of the returns after we have control for the birth year and acceptance year cohort is extremely relevant to the validity of our empirical specification. To investigate this claim in Table 5, we replicate the reduced form specification but using different return time windows; specifically, we use returns between the retirement and the previous 3, 6 and 12 months, columns 1-3 and 7-9 document a positive significant and economically important effect of this different returns windows on longevity.[9] Importantly we conduct a placebo test by shifting the returns forward and estimating a reduced form that uses returns between the month after retirement and 3,6

[9]The only exception is column 3 and 9 which shows that the effects returns closed to the acceptance year affect in the same direction but with noise

and 12 months forward. Table 5, columns 4-6 and 10-12 show that there is no significant correlation between the future returns and the longevity of the retirees; more importantly, the estimated coefficients are also orders of magnitude smaller than the estimates using previous returns. Overall, this evidence reinforces the validity of our instrument.

The timing of the retirement choice is another source of concern; as described before, we alleviate some of those concerns by focusing on a sample of standard retirement for which this choice is restricted. To provide further evidence in favor of our interpretation, Table A1 replicates our main results but using a more restricted specification by adding to birth-year-cohort fixed effect, acceptance year fixed effect interacted with all the controls described in equations 1, 2 and 3, and clustering standard error by birth-year cohorts. The results are unchanged in Table A1. We find that annuities longevity is between 2.7 and 3.4 years. These results are statistically significant, with p-values of 0.054 and 0.028, respectively, and economically important.

3.3 How do annuities increase longevity?

We document the treatment effect of annuities on longevity, but how does the treatment effect operate, and what is causing the longevity of annuitants to increase? To answer this question, we use a biennial survey (CASEN) that describes the socioeconomic conditions of Chilean households. The survey reports information about income, work, education, health, household composition, and living standards for a representative sample of thousands of households across the country. Importantly for us, it includes a set of ten questions regarding problems with day-to-day activities such as eating, going to the bathroom, getting dressed, going out of the house, communicating, and others. Each response can go from 1 (no difficulty) to 5 (severe difficulty). The sample is a repeated

cross-sectional survey. Questions regarding sources of retirement income (e.g., PW or annuity) start with the 2011 survey. We focus on retired men (women) who are older than 65 (60), and who are receiving non-disability pension income from either PW or an annuity. Different from the longevity sample, here we don't observe the retirement decision date, but we do observe their retirement decision; in order to implement an empirical strategy similar to equation 3, we assign the retirement date to their standard retirement age of 65 for men and 60 for women, and we merge the relevant past return on the pension fund C for each retiree in the survey sample.

Table 6 reports summary statistics for the sample, 49% of retirees in the survey chose an annuity, the average age in the sample is 71.5 years, 57 % of them are men. Our measures of disability are constructed using the problems with daily activities question. Mean Disability is the average over the ten questions and has an average of 1.18 (sd 0.51). Max Disability is the highest number across the response to the ten questions and has an average of 1.39 (sd 0.88)

Replicating the analysis for the longevity sample Table 7 report the result of our empirical strategy in our survey sample. Table 7 column 1 shows the first stage specification that mimics the result in our main estimates in Table 4. Table 7 columns 4 and 7 shows the estimates for the 2SLS estimation, we document that annuities casually reduce mean disability by a -0.99 and max disability by -1.41 units, with a p-value of 0.016 and 0.072 respectively. Therefore, these estimates confirm that annuitants have a lower likelihood of reporting disability status than non-annuitants. These estimates are consistent with annuities providing an additional incentive to improve health and, therefore, producing an endogenous increase in life expectancy.

To further alleviate concerns about selection into treatment, we document the differences in these disability measures by annuitants and non-annuitants, looking at the

differences in these estimates by the time since retirement. Figure 4 and 4 bin the mean and max disability index residual (after controlling for survey year, income, age, and gender) by the time since retirement in 5-year intervals. Panels (1) split these bin-plots by the endogenous annuity decision (OLS) and Panels (2) by low and high previous returns (reduced form). The OLS figure shows no systematic differences between the two groups and, if anything, higher disability measures for annuitants. However, the reduced form plots show that low and high pre-retirement returns retirees are very similar for the first decades post-retirement; moreover, health differences arise after 20 years of retirement, low pre-return individual associated with higher annuity take-up reduce dramatically their disability measures in the latest decades after retirement. This additional evidence further alleviates potential concerns on individuals with better health status selecting into annuities.

4 Mechanisms

We conclude by exploring what drives the effects of annuities. By providing a steady monthly income, annuities help reduce the risk of running out of money and facing financial hardship, which may, in turn, improve health and longevity. To investigate this, we divide the sample based on retirement account balances. The results suggest that the impact of annuities on longevity is strongest for retirees in the top quartile of benefits, where the differences between phased withdrawals and annuity payouts are most substantial (see Table 8).

Retirees using phased withdrawals are also exposed to stock market fluctuations, which could negatively affect their health and life expectancy during downturns (Engelberg and Parsons (2016)). To test this, we examine the relationship between stock market returns

and longevity in the months following retirement. As shown in Table 5, stock market performance over three months, six months, or one year post-retirement has no significant effect on retirees' longevity. This evidence suggests that short-term market movements after retirement do not meaningfully influence life expectancy.

Annuities may also encourage retirees to take better care of their health, given that annuity payments depend on longevity. To explore this idea, we turn to the Health and Retirement Study (HRS). While the HRS data do not allow us to use the instrumental variable approach due to limited variation in annuitization choices in the U.S., we find notable differences between annuitants and non-annuitants. Table 9 shows that annuitants report better health outcomes, including fewer disabilities, better overall health, fewer symptoms of depression, greater satisfaction with retirement, higher rates of physical activity, lower smoking rates, and lower body weight. Although these results are correlational, they are consistent with the idea that annuitants may take more steps to maintain their health after retirement.

5 Conclusions

What is the relationship between annuities and longevity? By providing a stable stream of income for as long as someone lives, annuities can provide retirees a simple way to manage their finances later in life when individuals face cognitive decline. Moreover, annuities provide an additional economic incentive—a special kind of moral hazard—to improve health and longevity. Nonetheless, estimating the effects of annuities on longevity is tricky. Individuals might have informative subjective expectations on their own demise. Therefore, retirees with longer life expectancy might select annuities in the first place (a classical case of adverse selection).

Using data from over 65,000 Chilean retirees, we empirically investigate if annuities have a direct effect on longevity. For our identification, we rely on the fact that recent stock market returns provide a plausibly exogenous shock to the propensity to annuitize. In other words, the stock market return in the three/six months before someone happens to turn 65 (or 60 for women) should be exogenous and unrelated to mortality rates 20 years later. Our instrumental variable approach documents that annuities increase longevity in a sizable way between two to five years, depending on our empirical specification.

We analyze a survey of Chilean retirees to investigate the mechanism behind our results. Our IV estimates confirm that annuitants have better health and a lower likelihood of reporting disability status than non-annuitants. Notably, the health status of annuitants and non-annuitants are remarkably similar for the first-decade post-retirement. This additional evidence further alleviates potential concerns on individuals with better health status selecting into annuities.

Taken altogether our evidence has implications for the design of retirement income solutions in defined contribution plans (DC). The majority of DC plans do not offer an annuity payout option. Even when offered, annuities are not popular among retirees. The ease of managing payouts, the associated peace of mind, and the increased longevity that we document might represent substantial—yet so far overlooked—benefits of annuities.

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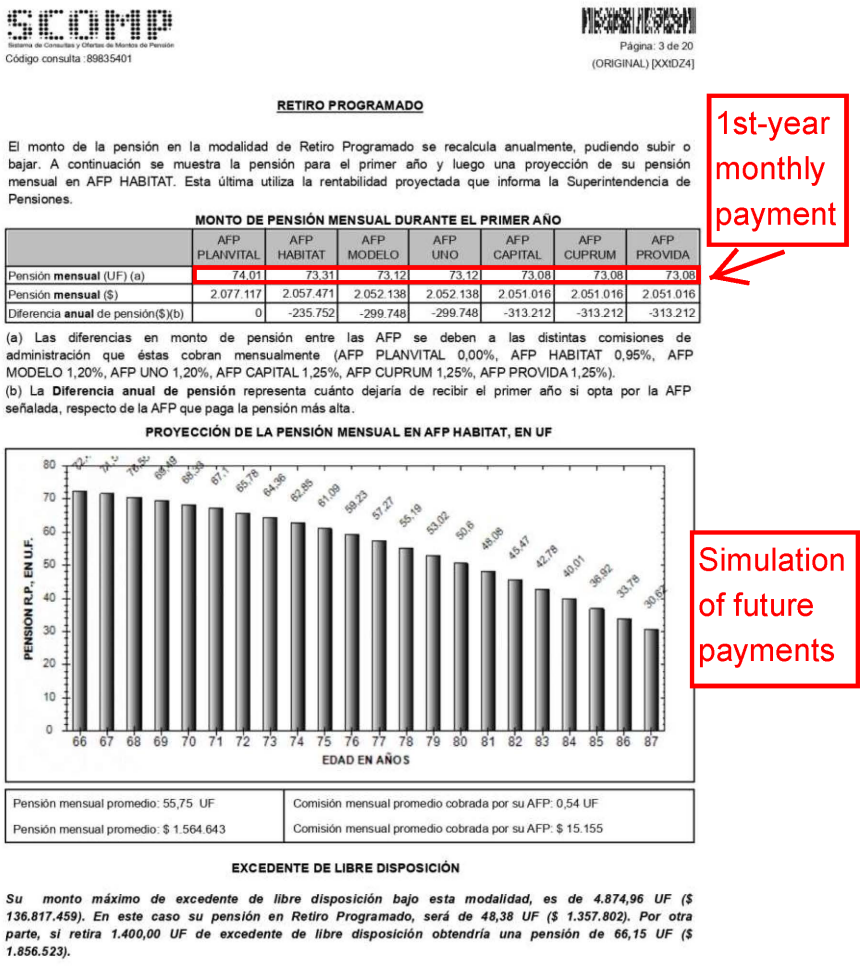
Figure 1: Offers of Programmed Withdrawal from SCOMP



SCOMP
Sistema de Consultas y Ofertas de Montos de Pensión
Código consulta :89835401

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RETIRO PROGRAMADO

1st-year monthly payment

El monto de la pensión en la modalidad de Retiro Programado se recalcula anualmente, pudiendo subir o bajar. A continuación se muestra la pensión para el primer año y luego una proyección de su pensión mensual en AFP HABITAT. Esta última utiliza la rentabilidad proyectada que informa la Superintendencia de Pensiones.

MONTO DE PENSIÓN MENSUAL DURANTE EL PRIMER AÑO

	AFP PLANVITAL	AFP HABITAT	AFP MODELO	AFP UNO	AFP CAPITAL	AFP CUPRUM	AFP PROVIDA
Pensión **mensual** (UF) (a)	74,01	73,31	73,12	73,12	73,08	73,08	73,08
Pensión **mensual** ($)	2.077.117	2.057.471	2.052.138	2.052.138	2.051.016	2.051.016	2.051.016
Diferencia **anual** de pensión($)(b)	0	-235.752	-299.748	-299.748	-313.212	-313.212	-313.212

(a) Las diferencias en monto de pensión entre las AFP se deben a las distintas comisiones de administración que éstas cobran mensualmente (AFP PLANVITAL 0,00%, AFP HABITAT 0,95%, AFP MODELO 1,20%, AFP UNO 1,20%, AFP CAPITAL 1,25%, AFP CUPRUM 1,25%, AFP PROVIDA 1,25%).
(b) La **Diferencia anual de pensión** representa cuánto dejaría de recibir el primer año si opta por la AFP señalada, respecto de la AFP que paga la pensión más alta.

PROYECCIÓN DE LA PENSIÓN MENSUAL EN AFP HABITAT, EN UF

Simulation of future payments

Pensión mensual promedio: 55,75 UF	Comisión mensual promedio cobrada por su AFP: 0,54 UF
Pensión mensual promedio: $ 1.564.643	Comisión mensual promedio cobrada por su AFP: $ 15.155

EXCEDENTE DE LIBRE DISPOSICIÓN

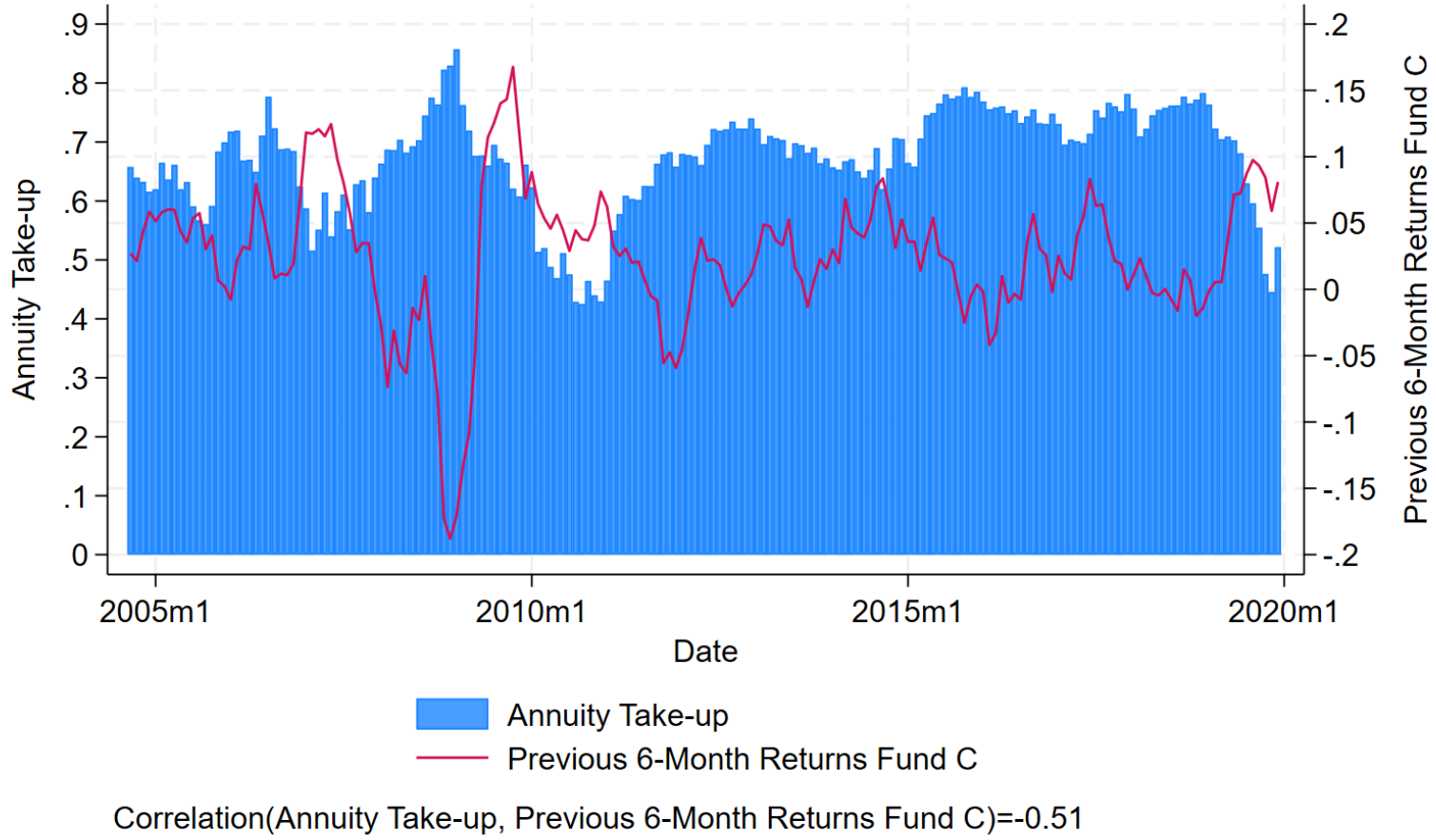
Su monto máximo de excedente de libre disposición bajo esta modalidad, es de 4.874,96 UF ($ 136.817.459). En este caso su pensión en Retiro Programado, será de 48,38 UF ($ 1.357.802). Por otra parte, si retira 1.400,00 UF de excedente de libre disposición obtendría una pensión de 66,15 UF ($ 1.856.523).

Notes: The figure shows an example of the summary of programmed withdrawal (*Retiro Programado*) offers that an individual receives from the SCOMP exchange. The 1st-year monthly payment is expressed in UFs (*Pension mensual (UF) (a)*) and pesos (*Pension mensual ($)*). Several pension fund administrators (*AFP*) make bids, and the table orders them from the least to the most expensive one in terms of fees for the individual. The difference between offers (*Diferencia anual de pension ($)(b)*) is the annual fee charged by each pension fund administrator compared to the least expensive one. The graph below the table shows a simulation of future monthly payments at different ages (*edad en años*) of the individual, and under one particular pension fund administrator. This example is taken from https://www.scomp.cl/scompsa/certificado-de-ofertas-pension-vejez-CO.html.

Figure 2: Retirement Age by Pension Type and Gender

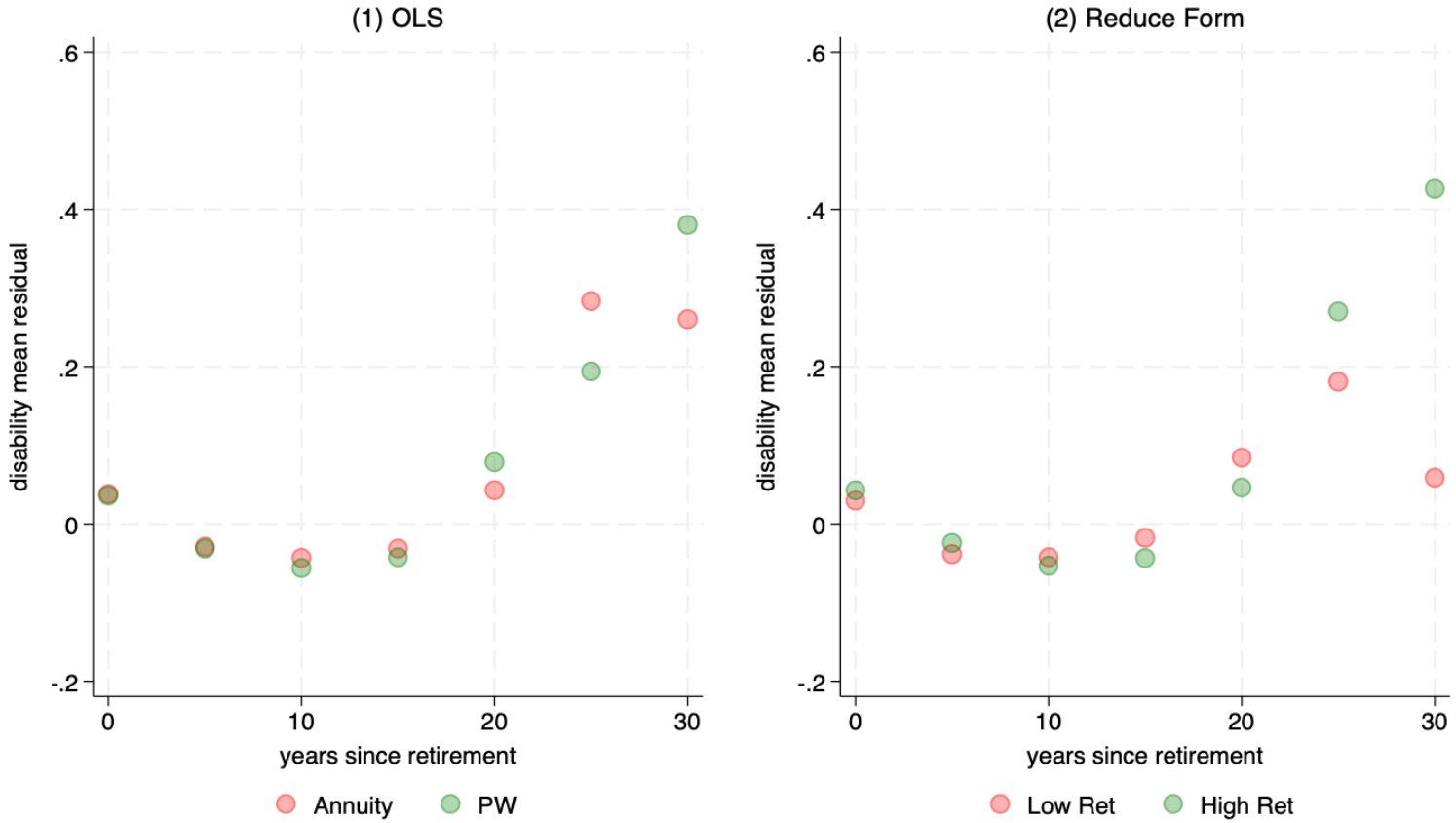
Notes: Data for this figure comes from the SCOMP database, and includes both currently alive and deceased retirees. The top left (right) corner figure represents the distribution of all men (women) retirees in the exchange sample, and the bottom left (right) represents the distribution of men (women) who retiree at the traditional legal age of 65 (60)

Figure 3: Annuity Take-up



Notes: Data for this figure comes from the SCOMP database and includes both currently alive and deceased retirees. The blue bars represent the fractions of retirees that take the annuity in a particular month, and the red line shows the previous 6-month cumulative returns in Fund C

Figure 4: Disability Mean Index and Time Since Retirement



Notes: Data from these figures use the CASEN survey sample. The y-axis uses the disability mean index residual, obtained by regression of the disability mean index for each individual in a set of controls that includes age, gender, income, and survey year; the left panel plots the average disability mean residual by annuity or program withdrawal grouping each observation using year since retirement bins of size five years, the right panel follow the same structure but divide the residual into low and high previous returns; therefore mimicking a reduce form estimation, where low previous returns are associated with higher annuity take-ups

Table 1: Summary Statistics for All Retirees

The table reports the averages of different variables according to the choice of pension: immediate annuity, deferred annuity, or programmed withdrawal (PW). All values are computed at the time of retirement. The sample includes all retirees that accepted an offer in the SCOMP exchange between 2004 and 2022.

	Annuity		
	Immediate	Deferred	PW
Annuity value or initial balance (UF)	2869.78	2254.91	2475.64
Initial annual payment (% value/balance)	5.59%	5.79%	7.69%
Initial monthly payment (UF)	13.37	10.88	15.86
Average monthly income (UF)	22.59	22.16	23.05
Last monthly salary (UF)	27.00	26.59	26.18
Initial monthly payment (% avg income)	59.21%	49.10%	68.82%
Initial monthly payment (% last salary)	49.53%	40.91%	60.59%
Months deferred		15.93	
Guaranteed annuity (1=yes, 0=no)	0.76	0.85	
Months guaranteed	130.00	142.00	
Change in pension mode (1=yes, 0=no)	0.17	0.18	0.00
Gender (1=Male, 0=Female)	0.65	0.64	0.70
Years contributed to system	25.22	25.96	25.93
Retirement age	62.21	61.53	62.62
Year of birth	1950.95	1953.11	1952.74
No. observations	202,952	210,714	271,900

Table 2: Longevity Sample: Summary Statistics for All Retirees

The table reports the averages of different variables for sub-samples within the longevity database. The longevity data consists of all retirees who are currently deceased and who chose an annuity or programmed withdrawal (PW) at the time of retirement through the SCOMP system. Last salary is measured before retirement. The accumulated balance is total pension savings before retirement. Years contributed correspond to the number of years during which the person saved for retirement. Returns correspond to the returns on Fund C (moderate fund) in the 6 months before the retirement decision (PW or annuity). Column 1 reports the average for the whole sample. Column 2 (3) reports averages for retirees choosing an annuity (programmed withdrawal). Column 4 reports the difference between columns 2 and 3, and the level of significance is estimated using a standard t-test. For columns 5 and 6 we split the sample according to the median of returns in the six months before retirement. Column 7 report the difference between columns 5 and 6, the level of significance is estimated partialling out birth-year and acceptance-year fixed effect and clustering standard error at the birth-year level. Significant at: *10%, **5% and ***1%.

	(1) All		(2) Annuity		(3) PW		(4) Diff. (2-3)	(5) Low ret.		(6) High ret.		(7) Diff. (5-6)
All retirees	mean	sd	mean	sd	mean	sd		mean	sd	mean	sd	
Annuity	0.74	0.439	1					0.76	0.43	0.73	0.45	0.03**
Age of death (longevity)	67.5	8.2	67.4	8.2	67.8	8.0	-0.4***	67.1	8.2	67.7	8.2	-0.6**
Gender (1=Male, 0=Female)	0.81	0.39	0.81	0.40	0.82	0.39	-0.01**	0.80	0.40	0.81	0.39	-0.01
Last salary (Chilean UF)	21.6	19.4	22.3	19.3	19.4	19.2	2.9***	22.3	19.7	21.1	19.1	1.2
Accumulated balance (Chilean UF)	2410	2221	2479	1988	2214	2769	265***	2417	2144	2405	2272	12
Years contributed	22.4	7.9	22.8	7.6	21.2	8.6	1.6***	22.9	7.9	22.1	7.8	0.8
Retirement age	61.8	6.7	61.5	6.7	62.8	6.5	-1.3***	62.0	6.7	61.7	6.6	0.3***
Year of birth	1949.8	8	1949.9	8	1949.5	8	0.4***	1950.6	8	1949.2	8	1.4***
Returns (months t-6 through t-1)	0.027	0.049	0.026	0.05	0.029	0.047	-0.003***	-0.015	0.039	0.056	0.031	-0.071***
Observations	60749		44942		15807		60749	36040		24709		60749

Table 3: Longevity Sample: Summary Statistics for Standard Retirement

The table follows the format of Table 2. The sample excludes advanced retirement and disability pensions. The table reports the averages of different variables for sub-samples within the longevity database. The longevity data consists of standard age retirees who are currently deceased and who chose an annuity or programmed withdrawal (PW) at the time of retirement through the SCOMP system. Last salary is measured before retirement. The accumulated balance is total pension savings before retirement. Years contributed correspond to the number of years during which the person saved for retirement. Returns correspond to the returns on Fund C (moderate fund) in the 6 months before the retirement decision (PW or annuity). Column 1 reports the average for the whole sample. Column 2 (3) reports averages for retirees choosing an annuity (programmed withdrawal). Column 4 reports the difference between columns 2 and 3, and the level of significance is estimated using a standard t-test. For columns 5 and 6 we split the sample according to the median of returns in the six months before retirement. Column 7 report the difference between columns 5 and 6, the level of significance is estimated partialling out birth-year and acceptance-year fixed effect and clustering standard error at the birth-year level. Significant at: *10%, **5% and ***1%.

	(1) All		(2) Annuity		(3) PW		(4) Diff. (2-3)	(5) Low ret.		(6) High ret.		(7) Diff. (5-6)
Standard Retirement	mean	sd	mean	sd	mean	sd		mean	sd	mean	sd	
Annuity	0.688	0.463	1					0.71	0.453	0.67	0.47	0.04***
Age of death (longevity)	71.6	5.0	71.7	5.0	71.3	5.0	-0.4***	71.2	4.9	71.8	5.1	-0.58***
Gender (1=Male, 0=Female)	0.78	0.42	0.76	0.43	0.82	0.38	0.06***	0.78	0.42	0.78	0.42	0.003
Last salary (Chilean UF)	23.6	19.5	25.4	19.5	19.6	18.8	-5.8***	24.3	19.7	23.1	19.3	1.2
Accumulated balance (Chilean UF)	1977	1932	2027	1595	1869	2515	-158**	2003	1791	1958	2028	44
Years contributed	23.2	8.1	23.8	7.7	21.6	8.8	-2.2***	23.6	8.1	22.8	8.1	0.76
Retirement age	65.7	3.2	65.6	3.1	65.9	3.5	0.3***	65.7	3.2	65.7	3.2	-0.009
Year of birth	1946.0	5	1945.9	5	1946.4	5	0.5***	1946.6	5	1945.6	5	1.024***
Returns (months t-6 through t-1)	0.024	0.051	0.023	0.052	0.028	0.048	0.005***	-0.018	0.041	0.056	0.031	-0.074***
Observations	32768		22540		10228		32768	13822		18946		32768

Table 4: The Effect of Annuity on Longevity

The table reports regression results for the effect of annuity on longevity. Columns 1-4 report results for standard retirement choice. Columns 5-8 report the results for all retirees. All regressions include as control: last salary, accumulated balance, years contributed, dummies for retirement type (early, disability, standard), acceptance month dummies, and gender dummies interacted with birth-year and acceptance year fixed effects. Standard errors clustered at the birth-year level are reported in parentheses, and p-values are reported below standard errors. Significant at: *10%, **5% and ***1%.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Standard retirement				All retirees			
VARIABLES	Longevity	Longevity	Annuity	Longevity	Longevity	Longevity	Annuity	Longevity
Annuity	0.14***			3.36**	0.29***			2.99**
	(0.036)			(1.491)	(0.035)			(1.310)
	0.000			0.029	0.000			0.025
Returns (months t-6 through t-1)		-0.96**	-0.28***			-0.70**	-0.24***	
		(0.412)	(0.066)			(0.293)	(0.044)	
		0.025	0.000			0.019	0.000	
Regression Specification	OLS	Reduced form	1st Stage	2nd Stage	OLS	Reduced form	1st Stage	2nd Stage
Observations	32,767	32,767	32,767	32,767	60749	60749	60749	60749
F-stat			18.53				28.93	
R-squared	0.622	0.622	0.121		0.849	0.849	0.114	

Table 5: The Effect of Returns on Retirement Choice and Longevity

The table reports regression results for the effect of different returns on longevity for the whole sample of retirees (col 1-6) and the standard retirement sample (col 7-12). Returns correspond to the returns on Fund C (moderate fund) in the months before or after the retirement decision of each person. The sample includes all retirees. All regressions include as control: last salary, accumulated balance, years contributed, dummies for retirement type (early, disability, standard), acceptance month dummies, and gender dummies interacted with birth-year and acceptance year fixed effects. Standard errors clustered at the birth-year level are reported in parentheses, and p-values are reported below. Significant at: *10%, **5% and ***1%.

VARIABLES	(1) Longevity	(2) Longevity	(3) Longevity	(4) Longevity	(5) Longevity	(6) Longevity	(7) Longevity	(8) Longevity	(9) Longevity	(10) Longevity	(11) Longevity	(12) Longevity
Returns (months t-12 through t-1)	-0.76**						-0.66**					
	(0.299)						(0.263)					
	0.015						0.014					
Returns (months t-6 through t-1)		-0.96**						-0.70**				
		(0.412)						(0.293)				
		0.025						0.019				
Returns (months t-3 through t-1)			-0.38						-0.47			
			(0.850)						(0.515)			
			0.661						0.367			
Returns (months t+1 through t+3)				-0.08						-0.14		
				(0.796)						(0.557)		
				0.917						0.804		
Returns (months t+1 through t+6)					0.02						-0.06	
					(0.574)						(0.360)	
					0.974						0.861	
Returns (months t+1 through t+12)						-0.37						-0.34
						(0.553)						(0.300)
						0.512						0.264
Regression Specification				Red. form						Red. form		
Sample				Standard Retirement						All retirees		
Observations	32,767	32,767	32,767	32,767	32,767	32,767	60,749	60,749	60,749	60,749	60,749	60,749
R-squared	0.622	0.622	0.622	0.622	0.622	0.622	0.849	0.849	0.849	0.849	0.849	0.849

Table 6: Survey Evidence: Summary Stats

The table reports the number of observations and averages of different variables for retirees in the biennial CASEN survey (except for the Covid period). Retirees are men over 65 or women over 60 who are receiving non-disability pension income from an annuity or programmed withdrawal. Surveys earlier than 2011 do not ask for the source of pension income. Annuity is a dummy equal to one for an annuity. Age is measured in years. Income is the total income received by each person. Gender is equal to 1 for men and 0 for women. Mean Disability is the average of ten questions regarding problems with day-to-day activities such as eating, going to the bathroom, getting dressed, going out of the house, communicating, and others. Each response can go from 1 (no difficulty) to 5 (severe difficulty). Max Disability is the highest number across the response to the ten questions.

	(1) All		(2) Annuity		(3) PW		(4) Diff. (2-3)	(5) Low ret.		(6) High ret.		(7) Diff. (5-6)
	mean	sd	mean	sd	mean	sd		mean	sd	mean	sd	
Annuity	0.49	0.50	1		0			0.500	0.500	0.489	0.500	0.011
Age	71.5	6.9	72.1	6.7	70.9	7.0	-1.2***	71.0	6.5	71.9	7.1	-0.9***
Income (Chilean Pesos)	346,818	578,729	368,769	590,168	325,460	566,578	-43,309***	357,658	612,522	339,694	555,300	17,964
Gender (1=Male, 0=Female)	0.57	0.50	0.60	0.49	0.54	0.50	0.06***	0.569	0.495	0.570	0.495	0.001
Mean Disability	1.18	0.51	1.17	0.51	1.19	0.51	-0.02*	1.17	0.50	1.19	0.52	-0.02***
Max Disability	1.39	0.88	1.36	0.87	1.41	0.89	-0.05***	1.37	0.87	1.40	0.89	-0.03**
Returns (months t-6 through t-1)	0.024	0.061	0.023	0.062	0.025	0.061	0.002**	-0.025	0.057	0.057	0.039	-0.081***
Observations	36487		17994		18493		36487	14470		22017		36487

Table 7: Survey Evidence: The Effect of Programmed Withdrawal on Quality of Life during Retirement

This table uses the data summarized in Table 6. Returns correspond to the returns for Fund C (the only fund available since the creation of the system in 1982) between months $t-6$ and $t-1$ from the 65 (60) birthday month t for a male (female) retiree declaring to be T years old in each survey. Robust standard errors are reported in parentheses. p-values are reported below. Significant at: *10%, **5% and ***1%.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Annuity	Mean Disability	Mean Disability	Mean Disability	Max Disabilty	Max Disabilty	Max Disabilty
Annuity		-0.0144***		-0.985**	-0.0213**		-1.414*
		(0.00519)		(0.491)	(0.00880)		(0.785)
		0.00546		0.0446	0.0157		0.0717
Returns (months t-6 through t-1)	-0.117***		0.115***			0.165**	
	(0.0418)		(0.0407)			(0.0709)	
	0.00513		0.00465			0.0196	
Regression Specification	1st Stage	OLS	Reduced Form	2nd Stage	OLS	Reduced Form	2nd Stage
Fixed effects	Survey Year	Survey Year	Survey Year	Survey Year	Survey Year	Survey Year	Survey Year
Observations	36,487	36,487	36,487	36,487	36,487	36,487	36,487
R-squared	0.063	0.091	0.091		0.120	0.120	
1st Stage F-test	7.79						

Table 8: The Effect of Annuity on Longevity

The table reports regression results for the effect of annuity on longevity. Columns 1-3 report results for standard retirement choice. Columns 5-8 report the results for all retirees. Columns 1 and 4 replicate the main results; columns 2 and 3, 5 and 6, split the sample between the top balance quartile (High Balance) and all other observations (Low Balance). All regressions include as control: last salary, accumulated balance, years contributed, dummies for retirement type (early, disability, standard), acceptance month dummies, and gender dummies interacted with birth-year and acceptance year fixed effects. Standard errors clustered at the birth-year level are reported in parentheses, and p-values are reported below standard errors. Significant at: *10%, **5% and ***1%.

	(1)	(2)	(3)	(4)	(5)	(6)
	Standard retirement			All retirees		
VARIABLES	Longevity	Low Balance	High Balance	Longevity	Low Balance	High Balance
Annuity	3.36**	3.88	4.30*	2.99**	3.57	4.41*
	(1.491)	(2.829)	(2.348)	(1.310)	(3.259)	(2.381)
	0.029	0.178	0.076	0.025	0.277	0.069
Regression Specification	2nd Stage	2nd Stage	2nd Stage	2nd Stage	2nd Stage	2nd Stage
Observations	32,767	28,038	4,722	60,749	47,563	13,172
F-stat	18.53	4.994	13.43	28.93	4.009	15.41

Table 9: HRS Evidence: Summary Stats

The table reports averages of different variables for retirees in the Health and Retirement Survey. We use fully retired respondents to the surveys in 2002-2020. We compute the average for each variable across the multiple surveys where the individual appears, so each respondent is counted only once for the averages below. Any annuity means that the respondent says "yes" to the question about receiving income from annuities. Annuity>$18,000 means that annual income from annuities is higher than $18,000 (or $1,500 monthly). Mean Disability is the average number of "yes" answers to questions regarding problems with day-to-day activities such as eating, going to the bathroom, getting dressed, going out of the house, communicating, and others. Health status is a categorical variable that goes between 1 (excellent health) to 5 (poor health). The mean number of depression symptoms is the average number of "yes" answers to 8 cognitive questions (e.g.,"much of the time during the past week, you felt depressed"). The possible answers to the question about retirement satisfaction are 1 (very satisfied), 2 (moderately satisfied), or 3 (not at all satisfied). The no sports dummy is 1 if the respondent does not often take part in sports or vigorous activities. The smoking dummy is 1 if the respondent smokes. The log weight is the log of body weight in lbs. The log health expenses corresponds to the log of the amount paid for various health-related expenses. Columns 4 and 5 report the difference between averages in the previous columns. Significant at: *10%, **5% and ***1%.

	(1) Any Annuity	(2) Annuity>$18,000	(3) No Annuity	(4) Diff. (3-1)	(5) Diff. (3-2)
Mean # of disabilities (1=yes, 0=no)	0.232	0.244	0.296	0.064***	0.052***
Health status (1=excellent; 5=poor)	2.891	2.87	3.269	0.378***	0.399***
Mean # of depression symptoms (1=yes, 0=no)	1.269	1.226	1.815	0.546***	0.589***
Satisfied with retirement? (1=very; 3=not at all)	1.443	1.419	1.7	0.257***	0.281***
No sports (1= no sports; 0= yes sports)	0.581	0.594	0.627	0.047***	0.034**
Smoking (1=yes, 0=no)	0.06	0.058	0.149	0.089***	0.091***
Log weight	5.095	5.076	5.127	0.032***	0.051***
Log health expenses	5.023	5.027	4.914	-0.109***	-0.113*
Observations	2661	869	13593	16254	14462

The Effects of Annuities on Longevity

Online Appendix

A.1: The Effect of Annuity on Longevity

The table reports regression results for the effect of annuity on longevity. Columns 1-4 report results for standard retirees. Columns 5-8 all retirees including advanced retirement and disability pensions. All regressions include as control: gender, last salary, accumulated balance, years contributed, dummies for pension fund administrator, and dummies for retirement type (advanced, disability, standard); all of them fully interacted with birth-year fixed effects and acceptance year fixed effects. Standard errors are clustered at the birth-year are reported in parentheses. p-values are reported below. Significant at: *10%, **5% and ***1%.

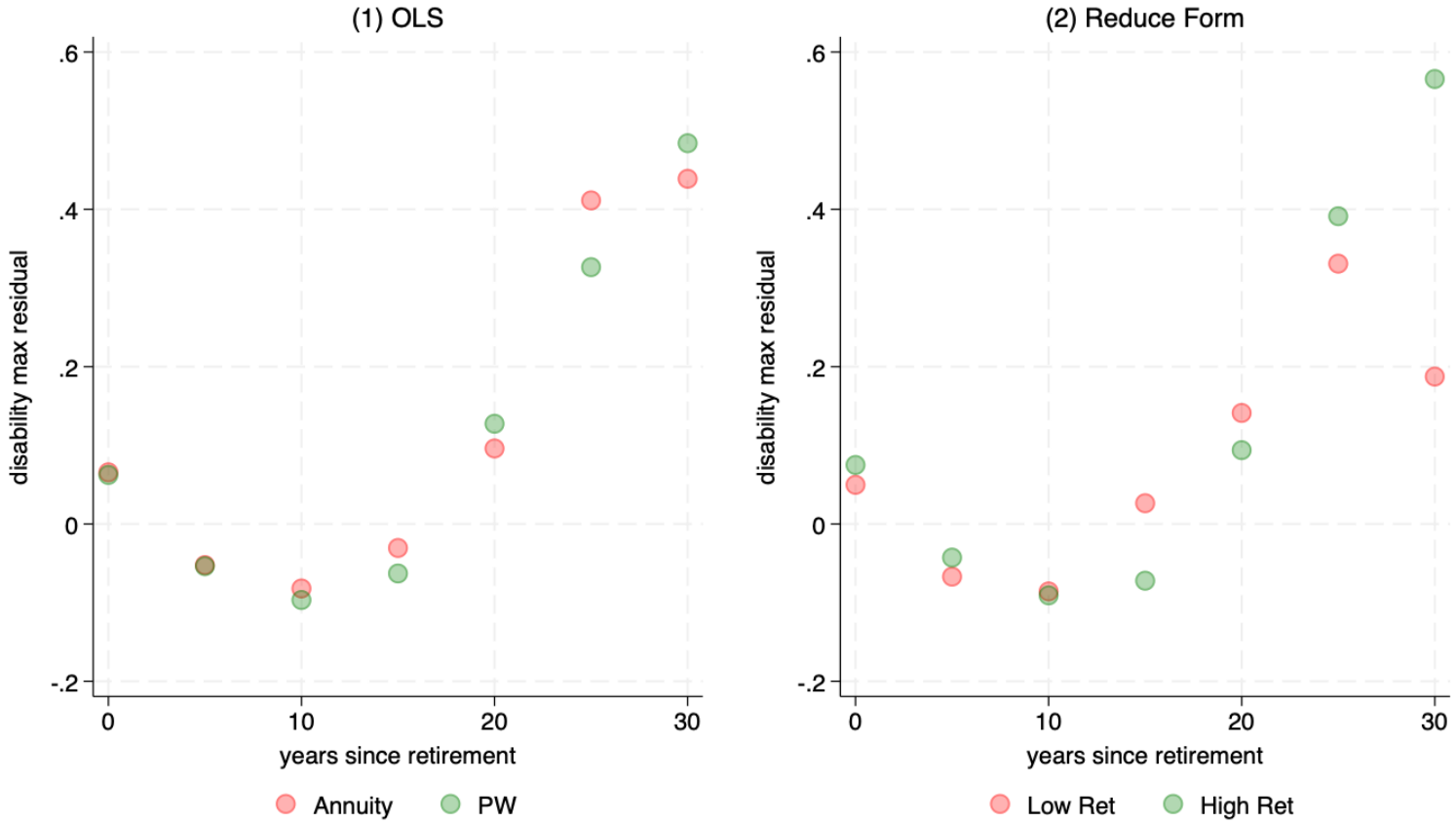
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Standard retirement				All retirees			
VARIABLES	Longevity	Longevity	Annuity	Longevity	Longevity	Longevity	Annuity	Longevity
Annuity	0.14***			3.36**	0.26***			2.67*
	(0.036)			(1.476)	(0.037)			(1.364)
	0.000			0.028	0.000			0.054
Returns (months t-6 through t-1)		-0.99**	-0.29***			-0.63**	-0.24***	
		(0.401)	(0.068)			(0.314)	(0.039)	
		0.018	0.000			0.048	0.000	
Regression Specification	OLS	Reduced form	1st Stage	2nd Stage	OLS	Reduced form	1st Stage	2nd Stage
Observations	32,732	32,732	32,732	32,732	60,696	60,696	60,696	60,696
F-stat				18.76				36.55
R-squared	0.623	0.623	0.148		0.850	0.849	0.138	

A.2: Survey Evidence: Summary Stats by Year

The table reports the number of observations and averages of different variables for retirees in the biennial CASEN survey (except for the Covid period). Retirees are men over 65 or women over 60 who are receiving non-disability pension income from an annuity or programmed withdrawal. Surveys earlier than 2011 do not ask for the source of pension income. Annuity is a dummy equal to one for annuity. Age is measured in years. Income is the total income received by each person. Gender is equal to 1 for men and 0 for women. Mean Disability is the average of ten questions regarding problems with day-to-day activities such as eating, going to the bathroom, getting dressed, going out of the house, communicating, and others. Each response can go from 1 (no difficulty) to 5 (severe difficulty). Max Disability is the highest number across the response to the ten questions.

		Annuity		Age		Total Income		Gender		Mean Disability (1-5)		Max Disability (1-5)	
Survey Year	Obs.	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
2011	14,411	0.44	0.50	72.40	6.99	286,390	474,360	0.57	0.49	1.20	0.46	1.41	0.80
2013	4,411	0.62	0.48	70.52	6.35	298,237	379,713	0.6	0.49	1.19	0.58	1.23	0.70
2015	7,465	0.58	0.49	70.76	6.60	378,213	715,387	0.58	0.49	1.13	0.49	1.31	0.87
2017	6,772	0.56	0.50	71.10	6.83	424,026	775,589	0.56	0.50	1.13	0.48	1.31	0.88
2022	3,428	0.26	0.44	71.46	7.27	442,477	299,187	0.51	0.50	1.30	0.65	1.80	1.22
Total	36,487	0.49	0.50	71.51	6.87	346,818	578,729	0.57	0.50	1.18	0.50	1.39	0.88

A.1: Disability Max Index and Time Since Retirement



Notes: Data from these figures use the CASEN survey sample. The y-axis uses the disability max index residual, obtained by regression of the disability mean index for each individual in a set of controls that includes age, gender, income, and survey year; the left panel plots the average disability max residual by annuity or program withdrawal grouping each observation using year since retirement bins of size five years, the right panel follow the same structure but divide the residual into low and high previous returns; therefore mimicking a reduce form estimation, where low previous returns are associated with higher annuity take-ups

A.3: Characterization of Compliers

This table shows the ratio of the first-stage coefficient in a subsample divided by the full-sample first-stage coefficient. Sub-samples are sample defined using a categorical variable (e.g., men, early sample) or observations above the median of a given characteristic (e.g., balance, years contributed). If the ratio of first-stage coefficients is above (below) 1, then the compliers are more (less) likely to have that characteristic than the full sample. The 95% confidence intervals for the ratio are computed through the delta method. The complier population is significantly different from the full sample (in terms of a given characteristic) if the confidence interval excludes the 1. Significant at: *10%, **5% and ***1%.

	Standard retirement				All retirees			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	men	large balance	years contributed	early sample	men	larger balance	years contributed	early sample
Ratio_Stake	0.843	2.104**	1.308	0.691	0.928	1.796**	1.606	0.581**
	(0.604 - 1.083)	(1.160 - 3.047)	(0.491 - 2.125)	(0.319 - 1.063)	(0.692 - 1.165)	(1.123 - 2.469)	(0.860 - 2.352)	(0.214 - 0.949)

A.4: Hazard Regression

This table displays the regression results from a linear probability model that examines the relationship between choosing an annuity at retirement and mortality outcomes within T years of retirement. The dependent variable (HS) is a binary indicator equal to one if an individual is deceased within T years of retirement. The table is organized into two panels: one for "Standard Retirement" and another for "All Retirees," with results presented for $T = 4$, $T = 6$, and $T = 8$. The regression specifications represent the second stage of a two-stage estimation procedure. At the bottom of the table, details on the number of observations, the mean and standard deviation (SD) of the dependent variable, and the first-stage F-statistic are provided for each specification. Standard errors are listed in parentheses below the coefficient estimates.

	Standard retirement			All retirees		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	T=4	T=6	T=8	T=4	T=6	T=8
Annuity	-0.05**	-0.08**	-0.05	-0.07**	-0.09***	-0.09**
	(0.018)	(0.034)	(0.044)	(0.028)	(0.027)	(0.040)
	0.012	0.026	0.264	0.024	0.001	0.030
Regression Specification	2nd Stage	2nd Stage	2nd Stage	2nd Stage	2nd Stage	2nd Stage
Observations	264,508	198,730	144,909	391,980	309,993	242,079
Mean of LHS	0.05	0.09	0.16	0.07	0.12	0.18
SD of LHS	0.21	0.29	0.37	0.25	0.32	0.38
F-stat	66.08	63.42	55.07	66.54	79.22	80.31