Annuities and Endogenous Longevity

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Abstract

Annuities hedge against longevity risk. Do they also have a direct effect on longevity? We address this question by investigating the annuitization choices of about 65,000 deceased Chilean retirees. Retirees are less likely to choose an annuity following high stock market returns. Using the returns around retirement as an instrument for selecting an annuity, we document that annuities increase longevity by two to five years. Using independent survey data from Chilean retirees, we confirm annuitants have better post-retirement health than non-annuitants. Our results document a significant yet overlooked benefit of annuities, which has implications for designing retirement income solutions in defined contribution plans.

Keywords: retirement; longevity; annuities

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1 Introduction

Defined contribution (DC) plans are the most common retirement plans worldwide. Retirees from DC plans have significant autonomy in managing their retirement assets, how much to save, and how to invest. This autonomy implies they also face the challenge of hedging their longevity risk. Annuities that pay a lifetime income as long as someone lives are the most straightforward solution to hedge the risk of outliving the retirement wealth. Despite their ability to hedge the longevity risk, annuities are so unpopular that economists have pointed out decades ago the existence of an "annuity puzzle."

Researchers have proposed several rational and behavioral explanations for the annuity puzzle.[1] Subjective life expectations could be an important determinant of the decision to annuitize. Studying the voluntary annuity market in the United Kingdom, Finkelstein and Poterba (2004) find that actual survival rates are associated with the types of annuities purchased, with longer-lived retirees being more likely to buy back-loaded annuities. Using more recent evidence from the English Longitudinal Study of Ageing (ELSA), O'Dea and Sturrock (2023) document that individuals underestimate their longevity and that this survival pessimism can account for the low annuity demand.

While subjective life expectations can influence annuitization, annuities can, in turn, have a direct effect on longevity. By providing a monthly income stream, annuities can reduce the risk of running out of money and financial hardship, which can have positive effects on health and longevity. Even without facing financial distress, retirees can still experience higher stress due to managing a lump sum and deciding how much to spend and how to invest. For example, retirees with a lump sum are more exposed to stock market downturns that can negatively influence their health (Engelberg and Parsons (2016)) and life expectancy. Moreover, choosing an annuity offers the ultimate incentive to improve one own health, given that annuity payments are life-contingent. In other words, retirees can exhibit a special case of moral hazard as they have an incentive to increase their longevity

[1] For a review, see Brown (2007) and Benartzi, Previtero, and Thaler (2011).

risk.

In this paper, we empirically investigate the effects of choosing an annuity on longevity. Estimating this relationship is challenging because choosing an annuity is an endogenous decision that can depend on variables unobserved to the econometrician, 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.

Using a sample of over 65,000 deceased retirees from Chile, we investigate the relationship between annuity and longevity. To account for 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.[2] In our favorite specifications with birth-cohort fixed effects interacted with all the available control variables, we find that choosing an annuity increases longevity between 2.4 and 5.5 years for all retirees and for those individuals retiring after the standard retirement age, respectively. Additional analyses using survey data confirm that retirees choosing an annuity are less prone to report suffering from disability later in life.

Studying the retirement choices in the Chilean population represents an ideal testing ground because the Chilean pension system was privatized in 1980 with the creation of a defined-contribution system with roughly 85% of workers participating in the pension system. Given the early start of the defined-contribution system, we can already observe payout choices and life expectancy for many retirees. At retirement, individuals enrolled in the pension system can choose between an annuity or leaving their retirement wealth in the pension fund and withdrawing it over time with some discretion.

[2]Analogously, Previtero (2014) documents that—because of extrapolative beliefs—after a recent increase in the stock market, retirees are substantially less likely to choose an annuity, in essence, a fixed-income product.

We document three sets of results. First, in our favorite specification with birth-cohort f.e. and their interactions with all the control variables, we find that a one-standard-deviation increase in stock market returns leads to a decrease in the probability of taking an annuity by roughly 2.5 percentage points (pp) (our first stage). As a robustness check, we present similar results using returns over the past 12 and three months before retirement. As a placebo test, we document no relationship between annuitization and future stock market returns (three, six, or twelve months following retirement). Second, when we run a 2SLS instrumenting annutization with the past six-month stock returns, we find that annuities increase longevity by 3.9 years. It is worth noting that we estimate in OLS regressions that annuities have no statistically or economically significant effects on longevity. As a robustness check, we find similar results if we restrict our analyses to individuals who retire at their standard retirement age (65 for men, 60 for women). In this sample, the concern that individuals are also choosing when to retire is mitigated. Last, using data from a biennial survey (CASEN) of Chilean households, we confirm that annuities—as instrumented by recent stock market returns—reduce the average disability score assigned several years after retirement (but not in the first few years following retirement).

Our study contributes to several strands of literature. Many researchers have posed 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, 2001). Additionally, 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 a significant yet unexplored benefit of annuities. Annuities have the potential to make us live longer. This evidence casts all the considerations about the money-worth of annuities in a different light. Insurance companies price annuities based on average life expectancy of both annuitants and non-annuitants. If annuities increase longevity, then they are indeed a better deal than previously estimated, considering that the low annuitization rates in the

population prevent these longevity gains from showing in the mortality tables.

Several studies have investigated subjective beliefs about life expectancy and actual 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. We find that the OLS estimates substantially understate the effects of annuities on longevity, suggesting that, indeed, individuals might underestimate their life expectancy.

Last, our study contributes to the literature that investigates the health effects of financial decisions. For example, Engelberg and Parsons (2016) document that stock market downturns can have negative effects on investors' health. We contribute to this evidence by showing that annuities have the potential to generate more long-term effects on retirees' health status and, ultimately, longevity.

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 US$175 billion, or close to 65% of Chilean GDP. Fund C, which started in 1980 instead of 2002, is the largest, with US$65 billion 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 the option of retiring before reaching the legal age, if the person has sufficient funds in her account to obtain a certain pension (70% of the average wage received in the last 10 years by the individual, plus other conditions). Early retirement is also an option for anyone who has been declared disabled by a medical committee of the pension regulator.

Retirees 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 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.[3] Retirees receive offers from insurance companies regarding the type of annuity contracts they have selected. Sales agents from insurance companies or financial advisors from PFAs help retirees access SCOMP, and charge a fee for their services. 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 sample. The average value of the annuity or the initial balance under PW is around 2500 Chilean UF or about 217,000 USD.[4] 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. Also, more than 75% of individuals who chose an annuity have received (paid) financial advice from an intermediary. About 16% of individuals choosing PW have

[3]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.

[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).

a financial advisor. 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 Panel A shows the fraction of retirees by calendar year who choose an annuity. Figure 3 Panel B plots the fraction by birth year cohort.

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 67.9 years, 82 % 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. The average accumulated balance is 2449 Chilean UF, or about 200,000 USD. Households in Chile, on average, contribute for 22.8 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. Retirees in this sample live longer, on average 71.3 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 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). All the controls are fully interacted with the birth-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 1 and 2, 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 uncorrelated with retirees' longevity, the estimates are insignificant and 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 1.56 to 2.05 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 0.52 and 0.29 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 1.5 to 2.5 percentage points.[5]

Finally, Table 4 columns 4 and 8 document our 2SLS specification described in equation 3. We find that annuities increase longevity between 3.9 and 5.4 years. These results are statistically significant, with p-values of 0.00 and 0.07, 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 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.[6] Importantly

[5]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 0.52*0.049=2.5% and 0.29*0.051=1.5%

[6]The only exception is column 9 with a p-value of 0.101

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 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 two-ways by birth-year and acceptance year cohorts. The results are unchanged in Table A1. We find that annuities longevity is between 2.4 and 5.5 years. These results are statistically significant, with p-values of 0.07 and 0.042, 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 7 report the result of our empirical strategy in our survey sample. Table 6 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 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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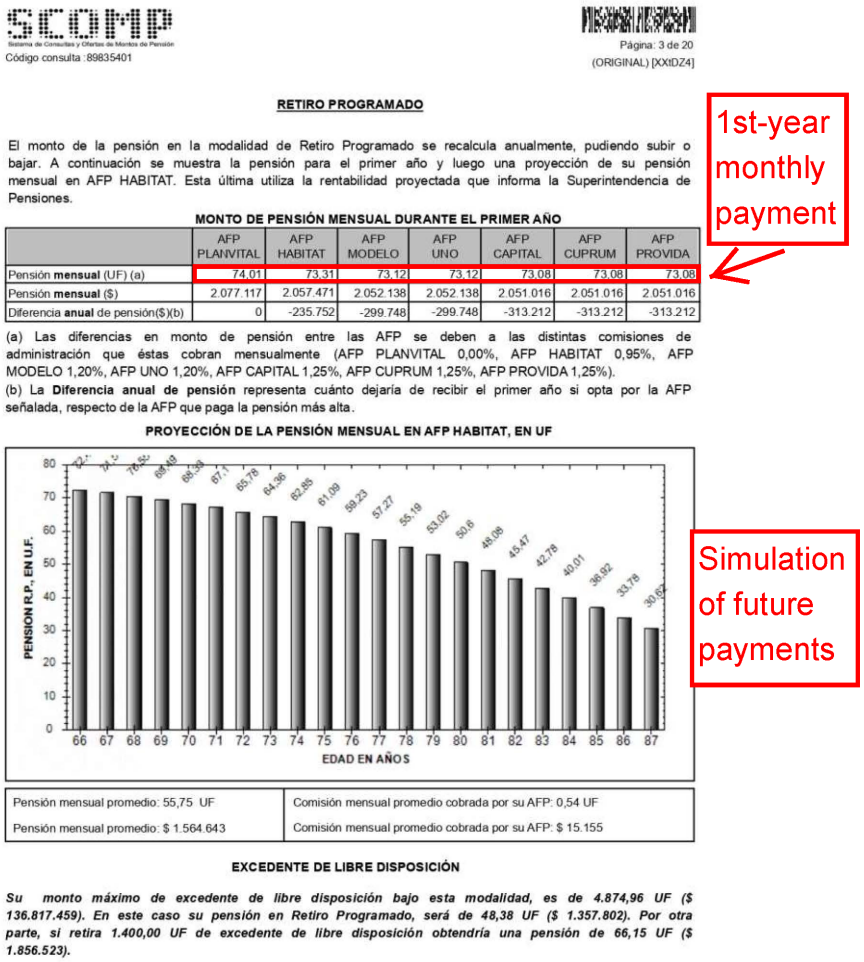
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Figure 1: Offers of Programmed Withdrawal from SCOMP



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

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(ORIGINAL) [XXIDZ4]

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).

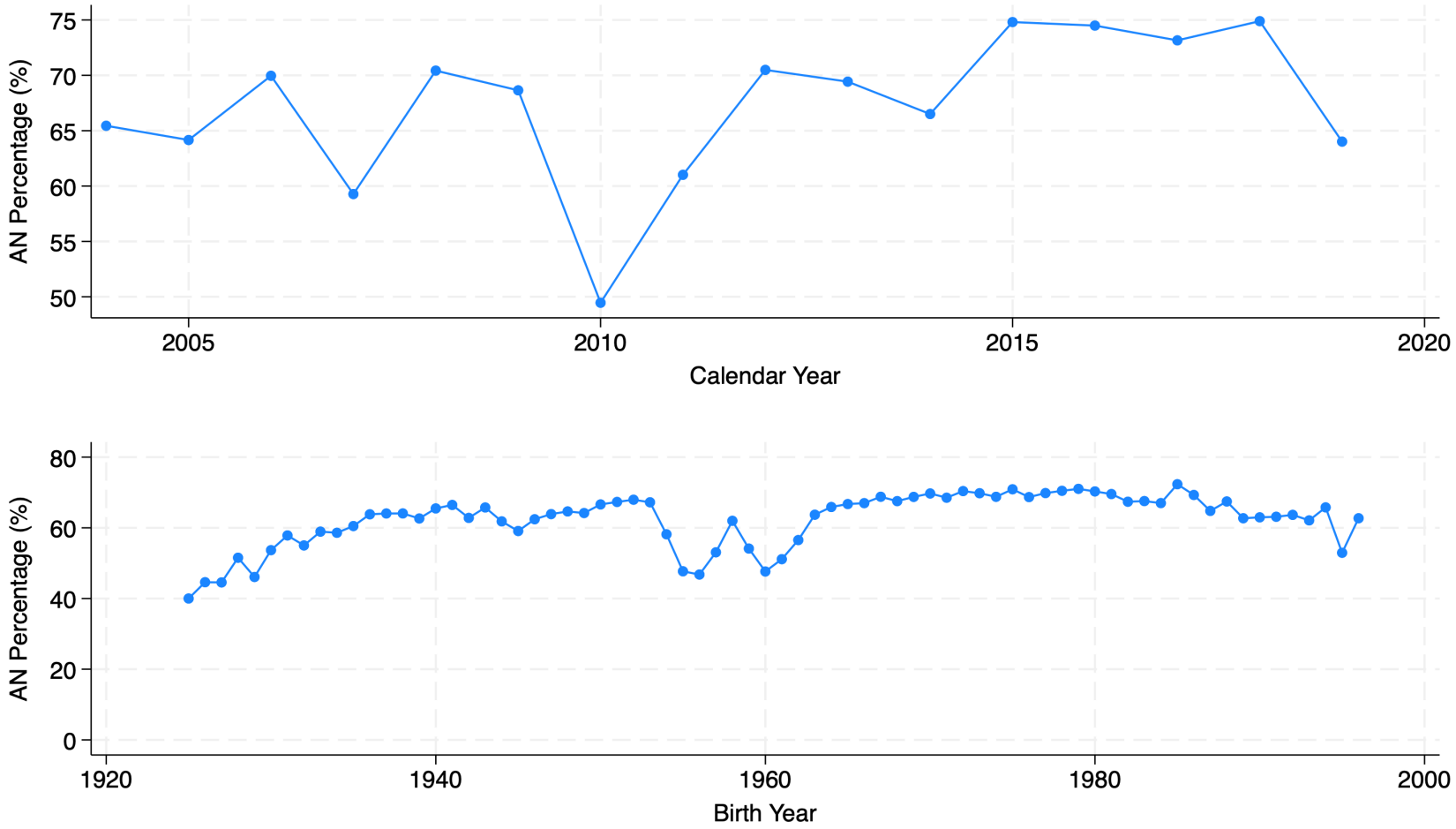
Notes: The figure shows an example of the summary of programmed withdrawal (*Retiro Programado*) offers that an individual receives from the SCOMP exchange. The 1st-year monthly payment is expressed in UFs (*Pension mensual (UF) (a)*) and pesos (*Pension mensual ($)*). Several pension fund administrators (*AFP*) make bids, and the table orders them from the least to the most expensive one in terms of fees for the individual. The difference between offers (*Diferencia anual de pension ($)(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



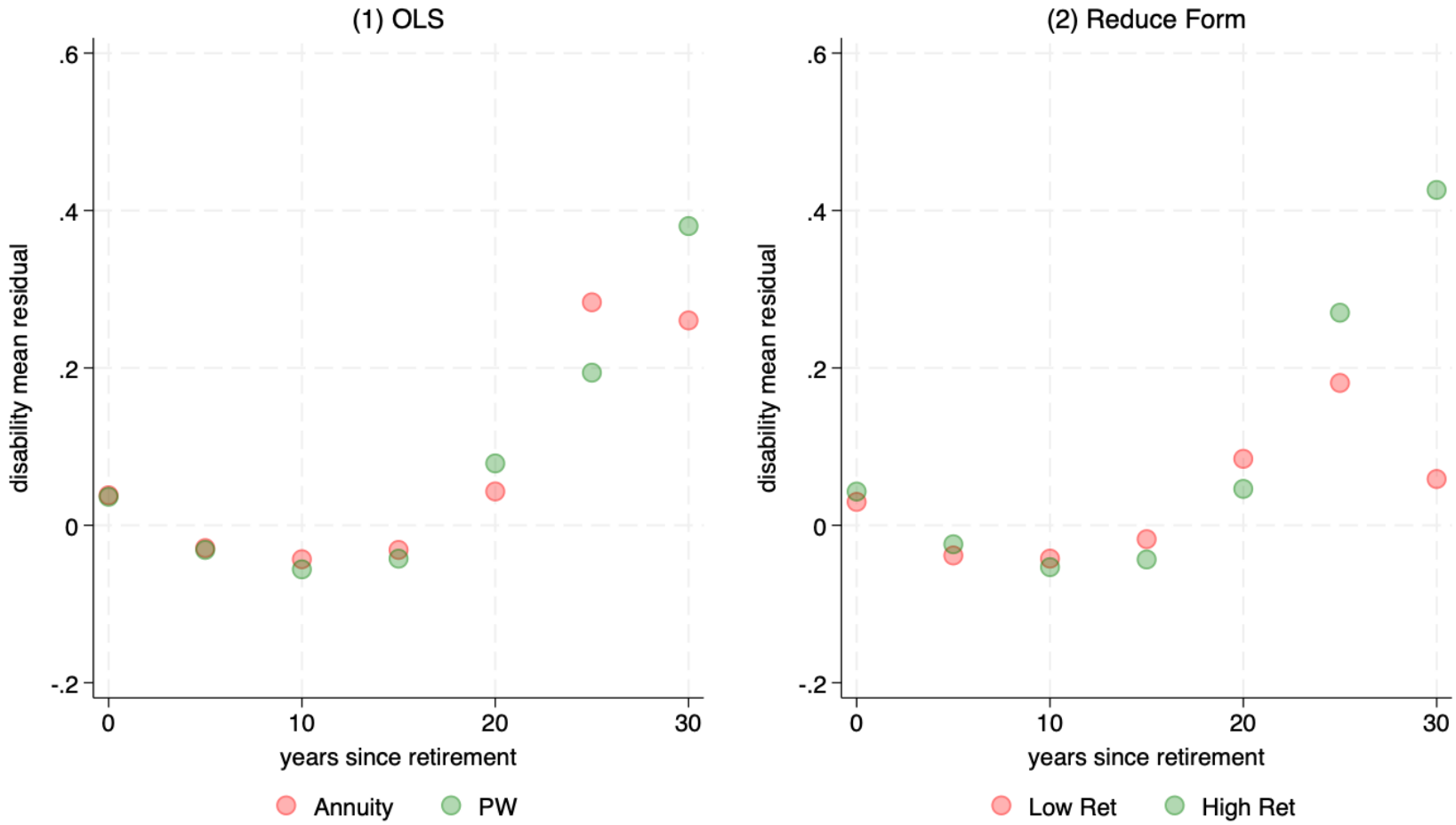
Notes: Data for this figure comes from the SCOMP database, and includes both currently alive and deceased retirees. The top left (right) corner figure represents the distribution of all men (women) retirees in the exchange sample, and the bottom left (right) represents the distribution of men (women)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

Figure 3: Annuity Take-up



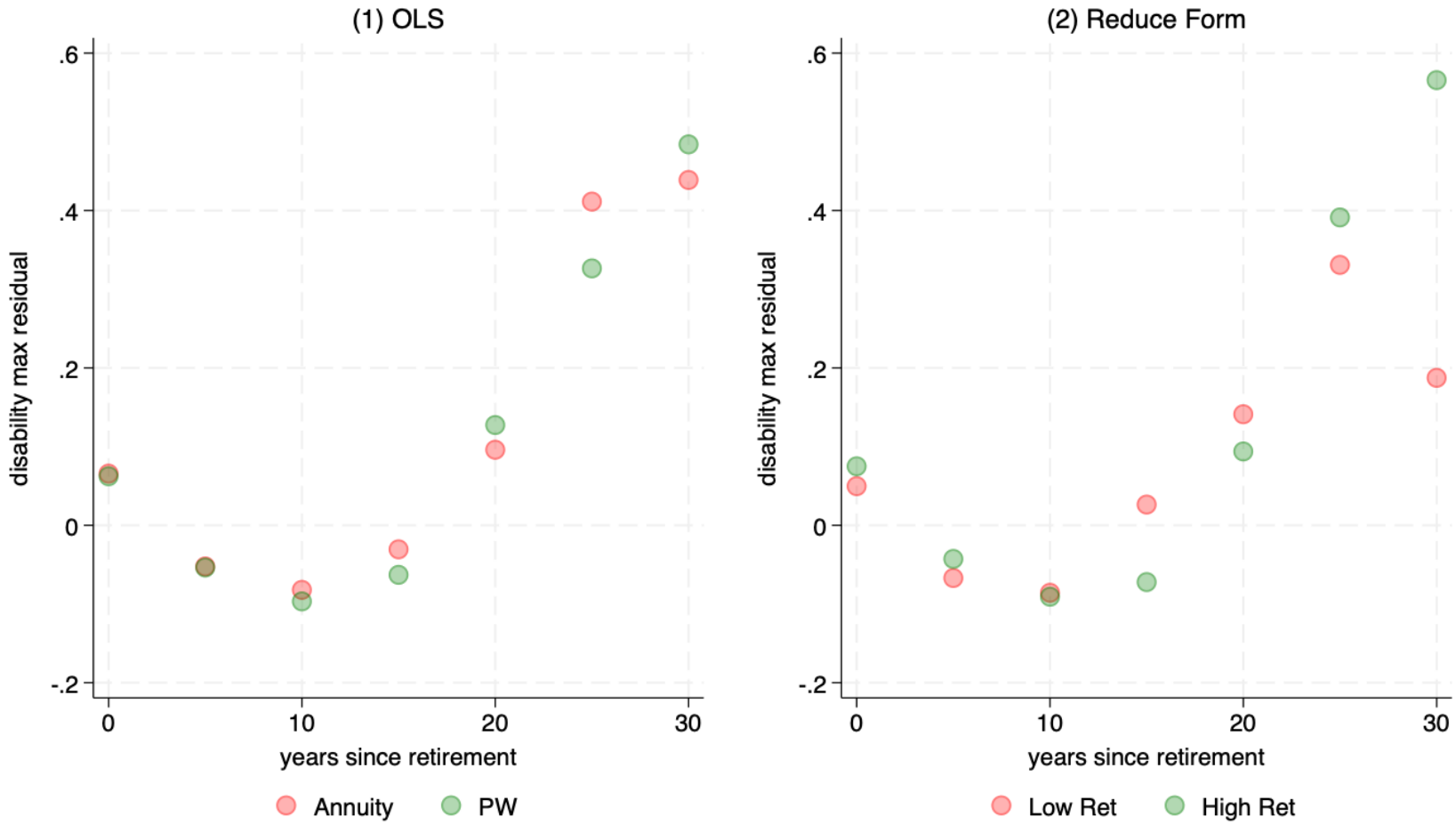
Notes: Data for this figure comes from the SCOMP database, and includes both currently alive and deceased retirees. The top panel plots the annuity take-up rate per calendar year, and the bottom panel plots the annuity rates as a function of the birth year of all retirees in our sample

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

Figure 5: 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

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	
Financial advisor (1=yes, 0=no)	0.74	0.82	0.16
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 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	0.66	0.47	1		0			0.70	0.46	0.63	0.48	0.07***
Age of death (longevity)	67.9	7.0	67.8	7.2	68.0	6.7	-0.3***	67.6	7.0	68.1	7.0	-0.5***
Gender (1=Male, 0=Female)	0.82	0.39	0.81	0.39	0.84	0.37	-0.03***	0.81	0.39	0.83	0.38	-0.02
Last salary (Chilean UF)	21.6	19.2	22.5	19.3	20.0	19.0	2.5***	22.3	19.6	21.2	19.0	1.1***
Accumulated balance (Chilean UF)	2449	3162	2479	1978	2389	4673	90**	2443	2169	2453	3695	-10
Years contributed	22.8	7.5	23.2	7.2	22.1	7.8	1.1***	23.2	7.5	22.5	7.4	0.7***
Retirement age	61.9	5.6	61.9	5.7	62.0	5.5	-0.1**	62.2	5.6	61.7	5.6	0.5***
Year of birth	1949.4	7	1949.4	7	1949.2	6	0.2***	1950.0	7	1948.9	6	1.1***
Returns (months t-6 through t-1)	0.028	0.049	0.026	0.05	0.033	0.047	0.007***	-0.014	0.039	0.057	0.031	-0.071***
Observations	64145		42381		21764		64145	26227		37918		64145

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.

	(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	0.66	0.48	1		0			0.68	0.47	0.64	0.48	0.04***
Age of death (longevity)	71.3	4.6	71.4	4.7	71.1	4.4	0.3***	71.0	4.5	71.5	4.6	-0.5***
Gender (1=Male, 0=Female)	0.77	0.42	0.75	0.43	0.81	0.39	-0.06***	0.78	0.42	0.77	0.42	0.01
Last salary (Chilean UF)	23.6	19.3	25.4	19.4	20.4	18.8	5***	24.2	19.5	23.2	19.2	1
Accumulated balance (Chilean UF)	2004	1982	2023	1560	1968	2601	55*	2012	1740	1998	2151	14
Years contributed	23.5	7.7	24.1	7.3	22.2	8.3	1.9***	23.8	7.8	23.2	7.7	0.6
Retirement age	65.4	2.6	65.4	2.6	65.5	2.7	-0.1***	65.4	2.6	65.4	2.6	0
Year of birth	1946.4	5	1946.2	5	1946.7	4	-0.5***	1946.9	5	1946.0	5	-0.879***
Returns (months t-6 through t-1)	0.024	0.051	0.023	0.052	0.028	0.048	-0.005***	-0.017	0.041	0.056	0.031	0.073***
Observations	32965		21603		11362		32965	14371		18594		32965

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 all retirees. Columns 5-8 exclude 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. 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)
	All retirees				Standard retirement			
VARIABLES	Longevity	Longevity	Annuity	Longevity	Longevity	Longevity	Annuity	Longevity
Annuity	0.03			3.92***	-0.02			5.44*
	(0.031)			(1.025)	(0.047)			(2.920)
	0.341			0.000	0.639			0.071
Returns (months t-6 through t-1)		-2.05***	-0.52***			-1.56**	-0.29***	
		(0.500)	(0.072)			(0.647)	(0.084)	
		0.000	0.000			0.021	0.002	
Regression Specification	OLS	Reduced form	1st Stage	2nd Stage	OLS	Reduced form	1st Stage	2nd Stage
Observations	64,145	64,145	64,145	64,145	31,938	31,938	31,938	31,938
F-stat			176				27.78	
R-squared	0.810	0.810	0.191		0.609	0.609	0.235	

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: 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. 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)	-1.78***						-1.08**					
	(0.360)						(0.462)					
	0.000						0.025					
Returns (months t-6 through t-1)		-2.05***						-1.56**				
		(0.500)						(0.647)				
		0.000						0.021				
Returns (months t-3 through t-1)			-2.00***						-1.21			
			(0.569)						(0.722)			
			0.001						0.101			
Returns (months t+1 through t+3)				-0.48						-0.00		
				(0.779)						(1.122)		
				0.536						1.000		
Returns (months t+1 through t+6)					-0.16						0.32	
					(0.468)						(0.681)	
					0.731						0.636	
Returns (months t+1 through t+12)						-0.07						0.07
						(0.287)						(0.565)
						0.807						0.903
Regression Specification				Red. form						Red. form		
Sample				All retirees						Standard Retirement		
Observations	64,145	64,145	64,145	64,145	64,145	64,145	31,938	31,938	31,938	31,938	31,938	31,938
R-squared	0.810	0.810	0.810	0.810	0.810	0.810	0.609	0.609	0.609	0.609	0.609	0.609

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						

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 all retirees. Columns 5-8 exclude 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 two-way clustered at the birth-year and acceptance year level are reported in parentheses. p-values are reported below. Significant at: *10%, **5% and ***1%.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All retirees				Standard retirement			
VARIABLES	Longevity	Longevity	Annuity	Longevity	Longevity	Longevity	Annuity	Longevity
Annuity	0.04			2.44*	-0.02			5.49**
	(0.030)			(1.262)	(0.045)			(2.501)
	0.224			0.070	0.689			0.042
Returns (months t-6 through t-1)		-1.10	-0.45***			-1.78*	-0.32***	
		(0.724)	(0.142)			(0.850)	(0.095)	
		0.147	0.005			0.052	0.003	
Regression Specification	OLS	Reduced form	1st Stage	2nd Stage	OLS	Reduced form	1st Stage	2nd Stage
Observations	62,709	62,709	62,709	62,709	30,230	30,230	30,230	30,230
F-stat			80.85				22.61	
R-squared	0.840	0.840	0.293		0.662	0.662	0.355	

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