Health Shocks and Annuity Choices

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Abstract

This study examines the impact of a severe health shock on annuity demand. Utilizing a quasi-experimental design with Swedish administrative data, we find that a first-time malignant cancer diagnosis near retirement age lowers annuitization rates by 5%. This corresponds to a 33% reduction in the present value of life annuities due to decreased life expectancy, indicating a suboptimal response. Our analysis shows that this effect is primarily shaped by the presence of a default option, suggesting that default-based policies can disadvantage vulnerable individuals. Additionally, we demonstrate that inattention and limited experience further explain the muted response to the health shock.

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1 Introduction

Many studies have shown that annuities have substantial value in mitigating retirees' longevity risk (Brown, 2003; Davidoff, Brown, & Diamond, 2005; Gong & Webb, 2010; Yaari, 1965). Researchers have actively sought to identify the factors that determine the demand for annuities. One such factor that has received significant attention in the literature is asymmetric information about life expectancy.[1,2] It has been proposed that individuals with a higher financial risk of living longer are more likely to purchase life annuities, as they benefit more from sharing longevity risk with others. This argument defines adverse selection in the annuity market (Bello, Brugiavini, & Galasso, 2024; Finkelstein & Poterba, 2004; Hosseini, 2015; McCarthy & Mitchell, 2010; Sheshinski, 2008). However, the existing evidence on adverse selection in the annuity market is primarily correlational, demonstrating an ex-post association between longevity and annuity choices that may be endogenously determined by other factors related to life expectancy, such as health status and risk preferences.

In this study, we leverage the timing of an unpredictable health shock with potentially severe consequences—a first-time cancer diagnosis that is known to affect subjective longevity risk (McGarry, 2022; O'Dea & Sturrock, 2021)—to investigate the causal impact of expected longevity on annuitization choices. We use variation in the timing of the unexpected shock to create two groups: a treatment group composed of retirees who experience the shock immediately preceding the annuity payout choice and just in time to re-optimize their payout plans; and a control group composed of individuals who experience the shock immediately after their payout choice when the choice is irreversible. Our identification strategy relies on the assumption that the timing of a first-time cancer diagnosis is independent of the timing of the annuity payout decision.

[1] Other potential factors influencing annuity decisions include bequest motives, the presence of public social security programs, market incompleteness, frictions, and various behavioral explanations (Benartzi, Previtero, & Thaler, 2011; Brown, Mitchell, Poterba, & Warshawsky, 2001; Hagen, Hallberg, & Sjögren-Lindquist, 2022; W. J. Horneff, Maurer, Mitchell, & Dus, 2008; Hurwitz & Sade, 2020).

[2] Adverse selection has been identified in many insurance markets (Cohen & Siegelman, 2010); for example, Cutler and Zeckhauser (1998) has identified it in the health insurance market; Ellis and Jaspersen (2024) studies in the context of life insurance lapsation; Cohen (2005) examines adverse selection in automobile insurance.

We study annuity choices within the context of a major occupational pension plan for white-collar workers in Sweden. In this plan, individuals can choose between a life annuity—the default option—and fixed-term payouts with a minimum duration of five years.[3] The insurance price (i.e., "conversion factor") is uniform for all retirees and remains unaffected by individual characteristics such as gender or health condition.[4] The financial stakes involved in this decision are substantial. The pension in question accounts for 20% of an individual's total pension income, with an average expected discounted present value (EPDV) of 57,750 USD. We merge unique administrative data on annuity choices from the pension company managing this plan with administrative records on hospitalizations and cause-specific mortality. The health data enable us to identify health shocks on a monthly basis and track subsequent mortality rates.

To validate the research design, we demonstrate that the treatment and control groups are similar across a wide range of socio-economic and health dimensions measured before the health shock. This similarity suggests that any difference in the propensity to choose a life annuity between these two groups is likely due to the causal impact of revised longevity expectations resulting from the health shock rather than other private information.

Our main findings show a significant effect of the health shock on the decision to choose a life annuity, with those experiencing more severe shocks less likely to choose this annuity. Specifically, retirees diagnosed with malignant cancer prior to retirement are 4 percentage points less likely to choose a life annuity compared to retirees in the control group diagnosed with cancer after retirement. Moreover, retirees diagnosed with digestive cancer prior to retirement, a condition associated with lower survival probability (Tuo et al., 2022), experienced a significant reduction of approximately 8 percentage points in annuitization rates. Conversely, individuals diagnosed with skin cancer before retirement, characterized by higher survival rates (Saginala, Barsouk, Aluru, Rawla, & Barsouk, 2021), exhibited a low and insignificant decrease in their annuity choices.

[3] A fixed-term payout is also known as a "years certain annuity," "annuity certain," or "term certain annuity."
[4] The conversion factor is set by Alecta and may vary from year to year. Our econometric models include year fixed effects, which mitigate concerns about its potential impact on annuity choice.

While these findings are consistent with the concept of adverse selection, the magnitude of the effect appears surprisingly low, given the known impact of a cancer diagnosis on life expectancy. To assess the implications of this effect, we compare the EPDV of the life annuity option to a five-year payout for individuals diagnosed with malignant cancer prior to retirement. We show that the ratio between these two values, often referred to as the money's worth ratio (MWR), stands at only 67%. In financial terms, this means that a retiree who receives a malignant cancer diagnosis could potentially forfeit more than $20,000 on average, by choosing a life annuity over a five-year payout option.

One likely reason for the perceived limited impact of malignant cancer on annuity choices is that the default option in our settings is a life annuity. Individuals may adhere to the default for various reasons, including the complexity of the decision and the significant effort and emotional burden involved in making an active choice during a challenging time. Research indicates that cognitive decline is often associated with a cancer diagnosis (Andreotti, Root, Ahles, McEwen, & Compas, 2015; Härter et al., 2001; Mallet, Huillard, Goldwasser, Dubertret, & Le Strat, 2018), further impeding decision-making. Additionally, if the default option is perceived as a recommended choice by trusted authorities or the norm, individuals may be less likely to reassess their financial decisions even when facing significant health adversities.

Since the default option remained unchanged during the study period, we used an experimental method to explore the mediating role of default options under changing survival expectations. Specifically, we designed and conducted an incentivized, pre-registered laboratory experiment among students. Participants were randomly assigned into two types of "longevity" treatments (i.e., high vs. low longevity) with and without defaults to study how defaults affect individuals' annuitization decisions when facing uncertain expenses. The experiment confirms that in the absence of a default option, participants with higher expected longevity chose higher annuities (the "adverse-selection" effect), relative to participants with lower expected longevity. However, when a full life annuity was set as the default option, the "default effect" masks the "adverse-selection" effect. This means that, in the presence

of a default, the reduction in longevity expectations has no impact on individuals' annuity decisions.

Using our register data, we proceeded to analyze heterogeneous responses to the health shock, exploring additional underlying mechanisms that, alongside the default option effect, may explain the relatively modest impact of a cancer diagnosis on annuity demand. Our analysis indicates that inattention is a key factor in our findings. To measure (in)attention, we used larger pension wealth and deviations from the default retirement age of 65 as proxies, assuming that individuals with more pension wealth or those who choose a non-default retirement age are more engaged in the retirement planning process therefore pay closer attention to annuity payout choices. Our results show that such individuals are significantly more likely to opt out of the life annuity in response to a health shock.

In addition, our lab findings point to the importance of experience in shaping annuity demand. In the experiment, which included two decision rounds, participants exhibited a significantly stronger response to the health shock in the second round, underscoring how interactive learning and actual experience influence decision making.

We further examine the role of additional mechanisms, including risk preference, financial education, and family risk pooling. Our results suggest that these factors do not play a significant role in shaping the cancer effect.

Our findings hold significant implications for policymakers, insurers, and financial planners. The incorporation of defaults in the withdrawal phase is a common recommendation among scholars and regulatory bodies, including the OECD (Brown, 2009; Brown & Nijman, 2012). By demonstrating that even in cases of severe illness such as cancer, where survival expectations are low, individuals still adhere to default options, we highlight the potential costs of relying on default options in such critical financial decisions. In the final section, we provide a comprehensive discussion of the study's implications and offer policy recommendations.

The remainder of the paper proceeds as follows: We introduce our settings in Section 2. In Section 3 we describe our research design followed by a discussion of our data and empirical

design in Section 4. Section 5 presents our main findings on adverse selection. Section 6 investigates the potential mechanisms explaining our results. In Section 7, we provide additional robustness tests, and Section 8 presents a discussion of policy implications and concludes.

2 Institutional Setting

2.1 The Swedish pension system

The Swedish pension system consists of two main pillars: a universal (mandatory) public pension system and a quasi-mandatory, occupational pension system, offered to workers whose employer is tied to an occupational pension plan. Individuals may receive occupational pension income from multiple plans, and hence they are required to make more than one payout decision.

2.1.1 The occupational pension plan for white-collar workers (ITP)

The focus of this study is on payout choices in the second pillar, specifically in a pension plan for white-collar workers in the private sector known as the ITP plan (short for *Industrins och handelns tilläggspension*). We study payout decisions that concern pension wealth in the *Defined Benefits* (DB) component, called ITP2. The data used in this paper do not include information on annuity choices in other pension plans.

Benefits from ITP2 depend on an individual's final wage prior to retirement. The basic replacement rate of ITP2 is 10% of the final wage. This rate applies to earnings below the so-called income ceiling in the public pension system. The replacement rate for the portion of the final wage that exceeds the income ceiling is 65%. Payments are adjusted for inflation.

Like many other DB plans, ITP2 offers limited flexibility for individual retirement savers to make personal decisions about their pensions. Savers cannot determine the amount of their contributions or choose how their funds are invested during the accumulation phase. Additionally, replacement rates are standardized and applied uniformly to all participants.

Furthermore, transferring wealth from the default managing company to another pension provider is not permitted. However, upon retirement, individuals can choose to receive their pension as either a lifetime annuity or a fixed-term payout, which we explore in greater detail in the next section.

The ITP2 pension includes a survivor's benefit tailored for individuals with higher income and is provided regardless of their withdrawal choice. The remaining pension wealth accrues to other pension plan participants.

2.2 The payout decision

In the ITP2 plan, the default payout option is a life annuity paid from age 65 onward, while the alternative options are term annuities over a fixed number of years—5, 10, 15, or 20 years (which became available to insured individuals in 2008).[5]

The value of the annuity is determined based on a conversion factor that depends on actuarial assumptions about average life expectancy at claiming age, as well as the rate of return on the pension capital. The conversion factors are, however, independent of gender and marital status, as well as health status. Fixed-term payouts therefore increase liquidity but remove the insurance against longevity.

Individuals are informed about these options through a standard retirement procedure that includes a letter from Alecta approximately 3 months before their 65th birthday.[6] The letter specifies their retirement date and estimates the income they can expect from the default payout scenario and also allows participants to indicate their preference for a fixed-term payout. Individuals are not influenced or nudged in any other manner after receiving the letter.

On the one hand, the payout letter is relatively simple to understand, and choosing a

[5]Occupational pension plans for workers in the Swedish private sector typically assume a retirement age of 65, with automatic payouts starting at that age. Pension accrual discontinuities create a strong disincentive to continue working beyond 65. Although the public pension system offers a flexible retirement age with actuarial adjustments, 65 remains a common claiming age due to eligibility for the minimum guarantee and means-tested housing benefits for the elderly, as well as strong historical norms (Hagen, 2017).

[6]See Appendix Figure F.2 for an example letter.

fixed-term payout requires minimal effort. On the other hand, the financial implications of choosing a fixed-term payout are not clearly highlighted. Specifically, on the last page of the seven-page document, it states that the monthly amount for a fixed-term payout is determined by multiplying the monthly amount of the life annuity by the appropriate conversion factor. This limited clarity of information likely increases the chance that individuals will stick with the default option of the life annuity. This argument is supported by evidence from Hagen et al. (2022) that utilized Swedish data from another pension company and demonstrates that the way alternative options are presented significantly influences retirees' annuity decisions.

Life annuities in Sweden are not transferable, renewable, or tradeable in the market. Once a payout choice is made, the decision is irreversible.[7] Furthermore, there is no option to buy an annuity later or to roll term annuities into a new annuity after the end of the chosen period. Generally, individuals are allowed to withdraw their annuity from the age of 55, with no upper age limit for initiating a payment.[8]

3 Research Design and Empirical Model

3.1 Quasi-experiment

Our empirical strategy relies on existing literature that points to the notion that life annuity choices are primarily dictated by risk type (Cutler, Finkelstein, & McGarry, 2008; Einav, Finkelstein, & Schrimpf, 2010; Finkelstein & Poterba, 2004; Rothschild, 2009). Accordingly, we define the probability to annuitize as a function of actual longevity, assuming all else equal, as follows:

$$Prob(\text{Life annuity}_i = 1) = f\left(\text{Longevity}_i\right), \tag{1}$$

[7]The presence of non-reversible decisions in pension systems is not unique to Sweden. Similar features can be found in several other countries, including Switzerland, the Netherlands, the UK, and the United States (Murthi, Orszag, & Orszag, 2000; van Marle, 2013).

[8]Additional institutional details are available in Appendix A.

where Life annuity$_i$ is a binary variable for whether the individuals chose a life annuity upon retirement, and Longevity$_i$ is the underlying longevity risk.

The ideal experiment for studying the impact of longevity risk types on annuity choices would involve randomly assigning shocks that modify longevity risk to individuals *before* retirement and tracking their annuitization decisions. This experiment would allow examining the causal effect of a change in risk type on annuity demand by comparing the response of individuals who experienced the shock with similar others who did not.

We utilize a quasi-experimental research design that approximates this ideal experiment. Our design leverages the potential randomness in the timing of a severe health shock of a cancer diagnosis that occurs within a short period around retirement. We form two experimental groups based on the timing of the severe health shock: a treatment group, composed of individuals diagnosed with cancer in the period of Δ pre-retirement and a control group composed of individuals who experienced a similar shock at the period Δ post-retirement. Our choice of Δ is three years,[9] which implies that we focus on individuals who received a first-time cancer diagnosis within a six-year period surrounding their retirement. The identification assumption underlying our analysis is that the timing of the malignant cancer diagnosis in this period around retirement is as good as random. We return to this assumption in Section 4.4.

3.2 Empirical model

Using the first-time cancer diagnosis shock we examine the hypothesis that a change in an individual's longevity expectations cause a change in annuity choice. Specifically, we define variable D_i as an indicator that takes the value of 1 if retiree i has experienced a diagnosis of cancer before making an annuity choice and 0 otherwise. We utilize the diagnosis in a binary choice model as follows:

[9]The trade-off in the choice of Δ is the comparability of the experimental groups—presumably higher when Δ is smaller—against the sample size. We assess the robustness of our analysis to the choice of Δ and find that modifying it between one and three years yields similar results, as presented in Appendix Table F.1.

$$Prob(\text{Life annuity} = 1) = Prob\left(\alpha + \tau D_i + \beta X_i + \varepsilon_i\right), \tag{2}$$

where the outcome variable Life annuity takes the value 1 if retiree i chose the life annuity and 0 if she/he chose a 5- or 10-year fixed-term payout. The 15- and 20-year fixed-term payout options were omitted due to their low popularity, with only 3% of individuals opting for them.[10]

The vector X_i comprises an extensive range of control variables that have the potential to impact the annuity decision. These variables include demographic factors such as gender, marital status, number of children, and highest level of education (elementary, high school, or college/university degree). Additionally, the vector incorporates a comprehensive set of health-related factors including the average number of days of hospitalizations in each year (before retirement/diagnosis [from 1990]); the average number of unique drugs consumed by each individual (at the 3-digit ATC level per year [between 2005 and 2015]); a variable that indicates whether an individual has received sickness benefits before retirement/cancer diagnosis (from 2003); where sickness benefits are received in cases of absence from work for more than 14 days; and a variable that indicates whether an individual received disability pension before claiming ITP2 [between 2008 and 2015]. These health-related variables are important in capturing individuals' underlying health status that may influence the annuity choice.

We further control for retirees' financial positions through records of individuals' average disposable income five years before retirement, and real and financial assets in 2007. This enables us to address the concern that wealth is positively correlated with longevity (Finegood et al., 2021) and to preclude the potential bias that arises from retirement wealth being part of a portfolio problem (Hurwitz & Sade, 2024). Finally, we include dummy variables for claiming the ITP2 pension before the default age of 65 and for withdrawing from the public

[10] An alternative dependent variable could have been the realization of the payment duration. However, due to constraints related to data availability, we only have access to health records and death registry information up to the year 2015. We also confirmed that including the 15- and 20-year fixed-term payout options as a life annuity choice yields consistent results.

pension.

Inclusion of this rich covariates set is informative in determining how much of the private information about longevity risk can be attributed to private knowledge about one's characteristics (pre-shock), beyond the adverse selection effect (ruling out moral hazard). The error term ε_i is assumed to be uncorrelated across individuals.

We estimate the model using a *logit* procedure and calculate the marginal effect to facilitate interpretation. This estimation exploits time variation in the health shock to identify the effect of a decrease in longevity risk due to an unexpected cancer diagnosis on annuity choice as represented by the key parameter of interest, τ. Specifically, τ allows us to test the hypothesis of asymmetric information, in which $\tau < 0$ indicates adverse selection, with more negative values of τ signaling a stronger adverse selection-effect.

4 Data

4.1 Data sources

We utilize data from Alecta, a major occupational pension company that administers pension contributions and payouts for private-sector, white-collar Swedish workers under the ITP pension plan. Alecta is one of the largest owners on the Stockholm Stock Exchange and the fifth-largest pension fund in Europe. Our dataset consists of information on 241,896 of Alecta's retirees born between 1943 and 1953. The dataset records retirement choices from May 2008 through December 2015 and importantly, it includes information on the year and month each retiree claimed their occupational pension and the chosen payout length.

For each retiree we extract demographic variables from the Longitudinal Integration Database for Health Insurance and Labour Market Studies (LISA) obtained from Statistics Sweden, which covers the entire Swedish population between 1990 and 2014. This database includes information about gender, age, education, sources of income, employment status, and marital status. The data contains wealth information, including financial assets and housing, between the years of 1999 and 2007. Additionally, this database also allows us to

match retirees with their biological parents.[11]

We utilize three additional databases provided by the Swedish National Board of Health and Welfare. First, we use the National Patient Register that covers all inpatient and outpatient hospitalizations from 1990 to 2015.[12] For each hospitalization event, the database includes details on arrival and discharge dates along with detailed diagnoses using the International Classification of Diseases (ICD) codes, which enables us to identify specific health shocks and their precise timing. Second, we use the Causes of Death Registry from 1969 to 2015 that indicates the exact death date and specific cause of death for each person, classified using the ICD coding system. This information allows us to identify whether the cause of death was cancer, which we leverage to assess heterogeneity in the impact of a change in survival probability on annuity choice. Moreover, by combining cause-of-death data with our retiree-parent matches, we construct a supplementary proxy for risk type based on parental ages and causes of death, which we utilize to strengthen our main analysis. Third, we use the Prescription Drug Register, that contains detailed information about all over-the-counter sales of prescribed medicine from 2005 to 2015. For each record, the dataset indicates the type of medicine (using the Anatomical Therapeutic Chemical [ATC] classification system), and the purchased quantity. We use this data to derive a metric that quantifies an individual's drug consumption and the diversity of drugs they consume, enabling us to assess overall health.

4.2 Defining the health shock

The term "first-time cancer diagnosis" denotes an individual's initial cancer-related record in either inpatient or specialized outpatient care, starting from the year 1990 and onward. We categorize individuals with a cancer diagnosis as having low longevity risk, and those with no such diagnosis as having high longevity risk. Additionally, we distinguish between diagnoses

[11] Information on parents' date of birth and mortality is available for 91.5% of the sample. The remaining 8.5% have parents who never lived in Sweden and do not show up in the registers for this reason. These individuals are excluded from the sample in some of our relevant analyses.

[12] Since we do not observe health information among those who retired after December 2015, only individuals diagnosed before retirement are present in our analysis.

of malignant tumors (classified under ICD-10 code C), benign tumors (classified under ICD-10 code D), and classifications of specific cancer types, which enables us to examine the relationship between risk type levels and the likelihood of investing in annuities.

We focus on a first-time cancer diagnosis as a health shock because such diagnoses have been demonstrated to significantly impact individuals' mortality—and thus subjective survival probabilities—leading to a change in perceived risk type. For instance, McGarry (2022) found a significant decline in self-reported survival probabilities to a target age of 75 among older individuals diagnosed with cancer, and O'Dea and Sturrock (2021) reported that a new cancer diagnosis caused a significant 4 percentage points decrease in survival expectations. The prevalence of this health shock across genders and socio-economic groups (A. S. Ahmad, Ormiston-Smith, & Sasieni, 2015) makes our analysis relevant for a large share of the population, as cancer is the second leading cause of death both in the U.S. (F. B. Ahmad & Anderson, 2021) and in Sweden (Debiasi, Dribe, & Brea-Martinez, 2021).[13]

4.3 Sample restrictions and descriptive statistics

We conduct our analysis on 30,062 individuals that were diagnosed with cancer 3 years around retirement (hereafter referred to as the "Cancer Sample"). Table 1 presents descriptive statistics of the full sample of retirees claiming their ITP2 pension between 2008 and 2015, as well as a description of the cancer sample.

TABLE 1

The primary outcome variable is the choice of a life annuity, as described in the first row of Table 1. Column 1 shows that out of the entire sample, 74% of employees chose the life annuity, which is consistent with the pattern observed in the cancer sample, presented in Column 2. This rate is similar to that of other countries with mandatory pension schemes, such as Chile (Illanes & Padi, 2019). Table 1 further shows that the share of employees out of the whole sample who chose the 5-year payout was 16% and slightly higher at 17% in the

[13] A recent study by (Døskeland & Kvaerner, 2022) explores how a similar health shock—a first-time cancer diagnosis—affects households' willingness to take risks with their financial wealth.

analysis sample, while the share of employees who chose the 10-year payout stands on 7% in both samples. The remaining 3% of the population selected fixed-term payouts of either 15 or 20 years.

Table 1 provides further information on a variety of variables. The variable *Pension from Alecta* represents the yearly amount of the occupational pension the retirees received from Alecta, which is slightly higher in the cancer sample relative to the entire sample and stands at approximately SEK 60,000, comprising around 20% of an individual's total pension income. The yearly benefit of the ITP2 component is approximately SEK 40,000, for both samples. Using standard population life tables from Statistics Sweden (2009-2013) and assuming pension payouts commence at age 65, the EPDV of the average ITP2 pension is calculated to be SEK 519,750 (approximately USD 57,750) (see Section 5.2 for further details on the EPDV calculation method). The EPDV of the average ITP2 pension can be benchmarked against the average financial wealth—covering bank accounts, stocks, funds, and other securities outside the pension system—which amounts to SEK 566,572 (approximately USD 63,000). Due to the significant variation in financial wealth, log transformations are applied in the subsequent empirical analyses.

The average claiming age of 64.7 suggests a strong tendency to adhere to the default payout age of 65. The *Early withdrawal* variable, representing the proportion of individuals who claimed their pension before the normal retirement age of 65, reveals that 14% of the sample retired early with only a small fraction opting to claim after age 65. This proportion was similar among the cancer sample. The share of retirees who received a disability pension in the year before the ITP2 decision was 16% for both the overall sample and the cancer sample. Similarly, the proportion of retirees claiming their public pension in the year prior to the ITP2 decision was 26% for the overall sample and 27% for the cancer sample.

Table 1 also reports a comprehensive set of demographic statistics that are mostly consistent across the entire sample and the cancer sample. In both samples, the average age at claim was 65. Sixty percent of the retirees were male in the entire sample and 63% in the cancer sample. Similarly, a majority were married, with 63% in the entire sample and 66%

in the cancer sample. On average, retirees in both groups had an average of two children and comparable educational backgrounds. However, retirees in the cancer sample were slightly wealthier in terms of financial and real assets compared to those in the entire sample.

Table 1 further presents health-related information, showing a similar rate of sickness benefits in the entire sample and the cancer sample. Additionally, hospitalizations and drug utilization rates were slightly higher in the cancer sample relative to the entire sample. The table also illustrates that the age and income of the retirees' partners were comparable across both samples, and approximately 35% of retirees in both samples had at least one parent who died from cancer. Finally, the table presents mortality rates within two and five years from claiming retirement. As anticipated, mortality rates are higher among the cancer sample for both time periods, highlighting the severity of the shock.

4.4 Research design validation

The identifying assumption of our analysis is that the timing of a cancer diagnosis relative to the annuity payout decision is effectively random—that is, whether it occurred before or after the payout decision. This suggests that the treatment and control groups should be comparable in all respects except for the diagnosis timing and the resulting decision outcome. To assess this assumption, Table 2 compares the two groups along various dimensions including demographic, health, and financial characteristics.

TABLE 2

The table indicates that retirees in the two groups are similar in terms of demographic variables, including age, marital status, education, and number of children. Although the proportion of males is slightly higher among those diagnosed after retirement (i.e., the control group), the difference is economically insignificant.

A potential concern is that individuals may possess private information shaping their decision to claim retirement early, which could result in endogenously biased estimates. This concern can be addressed by examining retirement timing. Specifically, observing no

difference between the groups in retirement timing is crucial, as it indicates that a cancer diagnosis does not trigger earlier withdrawals. Reassuringly, the table indicates that 14% of individuals in both the treatment and control groups opted to withdraw early (before the age of 65).[14]

Table 2 shows a comparison between health-related characteristics, which are measured prior to diagnosis. The evidence indicates that individuals did not have prior knowledge of their future cancer diagnosis. This is reflected in the similarity between the groups in hospitalization days, the number of unique drugs taken, and disability pension claims. Additionally, the proportion of retirees with a parent who passed away from cancer is similar in both groups. While there is a statistically significant difference in sickness benefits, the difference is economically negligible. Moreover, mortality rates are comparable between the treatment and control groups, with 6% (11%) mortality within 2 years (5 years) for individuals diagnosed before retirement, and 5% (12%) for those diagnosed after retirement.

Finally, another concern may arise regarding whether individuals diagnosed with cancer had prior knowledge about their likelihood of diagnosis, which could have impacted their perception of longevity risk and prompted financial actions. This issue is particularly relevant for the control group that were assumed not to have anticipated the health shock. Table 2 addresses this by showing that individuals diagnosed *after* retirement have annuitization rates at around 75%, which is similar to the general population. In contrast, those diagnosed *before* retirement, who likely adjusted their behavior in response to the health shock, exhibit an annuitization rate of 72%.[15]

Overall, Table 2 confirms that our quasi-experiment creates treatment and control groups that are balanced in demographic characteristics and healthcare-utilization patterns and validates our research design.

[14] Figure F.1 supports this by demonstrating that the average claiming age remains close to 65, regardless of the timing of the cancer diagnosis.

[15] A comparison between individuals with cancer (diagnosed at any time relative to retirement) with those without cancer, separately for annuitants and non-annuitants, provides further justification for the identification assumption, as shown in Appendix Section B.

5 Adverse Selection in the Annuity Market

5.1 Effects of cancer diagnoses

Table 3 displays the marginal effect coefficients of the binary choice models derived from Eq. (2). Column (1) shows that individuals diagnosed with *malign cancer* were about 4 percentage points less likely to choose a life annuity relative to individuals diagnosed post-retirement, supporting the hypothesis of adverse selection in the annuity market.[16] Column (2) indicates that a benign-tumor diagnosis reduces the likelihood of annuitizing by just 2.3 percentage points. Columns (3) and (4) illustrate the correlation between cancer severity and the response, further validating the adverse selection phenomenon. Column (3) shows that a diagnosis of digestive cancer, which is associated with low survival probabilities, leads to a significant 8.6 percentage points decrease in the demand for life annuities. In contrast, Column (4) demonstrates that a diagnosis of skin cancer, which has effective treatments and thus a smaller impact on survival probabilities, results in no significant change in annuity demand.[17]

TABLE 3

Figure 1 visualizes the results shown in Table 3 over time, by plotting the share of retirees who chose life annuities by the time of the cancer diagnosis relative to their pension-claiming time. This figure, as well as all the following figures, shows the marginal effect with the corresponding 95% confidence intervals. The x-axis denotes the diagnosis month relative to the pension-claiming month, normalized to period 0, and the y-axis denotes the share of retirees that chose the life annuity option.

[16] The results remain robust when excluding high income individuals defined as those in the fourth quartile of the gross income distribution), mitigating concerns about the potential impact of tax considerations on annuity choices.

[17] The results presented in this table remain consistent when estimating a model without control variables as indicated by the t-test in Table 2. Moreover, the findings remain consistent when parental longevity is included in the set of control variables, as well as when the sample is restricted to individuals without prior hospitalization records (healthy individuals), as show in Appendix Table F.2. Furthermore, including an interaction term between the treatment effect, D_i, and the control set ,X_i, does not change our main estimates.

FIGURE 1

Figure 1a provides a clear visual representation of the impact of a malignant cancer diagnosis on the likelihood of choosing a life annuity, which is significantly lower among those diagnosed with cancer before retirement. The figure further shows that the effect of diagnosis on the annuitization decision is uniform regardless of the timing of the diagnosis. This means that those diagnosed *before* retirement consistently exhibit a lower propensity to choose a life annuity regardless of when the diagnosis occurred. One potential explanation of this evidence is that the long-term implications of a malignant cancer diagnosis become deeply embedded in an individual's behavior and decision-making processes, potentially linked to the adoption of "survivor's identity" (Deimling, Bowman, & Wagner, 2007; Stein, Syrjala, & Andrykowski, 2008). This evidence alleviates concerns that individuals diagnosed only shortly before retirement might not be responding due to psychological reasons.

Figure 1b visualizes the effect of benign-tumor diagnosis over time. It illustrates the lower impact of such tumors, suggesting that they are generally considered less problematic compared to malignant ones (Patel, 2020).[18]

5.2 Financial implications of health shock responses

Table 3 shows that individuals respond to a malignant cancer diagnosis by reducing their demand for life annuities by 4 percentage points. To provide a more comprehensive understanding and quantify the implications of this estimate, we calculate the monetary implications of the adverse-selection estimate. Specifically, we adopt the approach introduced by Hagen (2015), who calculated the expected present discounted value (EPDV) of a life annuity and compared it with the EPDV of the five-year payout option. The EPDV of payout

[18] Sada et al. (2021) studied malignant vs. benign insulinoma and showed that survival probabilities for 120 months among patients diagnosed with benign insulinoma are close to 90%, while survival probabilities for individuals with malignant insulinoma are less than 60%.

option p purchased by an individual at age a with cancer type c is given by:

$$EPDV^{p}_{a,c}(B) = B^{p,c} \sum_{i=1}^{T} \pi_{a,a+1,c}(1+r)^{-i}, \tag{3}$$

where $\pi_{a,a+1,c}$ represents the probability of someone living i more years based on cancer-specific, life-tables estimates,[19] $B^{p,c}$ denotes the average annual gross benefit received by individuals diagnosed with each cancer type c under payout option p, r is the discount rate, and T represents the payment duration, which is determined using the cancer-specific life tables we constructed for the life annuity option. If the retiree selects the five-year payout option, T is fixed at a duration of five years. Based on these calculations, we compute the money's worth ratio (MWR), which is the ratio of life annuity EPDV to the five-year payout option EPDV.[20]

TABLE 4

Table 4 summarizes the results derived from Eq. (3) and indicates that for individuals diagnosed with any form of malignant cancer, the average EPDV of a life annuity is USD $44,455. In comparison, the average EPDV for the five-year payout option for the same group is USD $66,012, implying that the life annuity option EPDV amounts to only 67% of five-year payout option EPDV. Consequently, choosing a life annuity results in an average financial loss of USD $21,558 for those diagnosed with malignant cancer. Table 4 further shows that for individuals with digestive cancer, the average life annuity EPDV is comparatively lower at USD $38,423, while the average EPDV for the five-year payout option is higher at USD $60,565. These substantial financial differences indicate a significant loss, underscoring the economic significance of severe health shocks on the value of life annuities.

We also examine how each type of cancer affects the demand for life annuities in relation to corresponding changes in annuity prices, to provide a proxy for annuity demand elasticity.

[19] Section C in the Appendix details the methods used to create these cancer-specific life tables.

[20] As described in detail in section 2, the pension provided in the ITP2 layer includes a survivor's benefit that is granted regardless of the withdrawal choice; hence, it should not impact the comparison between the alternatives.

The reduction in MWR of a life annuity attributable to a specific cancer diagnosis is shown in Column (6), with a significant decrease amounting to a reduction of 32.7%.[21] Meanwhile, a diagnosis of malignant cancer results in a 5.7% decrease in the proportion of individuals opting for a life annuity (Column 7). The ratio presented in Column (8) provides an estimation of the elasticity of annuity demand in response to changes in its relative price. In the case of malignant cancers, this results in an elasticity of 0.175.[22] In addition, considerable disparity exists in the observed price elasticity across various cancer types. For instance, skin cancer demonstrates the lowest price elasticity at 0.05, whereas digestive cancer exhibits the highest at 0.34.

6 Mechanisms

The previous section indicates that the modest adverse selection effect we document leads to a substantial financial loss. We now explore the underlying mechanisms contributing to this effect, assisting in its interpretation. Subsection 6.1 describes an incentivized laboratory experiment we devised to study the impact of a default option on the adverse-selection effect. Subsequent subsections (6.2, 6.3, 6.4, and 6.5) explore heterogeneous responses to the health shock, focusing on the roles of attention, financial literacy, risk preference, and family risk pooling in explaining the adverse selection effect.[23]

6.1 Defaults

A notable feature of the Swedish annuity market is the existence of a default option. Prior literature has shown the substantial effect of maintaining defaults in a range of markets,

[21] As shown by Hagen (2015), the baseline MWR for an individual with an average life expectancy at age 65 is approximately 1.

[22] Bütler, Staubli, and Zito (2013) reported a 16.8% decrease in the demand for life annuities in response to a reduction of 7.9% in annuity value, implying higher demand elasticity compared to our findings. Meanwhile, Chalmers and Reuter (2012) observed a restrained reaction in the demand for annuities to changes in prices, indicating a limited elasticity. While the aforementioned studies concentrated on variations resulting from changes in actual prices or conversion factors, our methodology diverges by examining price shifts resulting from exogenous variations in life expectancy.

[23] Details about the estimation procedure is provided in Appendix Section E.1.

including savings plan participation, pension contributions, asset allocation, rollovers, and decumulation (Beshears, Choi, Laibson, & Madrian, 2009). Default options are not exclusive to Sweden. For example, in Switzerland, annuitization serves as the default option in many funds, although it is not universally adopted across all of them, and its implementation has been observed to increase annuitization rates (Bütler & Teppa, 2007).

The notion of incorporating defaults in the withdrawal phase are a common recommendation among scholars, including Brown (2009), and Brown and Nijman (2012). Moreover, various regulatory bodies, such as the OECD, have been advocating for incorporating default options during the payout phase.[24]

Experimental studies offer mixed results regarding the role of defaults in annuitizaiton choices. While an Australian experiment by Bateman et al. (2017) find a substantial impact of defaults on annuity choices, findings from an American experiment by Agnew, Anderson, Gerlach, and Szykman (2008) indicate that defaults did not significantly affect decisions.

Default options have the potential to mitigate adverse-selection and various behavioral biases while still allowing individuals the freedom to make their own choices. However, the impact of defaults on individuals with very low longevity risk, such as those with severely impaired health (as in our study), remains uncertain. Building on the aforementioned findings and the widespread recommendations to incorporate default options in annuity markets, we took a new approach and conducted an incentivized and pre-registered lab experiment that randomized longevity expectations treatments and tracked individuals' investment in annuities both with and without defaults.

6.1.1 Laboratory experiment design

Our experimental design consists of two rounds of a computerized task in which participants were asked to allocate funds between a life annuity (providing lifetime payments for the retiree) and a lump sum. The design is built upon the framework proposed by Hurwitz and Sade (2024) and Hurwitz, Sade, and Winter (2020), which integrates uncertainties in partic-

[24] https://www.oecd.org/daf/fin/private-pensions/designingfundedpensionplans.htm

ipants' longevity expectations and future consumption as well as considerations of bequest motives (Bernheim, 1991; Friedman & Warshawsky, 1990; Inkmann, Lopes, & Michaelides, 2011; Lockwood, 2012; Mitchell, Poterba, Warshawsky, & Brown, 1999; Reichling & Smetters, 2015), with the novel addition of default options. To streamline the task for participants, we opt to exclude certain real-world factors such as interest rates and taxes.[25]

Experiment participants are randomly assigned to either low- or high-longevity conditions, with or without a default option, resulting in four different treatment groups.[26] Participants who randomly assigned to the default treatment receive an initial value of a full annuity in the field designated for entering their choice and requires them to actively modify it if they desire. Those assigned to the no-default treatment were not presented with any default option on the decision screen initially.

To introduce uncertainty about longevity, participants in all conditions are informed that a computer will draw their life expectancy from a predefined distribution. We select a simplified distribution to ensure that this uncertainty remained reasonably understandable. Specifically, for participants randomly assigned to the high-longevity condition, the computer draws life expectancy from a range spanning 0 to 400 months, with an average of 200 months. In contrast, for those in the low-longevity condition, life expectancy is drawn from a set ranging from 0 to 200 months, with an average of 100 months. Although these figures do not represent precise survival probabilities, their purpose was to illustrate the concepts of uncertainty about longevity and variation in survival expectations among individuals, while keeping the information and decision-making process as straightforward as possible. Importantly, despite variations in longevity expectations across different conditions, the annuity pricing remained uniform, with the annuity conversion factor set to 200 on a monthly basis for all conditions.[27]

The experiment further incorporates uncertainty about future expenses. Participants in

[25] Translation of the instructions from Hebrew to English is provided in Appendix Section D.

[26] We had originally planned to also include a very low-longevity treatment in our study but encountered challenges with participant recruitment that prevented its inclusion.

[27] This is equivalent to 16.6 on a yearly basis, representing the price of the annuity. As a result, some participants may perceive the annuity as unfair, similar to how individuals with impaired health might perceive it in reality.

all conditions were informed that their monthly consumption would be either 3,000, 6,000, or 9,000 "Zuz," with these amounts being evenly distributed. To simplify the decision-making process, the consumption level was kept constant for each participant and could not be adjusted throughout their lifetime.

Mirroring real-life circumstances, participants are informed that the results of both the survival and consumption draws would only be revealed after they had made their payout choice, leaving them uncertain about the exact amount needed before making their decision. Under this setup, individuals must make retirement payment choices based on their expectations of longevity and future consumption, both of which can vary.

Throughout the experiment, we track participants' monthly balances, taking into account their choices and variable realizations. Surpluses, are accumulated (when monthly income exceeded consumption), while deficits are deducted from the lump sum when possible. Participants receive a show-up fee of 30 NIS, with an additional 20 NIS awarded if their account balance remains non-negative at the end of the experiment. Furthermore, any monthly surplus or unused lump sum allocated for consumption was added to participants' final payments, a feature explained in detail at the start of the experiment. This compensation feature aims to reflect bequest motives, which are known to impact annuitization decisions (Lockwood, 2012). Given that retiring without income or savings is highly undesirable, participants face penalties for depleting all their funds. If the annuity and remaining lump-sum withdrawal are insufficient to cover consumption costs, participants received only the show-up fee.

The experiment is structured as follows. First, all participants receive verbal instructions and complete two task examples to ensure understanding. Before starting the experimental task of fund allocation, participants provide demographic information. The fund allocation task consists of two rounds conducted under identical conditions to account for potential learning effects. Finally, participants answer additional demographic questions.[28]

[28]See Appendix D for complete description of the experiment details.

Participants and summary statistics

All experiment participants are students at the Hebrew University of Jerusalem and Tel-Aviv University and recruited through advertisements and emails from the academic staff. Participants ($N = 165$) are randomly assigned to one of four treatment ($n = 41; n = 41; n = 42; n = 41$). The mean age of participants is 26 years, and 57% are female. A comparison between the treatment groups reflects similarities in personal characteristics between the treatment groups. Despite randomization, there is a difference in age between the groups and a discrepancy in years of education for Treatment Group 4. As a result, we include these variables as controls in the regressions.[29]

TABLE 5

Experimental results

Table 5 presents the main experimental results, combining both rounds of the experiment.[30] Panel A shows the impact of low longevity on the decision to fully annuitize measured by a dummy variable that equals 1 if participants chose to annuitize their entire fund and 0 otherwise. This outcome variable is similar to the one used in the main analysis with administrative data. Panel B presents the analysis on the amount of money allocated to the annuity.

Columns (1) and (2) present the results for the entire experiment sample, highlighting the decrease in demand for life annuities when longevity expectations are low. Notably, when the sample is split into those who face a default payout option and those who do not, the estimates clearly reveal the source of the low longevity effect. Specifically, the estimates in Columns (3) and (4) show a small reduction in annuity demand in response to lower longevity expectations when a default option is available. This evidence align with the cancer effect observed in the administrative data. In contrast, Columns (5) and (6) demonstrate that low longevity significantly reduces the demand for life annuity when no default option is

[29] See Appendix Section D.2 for description of a comparison between the treatment groups.
[30] An analysis examining each round separately is presented in Section D.3.

available.[31] This key result suggests that the default option significantly masks the impact of longevity expectations and helps to explain the relatively muted cancer diagnosis response observed in the administrative data.

6.2 Attention

Pension capital. Lack of attention to an annuity decision could further help explain the limited response to the health shock. Previous research documents a reduced inclination to annuitize smaller funds, potentially due to less attention to such funds (Benartzi et al., 2011; Bütler & Teppa, 2007; Hagen, 2015; Hurwitz & Sade, 2024). In the context of our study, the effect of attention (or lack thereof) would imply that individuals with smaller accounts are less affected by a cancer diagnosis, particularly in light of the default option. This finding may be because they are more likely to adhere to the default option or because they exhibit less concern about the outcome.

TABLE 6

Building on this argument, we assess the impact of attention on the annuitization decision by comparing the response of individuals with small vs. large accounts to a malign cancer diagnosis using our Swedish data (see Section 4 for details). We categorize individuals in our cancer sample into three groups based on the value of their ITP2 pension under the life annuity option at the time of retirement: upper, middle, and lower. We then define those in the upper group as having "large" pension capital, and those in the lower group as having "small" pension capital. Our findings, detailed in Tables 6, reveal that the response to a malign cancer diagnosis is significantly stronger among individuals with large pension capital. Individuals with large pension capital diagnosed with cancer before annuity claiming are 6.5 percentage points less likely to annuitize compared to those diagnosed afterward. In contrast, the corresponding effect for the group with small pension capital is -2.4 percentage

[31] To enhance external validity, we conducted an additional online survey with 600 U.S. residents aged 40–60 using Prolific (www.prolific.ac) in July 2024. Participants provided advice on a withdrawal decision of USD 100,000 to vignette individuals with different expected longevity. The results reaffirm the impact of default options.

points. This evidence shows that the relatively small effect of a malign cancer diagnosis partly results from inattention.[32]

Claiming age. To further delve into the role of attention, we examine individuals who actively opt for early or late retirement. As shown in Panel B of Table 6, the likelihood of choosing the life annuity is 10.6 percentage points lower for those who retire early or late. In contrast, for those who claimed their pension at the default payout age of 65, the diagnosis leads to only a 2.9 percentage points reduction in the demand for life annuities.

These findings suggest that, while a cancer diagnosis does not directly trigger early retirement (see Section 4.4 for further discussion), attention plays a significant role in shaping the response to the cancer diagnosis shock. Individuals with higher attention–proxied by those who actively plan their retirement age–are more likely to consider the financial implications of their diagnosis, presumably by paying closer attention to their financial decisions, thus making better annuity choices.

6.3 Financial literacy and practical experience

Financial education. Financial literacy could potentially explain the small effect of receiving a cancer diagnosis on annuity choice. Individuals may lack a full understanding or awareness of the financial implications of their choices, and this lack of knowledge could lead individuals to opt for life annuities regardless of the change in their survival probability.

To explore this explanation, we utilize administrative data on individuals' educational study majors and overall educational background. Specifically, we analyzed the response to a malignant cancer diagnosis among individuals majoring in financially related subjects, such as finance, economics, business administration, accounting, taxation, or teacher training in any of these fields, as a proxy for financial literacy. Individuals' primary education topic is determined based on the highest completed level of education, beginning with high school and progressing to higher levels. We then compare how individuals with and without such

[32] Appendix Section E.2.1 presents an alternative measure of attention based on the value of retirees' ITP2 pensions.

study majors respond to the cancer diagnosis.[33]

The analysis presented in Panel C of Table 6 reveals that a cancer diagnosis impacts the decision to annuitize for both individuals *with* and *without* financial education. While the response is higher among those with a financial education, the difference is not statistically significant. Specifically, the diagnosis leads to a 4 percentage points reduction in the demand for annuities among individuals without a financial education, whereas those with this education experience a reduction of 4.9 percentage point. This finding shows that the financial illiteracy mechanism is weak in explaining the small adverse-selection effect.

Prior experience. The lab experiment allows us to shed light on whether practical experience helps individuals make more informed annuity decisions. We exploited the structure of having two rounds to study whether participants made more knowledgeable decisions in the second round, assuming that the first round provided them with hands-on experience. The results are striking, showing that the outcomes of the second round yielded a significantly higher response to the longevity shock.[34] In the first round, before gaining actual experience, participants had low responses to the longevity shock. In the second round, after gaining experience and understanding the financial consequences of their choices, the response to the longevity effect was stronger and yielded better outcomes.

This evidence indicates that a lack of actual experience with financial decisions could explain the low adverse-selection effect. It complements the results from the early withdrawal analysis, which indicates that awareness of financial planning and knowledgeable decision-making are crucial for benefiting individuals. This evidence is also important for policymakers aiming to improve welfare at retirement, a concept we elaborate on in Section 8.

6.4 Risk preference

We further aim to understand how risk preferences impact responses to a cancer diagnosis. We draw on prior research suggesting that the likelihood of buying insurance is influenced

[33]The categorization we employ, is based on the following International Standard Classification of Education (ISCED) codes: 340, 343, 344, 314, and related 145, available at https://www.ung.si/public/doc/mednarodni/ISCED_Code.pdf.

[34]Appendix Tables D.2 and D.3 present the results.

by risk preference (De Meza & Webb, 2001; Fang & Wu, 2018) in addition to risk type, as previously explored in relation to long-term care and health insurance (Finkelstein & McGarry, 2006).

To evaluate risk preferences in our context, we leverage financial information to construct a proxy based on wealth volatility. This proxy is grounded in the idea that an individual's risk preferences impact their financial portfolio composition, particularly the allocation of high-risk assets, resulting in variations in portfolio volatility over time. Importantly, as suggested by previous literature, changes in wealth do not affect the proportion of portfolios invested in risky assets (Brunnermeier & Nagel, 2008), which is crucial for the validity of our proxy. However, we acknowledge that our assessment relies on an ex-post realization, and an alternative approach could involve measuring risk preferences directly from individuals' financial portfolios, although such information is currently inaccessible to us.

Our aim is to focus on volatility derived from financial wealth resulting from differences in investment returns rather than from changes in income or deposits. To achieve this, we estimate a regression model with a financial wealth logarithm as the dependent variable, and an income logarithm as well as a lagged wealth logarithm as independent variables, following a method similar to Atkeson and Irie (2020).[35] We use the standard deviation of the residuals from this regression as a proxy for risk preferences. Portfolios with volatility above the 80^{th} percentile of the distribution of these residuals are defined as high volatility portfolio, indicating risk tolerance, while those with lower volatility are classified as risk-averse.[36]

The results, presented in Panel D of Table 6, reveal that the entire response to a malignant cancer diagnosis originates from risk-averse individuals. Specifically, those diagnosed before retirement are approximately 4 percentage points less likely to purchase annuities compared to those diagnosed after retirement. Interestingly, the estimate indicates that risk

[35] We limit the sample to individuals who maintained positive financial wealth in every year between 1999 and 2007, the period during which the wealth register was available.

[36] For robustness, we replicate the analysis, by defining risk-tolerant individuals as those with volatility above the 50^{th}–70^{th} percentiles, and the results of this analysis are robust and available from the authors upon request.

tolerant individuals did not change their demand for life annuities due to the cancer diagnosis. To address the concern that negative changes in wealth on risk preferences impacts risk preferences, we conducted the same analysis on a sub-sample of individuals who exhibited a positive average change in wealth during the same period. This analysis yielded similar results, mitigating such concern.[37]

Considering the similarity in magnitude of the effect for risk averse with the effect documented in the main analysis, the results suggest that risk preferences alone are not the primary force behind the small adverse-selection effect. Risk-averse individuals would typically value the protection annuities provide against longevity risk, which suggests they are likely to be less responsive to the shock. Yet, the fact that their response to a cancer diagnosis is similar to that of the general population, and the observing that the response is greater than the response of risk-loving individuals, points to risk preference not being a primary factor explaining the low response. Our findings support the prior literature suggestion that among some, annuities are perceived more as investment tools rather than as insurance against longevity risk (Brown, Kling, Mullainathan, & Wrobel, 2008).

6.5 Family risk pooling

Next, we examine the effect of marital status on responses to health shocks, drawing on the concept of family risk pooling. Previous literature has suggested that the utility gain from annuitization is smaller for couples than for single individuals, because married individuals can pool their longevity risk (Kotlikoff, Shoven, & Spivak, 1986; Kotlikoff & Spivak, 1981). If this mechanism accounts for the low response to the malign cancer diagnosis observed in the data, we would expect that married individuals' diagnosis response would be significantly stronger.

To study this issue, we focus on married vs. single individuals (including divorced and widowed) and examine their differential response. As shown in Panel F of Table 6, we find that the reduction in demand for a life annuity following a health shock is slightly *smaller*

[37]The results pertaining to heterogeneity in risk preferences remain robust without controls.

among married individuals compared to single individuals, which is contrary to expectations (although this difference is not statistically significant). Thus, our results suggest that family risk pooling does not significantly explain the small adverse-selection effect.

6.6 Other mechanisms

We acknowledge that other mechanisms may impact individuals' responses to a cancer diagnosis. For instance, the mental burden following such a diagnosis could impair cognitive capacity and make it more difficult to navigate complex financial decisions, which may result in suboptimal outcomes. Furthermore, increased emotional stress could diminish focus on proactive decision-making. Although our current data set does not enable a direct examination of these alternative pathways, they represent important avenues for future research.

Another potential mechanism to consider is the interplay between social norms and salience relative to decision avoidance amid abundant choices. In the Swedish pension system, age 65 has traditionally been a significant milestone. During the period of our study, most public and occupational pension withdrawals were initiated at this age, which also marked eligibility for the minimum pension and other elderly welfare benefits (The Swedish Pensions Agency, 2024). On one hand, strong norms surrounding this age could increase individuals' attentiveness and preparedness for retirement decisions, enhancing the salience of this decision phase. On the other hand, the abundance of decisions triggered by these norms might lead individuals to default to the standard option or avoid making an active choice altogether. Similar norms exist in many countries, making this tension between norms and decision fatigue relevant across various contexts. The combined impact of these tensions likely shapes individuals' responses to a health shock in complex ways, and the overall effect of these interacting channels remains unclear, warranting further exploration.

7 Supplemental Analysis

7.1 Proxying for risk type using parental longevity information

In this section, we extend our previous findings to include white-collar workers who have not been diagnosed with cancer. Individuals' annuity decisions often rely on imperfect indicators of their actual longevity, such as their dietary habits, level of physical activity, and parents' longevity (Beauchamp & Wagner, 2020; Bloom, Canning, Moore, & Song, 2006; Hamermesh, 1985; Hurd, McFadden, & Gan, 1998; Hurd & McGarry, 1995). We use parental information that is likely known to individuals well in advance of retirement to proxy for longevity risk. This analysis has the benefit of providing us with a broader view of the impact of risk type on annuity choice.

To construct the parental longevity proxy for risk type, we begin with the full sample of 241,896 white-collar workers (see Section 4) and then apply several restrictions. First, we exclude individuals whose parents died from external causes such as accidents or specific injuries to avoid measurement bias. Second, we use same-gender information to construct the proxy, meaning that subjective survival probabilities were calculated based on maternal longevity for females and paternal longevity for males. This approach accounts for the gender gap in life expectancy (Pinkhasov et al., 2010; Rochelle, Yeung, Bond, & Li, 2015; Waldron, 1993) and the evidence that individuals rely more heavily on the longevity of their same-gender parent when forming subjective survival probabilities (Liu, Tsou, & Hammitt, 2007). We omit the lower tail of the parental death age distribution at the 10^{th} percentile to account for the significant decline in mortality among young individuals over the past century (Crimmins, 1981; Hoekelman & Pless, 1988). Last, we exclude 6,630 individuals who opted for a 15- or 20-year payout. This results in sample of 188,525 individuals. We classify individuals with high-longevity risk as those with parental longevity above the median and individuals with low-longevity risk as those with parental longevity equal to or below the median.

TABLE 7

We implement the binary choice models in Eq. (2) such that the variable D_i in Eq. (2) is an indicator that equals 1 if retiree i has low parental longevity, and 0 otherwise. The key parameter of interest in Eq. (2) is τ, which captures the relationship between longevity risk and the propensity to choose life annuity.

Column (1) of Table 7 presents the marginal-effect estimates of the analysis and shows that retirees with low-risk types are 2 percentage points less likely to choose a life annuity at retirement. This estimate provides evidence that supports our previous findings, demonstrating a significant yet low impact of longevity expectations on annuity decisions.

7.2 Exploring gender differences

We study the link between risk type and demand for annuities by gender. In Columns (2) and (3) of Table 7 we report results showing that the decrease in life-annuity demand following a health shock of women is 5.4 percentage points and of men is 3.5 percentage points. This means that the decrease in life annuity demand among women is about 1.5 times higher than for men. Although these differences are not statistically significant, several factors suggest that responses to a cancer diagnosis may vary by gender. First, risk preference may play a role. Prior literature indicates that attitudes toward risk vary significantly by gender, with men generally exhibiting greater risk tolerance than women (Borghans, Heckman, Golsteyn, & Meijers, 2009; Byrnes, Miller, & Schafer, 1999; Watson & McNaughton, 2007). Interestingly, the results showing that women respond more proactively than men to a malignant cancer diagnosis suggest that risk aversion is not the primary factor driving this effect, aligning with the findings presented in Section 6.4.

Second, different types of cancer and survival probabilities are distributed differently across genders. Our data indicate that severe cancer types, such as digestive cancers, are similarly distributed between men and women, making this explanation less salient. Additionally, the perception of the risk and consequences associated with cancer may differ by gender.

Last, previous studies suggest that males have higher cancer incidence and lower survival

rates than females (Cook, McGlynn, Devesa, Freedman, & Anderson, 2011; Siegel, Miller, & Jemal, 2019). However, other studies, such as Micheli et al. (1998), show that although women generally tend to survive longer than men following a cancer diagnosis, this trend reverses for cancers diagnosed at older ages. In conclusion, while the differential responses of males and females to a cancer diagnosis are intriguing, exploring the underlying factors contributing to these differences is beyond the scope of this study.

8 Discussion and Conclusions

In this study, we analyze the impact of a severe health shock—a cancer diagnosis—on the demand for life annuities. We compare annuity choices of retirees who experience the shock just before making their payout decision with a control group who experience the shock immediately after their decision, when the choice is irreversible. This quasi-experimental approach allows us to establish a causal link between expected longevity and annuity choices, drawing on the identification assumption that the timing of a first-time cancer diagnosis is independent of the timing of the annuity payout decision.

Utilizing data from a major occupational pension provider in Sweden, combined with detailed information on retirees' demographics, mortality, and healthcare utilization, we first show that retirees diagnosed with cancer immediately *before* retirement exhibit a significant decrease of 4 percentage points in annuitization rates compared to those diagnosed immediately *after* retirement. Based on cancer-specific life tables developed for this study based on the entire Swedish population, we further show that this reduction in demand for annuities leads to a significant financial loss. Specifically, for an average person diagnosed with malignant cancer before retirement, opting for a life annuity results in a loss of USD $21,558 (which reflects a Money Worth Ratio (MWR) of only 67%). These analyses contribute to the ongoing scholarly discussion regarding adverse selection in the annuity market, enhancing our understanding of how health shocks affect the demand for annuities and illuminating the welfare implications of these effects.

We proceed by exploring the potential mechanisms that contribute to the relatively small

adverse selection effect. We designed an incentivized, pre-registered laboratory experiment, that simulates the annuitization decisions under conditions of varying longevity expectations and default options. The results of the experiment show that the default option masks the response to private longevity information. Specifically, when individuals face a default option, the longevity risk information does not impact annuity decisions. This result contributes to the literature studying the heterogeneous effects and limitations associated with setting a default options in various pension choices (Agnew et al., 2008; de Bresser & Knoef, 2025), highlighting the potential caveats associated with the common default-based policies.

Importantly, the tendency to incorporate default options in annuity markets has become increasingly prevalent, aligning with the broader trend of utilizing defaults in public policies across all stages of the pension life cycle (Brown, 2009; Brown & Nijman, 2012). The use of default options is not unique to Sweden. For instance, in Switzerland, annuitization serves as the default in many funds (although not universally across all funds) (Bütler & Teppa, 2007). Recently, the ERISA Advisory Council to the U.S. Department of Labor discussed the idea of making lifetime annuities a default option.[38] Moreover, the inclusion of default options during the payout phase became a common regulatory recommendation as highlighted in the OECD road-map for well-designed defined contribution pension plans: *"A certain level of annuitization of balances accumulated in DC pension plans should be set as the default mechanism for the payout phase, unless pay-as-you-go public pensions or the old-age safety net already provide for sufficient regular pension payments."*[39]

Our findings suggest that while default options offer significant benefits for many, they may disadvantage vulnerable populations, contributing to regulatory discussions aimed at increasing demand for longevity insurance. This raises important equity considerations. For example, individuals with impaired health may be disproportionately affected by default settings, leading to less favorable outcomes. While defaults can reduce complexity and promote better decision-making in certain contexts, they may inadvertently fix adverse selection

[38] https://www.plansponsor.com/erisa-advisory-council-explores-annuity-default-options-in-dc-plans/?sfnsn=wa

[39] https://www.oecd.org/daf/fin/private-pensions/designingfundedpensionplans.htm

problems by locking in less optimal outcomes for such individuals.

Given our results, one possible recommendation, supported by studies like V. Horneff, Maurer, and Mitchell (2020), is to default participants into deferred annuities in which some portion of pension savings purchases an annuity that starts payments around age 80, while the remaining money is available as a lump-sum. This suggestion targets increasing demand and allows individuals to purchase longevity insurance while maintaining flexibility.

Beyond the impact of default options, our analysis underscores the importance of attention to how individuals respond to health shocks. An equity perspective would also encourage us to consider how different groups' responses to health shocks—whether due to financial constraints, risk preferences, or cognitive biases—are influenced by default options and whether tailored interventions are needed. The findings suggest that default policies, while beneficial to some, may exacerbate disparities in annuity uptake and financial outcomes. Tailored interventions, such as financial education or advisory services, could play a key role in mitigating these effects.

Specifically, we recommend complementing default options with initiatives designed to improve individuals' attention to annuitization decisions and their understanding of the implications. Such interventions could include targeted educational programs and informational nudges alongside the claiming decision that are aimed at enhancing awareness and knowledge in the years leading up to retirement.

Finally, although real-life decisions typically offer only a single opportunity to make this choice, our findings suggest that actual experience can significantly enhance annuity decisions. This is because participants' choice demonstrated more knowledgeable decisions and clearer understanding of their choices during the second round of the experiment. One approach could be to implement accessible simulations that illustrate the money worth ratio or other straightforward statistics reflecting the value of specific payout options under different longevity scenarios. By leveraging the salience and practical experience generated through these simulations, the inclusion of professional advice could further support prospective retirees in making more informed choices.

Additional research is needed to evaluate the effectiveness of strategies aimed at improving retirees' decision-making at the point of retirement, particularly concerning health shocks. Based on our results, we identify several potential interventions, including interactive simulations and hands-on financial education programs, to help individuals navigate the complexities of annuitization under uncertain health conditions. We also recommend tailored advice and decision aids to increase attention and enhance the salience of the decision. Furthermore, we suggest adopting a policy of deferred annuities rather than unequivocally advocating for default options. These strategies could benefit large segments of the population, potentially leading to positive externalities that enhance overall social welfare.

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Table 1: Descriptive Statistics

	(1) All			(2) Cancer Sample		
	Mean	SD	N	Mean	SD	N
Life annuity	0.74	0.44	241896	0.74	0.44	30062
5-year payout	0.16	0.37	241896	0.17	0.37	30062
10-year payout	0.07	0.25	241896	0.06	0.24	30062
15- or 20-year payout	0.03	0.18	241896	0.03	0.18	30062
Pension from Alecta (SEK/year)	60079	82124	241896	65491	88208	30062
Pension from ITP2 (SEK/year)	40242	60727	241896	44241	66533	30062
Public pension (SEK/year)	156223	55761	175446	159816	54966	24019
Total pension (SEK/year)	304609	196843	175446	320980	211610	24019
Age (at claim)	64.72	0.91	241896	64.76	0.87	30062
Early withdrawal	0.14	0.35	241896	0.14	0.34	30062
Disability pension	0.16	0.36	241896	0.16	0.37	30062
Claimed public pension	0.26	0.44	241896	0.27	0.44	30062
Male	0.60	0.49	241896	0.63	0.48	30062
Married	0.63	0.48	241896	0.66	0.47	30062
Single	0.11	0.31	241896	0.10	0.30	30062
High school	0.48	0.50	241896	0.48	0.50	30062
University	0.32	0.46	241896	0.34	0.47	30062
Number of children	1.89	1.13	241896	1.90	1.12	30062
Financial assets (SEK)	566572	3658554	241896	602340	3366966	30062
log financial assets	10.92	4.01	241896	11.30	3.64	30062
Wealth volatility	0.10	0.08	212428	0.10	0.08	27091
log disposable income	7.72	1.38	241896	7.91	0.80	30062
log real assets	10.52	6.02	241896	10.92	5.81	30062
Self-incorporated	0.07	0.25	241896	0.07	0.25	30062
Sickness benefits (yes/no)	0.12	0.19	241902	0.12	0.20	30062
Mean hospitalization days per year	0.62	5.12	241902	0.68	5.03	30062
Number of unique drugs	3.23	3.20	241902	3.56	3.33	30062
Partner's age (at claim)	62.68	7.09	137258	62.72	6.87	18597
Partner's *log* disposable income	7.70	0.87	137258	7.71	0.84	18597
Parent died of cancer	0.34	0.47	241896	0.36	0.48	30062
Dead within 2 years	0.02	0.14	210214	0.05	0.23	27645
Dead within 5 years	0.05	0.22	116542	0.12	0.32	16227

Notes: Column (1) represents descriptive statistics of the entire dataset, while Column (2) shows descriptions of individuals diagnosed with cancer. The variable *Life annuity* is a dummy variable that indicates whether a retiree has chosen the life annuity option. The variables *5-year payout*, *10-year payout*, and *15- of 20-year payout* are dummy variables that indicate whether a retiree has chosen the five-year payout option. The*Pension from Alecta* variable represents the monthly amount of the occupational pension the employee receives from Alecta (in SEK/month). The *Pension from ITP2* variable represents the monthly amount of the occupational pension the employee receives from the ITP2 plan (in SEK/month). The *Early withdrawal* variable equals 1 for employees that have claimed their pension before the normal retirement age of 65. The *Disability pension* variable is an indicator for receiving a disability pension prior to retirement. The *Sickness benefits* variable is an indicator for absences from work due to illness for more than 14 days at any point in time between 2003 and retirement but prior to a cancer diagnosis. Financial assets, *log financial assets*, and *log real assets* are measured for 2007. The *Mean hospitalization days per year* variable is measured between 1990 and retirement, but prior to a cancer diagnosis. The *Parent died of cancer* variable is an indication that equals 1 if one of the parents died of cancer. The *Number of unique drugs* variable captures the number of drug substances (at the 3-digit ATC level) taken between 2005 and retirement but prior to a cancer diagnosis.

Table 2: Comparison Between Retirees Diagnosed with Cancer Pre- and Post-Retirement

	Diagnosis pre-retirement		Diagnosis post-retirement		Difference	
	Mean	SD	Mean	SD	Diff	t
Life annuity	0.72	0.45	0.75	0.43	0.04***	(7.11)
5-year payout	0.18	0.38	0.16	0.36	-0.02***	(-5.17)
10-year payout	0.07	0.25	0.06	0.23	-0.01***	(-3.80)
15- or 20-year payout	0.03	0.19	0.03	0.18	-0.00	(-1.55)
Pension from Alecta (SEK/Year)	66449	90559	64543	85813	-1905	(-1.87)
Pension from ITP2 (SEK/Year)	45147	68763	43345	64241	-1801	(-2.35)
Public pension (SEK/Year)	159786	54250	159839	55526	53	(0.07)
Total pension (SEK/Year)	319081	200422	322478	220024	3397	(1.25)
Age (at claim)	64.77	0.91	64.75	0.84	-0.02	(-2.02)
Early withdrawal	0.14	0.35	0.14	0.34	-0.01	(-1.45)
Disability pension	0.16	0.37	0.16	0.37	-0.00	(-0.17)
Claimed public pension	0.28	0.45	0.27	0.44	-0.01	(-1.80)
Male	0.62	0.49	0.64	0.48	0.02**	(3.09)
Married	0.66	0.47	0.67	0.47	0.01	(1.00)
Single	0.10	0.30	0.10	0.30	-0.00	(-1.41)
High school	0.48	0.50	0.48	0.50	-0.00	(-0.01)
University	0.34	0.48	0.33	0.47	-0.01	(-1.88)
Number of children	1.89	1.12	1.90	1.12	0.00	(0.23)
log disposable income	7.93	0.74	7.90	0.86	-0.02	(-2.52)
log financial assets	11.26	3.61	11.34	3.66	0.07	(1.77)
Wealth volatility	0.10	0.08	0.10	0.08	-0.00	(-2.41)
log real assets	10.94	5.79	10.90	5.84	-0.03	(-0.48)
Sickness benefits (yes/no)	0.13	0.21	0.12	0.19	-0.01***	(-4.97)
Number of hospitalization days	0.73	5.64	0.63	4.35	-0.10	(-1.70)
Number of unique drugs	3.52	3.30	3.60	3.36	0.07	(1.95)
Self-incorporated	0.07	0.25	0.07	0.25	-0.00	(-0.75)
Partner's age (at claim)	62.70	7.00	62.73	6.76	0.04	(0.36)
Partner's log disposable income	7.71	0.84	7.70	0.83	-0.01	(-1.09)
Parent died of cancer	0.36	0.48	0.36	0.48	-0.00	(-0.12)
Dead within 2 years	0.06	0.24	0.05	0.22	-0.01***	(-4.05)
Dead within 5 years	0.11	0.31	0.12	0.33	0.01*	(2.55)
Observations	14945		15117		30062	

Notes: ** $p < 0.05$, *** $p < 0.01$. Variables are defined as in Table 1.

Table 3: The Effect of Cancer Diagnosis on Annuity Investment

	Dependent Variable: Full Annuity Dummy			
	(1) Malignant cancer	(2) Benign tumor	(3) Digestive cancer	(4) Skin cancer
Effect Estimation	-0.040	-0.023	-0.086	-0.008
SE	0.007	0.007	0.021	0.013
N	14,990	14,047	1,690	3,934
Baseline mean	0.78	0.78	0.77	0.78
Controls	Yes	Yes	Yes	Yes

Notes: This table reports the effects of receiving a tumor or cancer diagnosis on the choice of a life annuity. Column (1) shows the results for malignant cancer, Column (2) for a benign diagnosis, Column (3) for malignant digestive cancer, and Column (4) for malignant skin cancer. The coefficients shown represent the marginal effects from a logit estimation of Eq. 2, with each column generated from a separate regression analysis. The regression model includes controls for individual characteristics such as age, marital status, gender, pre-retirement income, education, and health-related variables. The analysis is based on the sub-sample of participants diagnosed with cancer within three years of retirement. The dependent variable is a dummy for the life annuity choice, which equals 1 if the individual chose a life annuity and 0 if they opted for 5- or 10-year fixed payments. Other payout options are excluded from the sample. The baseline mean reflects the annuity choice among the control group, comprised of individuals who received a cancer diagnosis after retirement.

Table 4: EPDV and Financial Loss by Cancer Type

	(1) N	(2) Annual benefits (USD)	(3) EPDV life annuity	(4) EPDV 5-year payout	(5) EPDV loss annuity	(6) %ΔMWR-1	(7) %ΔAnnuity	(8) %ΔAnnuity/ (%ΔMWR-1)	(9) % Dead within 5 years*
All malignant	14,990	3,741	44,455	66,012	-21,558	-32.7	-5.7	0.18	18.0
Digestive	1,690	3,457	38,423	60,565	-22,142	-36.6	-12.6	0.34	42.7
Skin	3,934	3,915	48,867	69,312	-20,444	-29.5	-1.4	0.05	3.4
Breast	1,491	2,069	29,076	36,923	-7,847	-21.3	-6.2	0.29	6.6
Genital	5,535	4,302	55,670	76,373	-20,703	-27.1	-4.5	0.17	10.0
Other	2,326	3,391	36,273	59,165	-22,892	-38.7	-11.5	0.30	48.2

Notes: Column (2) shows the average ITP2 benefit under the life annuity option. Columns (3) and (4) show the EPDV of the life annuity and the five-year payout, respectively. Column (5) presents the difference between them which gives the loss in EPDV terms of choosing the life annuity. Column (6) shows the cancer-induced percent change in the MWR. Column (7) shows the annuitization rate difference between individuals diagnosed with cancer before and after retirement. Column (8) shows the percentage change in annuity demand (from Column (6)) divided by the percentage change in the MWR (from Column (7)). We adopted a discount rate of 1.159%, reflecting the mean yield of 10-year Treasury notes in 2012. We assume that the annuity decision is made at age 65, i.e. $a = 65$. We also present the percentage of individuals who died within five years post-retirement (*restricted to claims in 2011 or earlier).

Table 5: The Impact of Default and Cancer on Annuity Choice using the Laboratory Experiment.

Panel A.	Dependent Variable: Full Annuity Dummy					
	All		Default		No Default	
	(1)	(2)	(3)	(4)	(5)	(6)
Low longevity=1	-0.0993**	-0.0888**	-0.0610	-0.0222	-0.136**	-0.170**
	(0.0421)	(0.0418)	(0.0642)	(0.0690)	(0.0566)	(0.0574)
Baseline mean	0.188	0.188	0.213	0.213	0.163	0.163
R^2	0.0508	0.158	0.00554	0.202	0.0408	0.220
Controls	No	Yes	No	Yes	No	Yes
Number of observations	330	330	164	164	166	166

Panel B.	Dependent Variable: Amount Allocated for Annuity					
	All		Default		No Default	
	(1)	(2)	(3)	(4)	(5)	(6)
Low Longevity=1	-925.2**	-1029.0**	-628.0	-300.8	-1216.5**	-1543.1**
	(304.9)	(298.2)	(449.4)	(467.3)	(417.3)	(424.7)
Baseline mean	6923.9	6923.9	7021.3	7021.3	6827.7	6827.7
R^2	0.0355	0.171	0.0119	0.257	0.0504	0.221
Controls	No	Yes	No	Yes	No	Yes
Number of observations	330	330	164	164	166	166

Notes: The table presents the main results of the laboratory experiment, illustrating the effect of the default option on life annuity choice. The estimates were derived from regressions that incorporate data from two rounds of the experimental task for each participant. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Exploring the Mechanism of a Malign Cancer Diagnosis on Investment in Annuity.

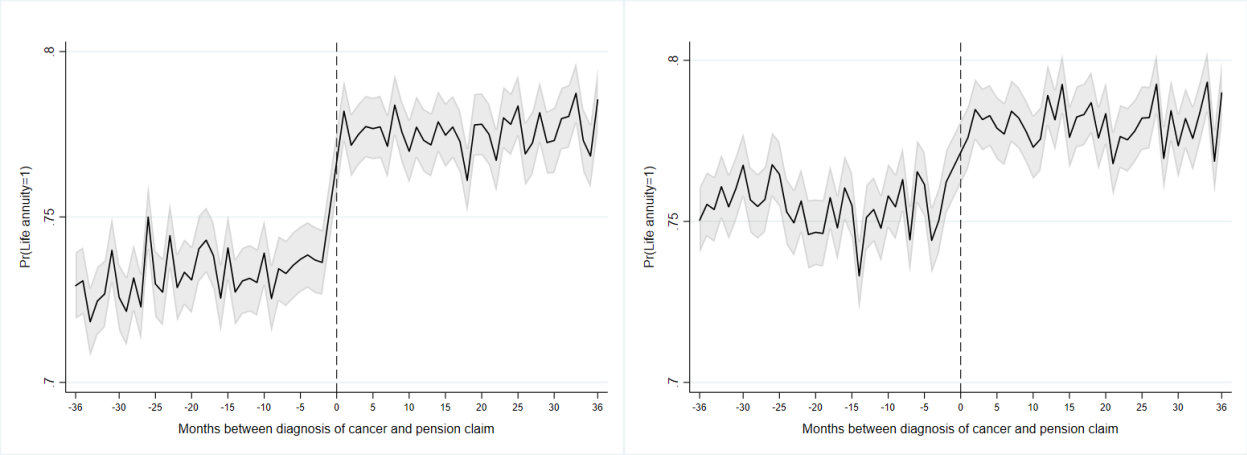
	Dependent Variable: Full Annuity Dummy		
	(1)	(2)	(3)
Panel A. Attention: Pension Capital			
	Cancer effect	"Small" Account (Q1)	"Large" Account (Q3)
Any malign cancer	-0.041	-0.026	-0.049
SE	0.007	0.014	0.010
Baseline mean	0.780	0.641	0.826
N	14,990	4,685	5,215
Panel B. Attention: Claim Age			
	Cancer effect	Early/late claim	Default age
Any malignant cancer	-0.041	-0.106	-0.029
SE	0.007	0.020	0.007
Baseline mean	0.780	0.620	0.801
N	14,990	2,341	12,649
Panel C. Financial Education			
	Cancer effect	Financial-related major=0	Financial-related major=1
Any malignant cancer	-0.041	-0.040	-0.049
SE	0.007	0.007	0.020
Baseline mean	0.780	0.775	0.779
N	14,990	13,202	1,788
Panel D. Risk Preferences			
	Cancer effect	Risk averse	Risk loving
Any malignant cancer	-0.040	-0.047	-0.012
SE	0.008	0.009	0.019
Baseline mean	0.783	0.735	0.744
N	10,538	8,392	2,097
Panel F. Family Risk Pooling			
	Cancer effect	Singles	Married
Any malignant cancer	-0.041	-0.057	-0.033
SE	0.007	0.012	0.008
Baseline mean	0.780	0.768	0.780
N	14,990	9,959	5,031

Notes: This table explores various mechanisms that could explain the source of the adverse-selection effect presented in Table 3. It shows marginal effects from an interaction model described in Appendix Section E.1 in which a pre-claim cancer diagnosis dummy is interacted with various categories presented in Columns (2) and (3). Each panel represents the estimates derived from a different regression model. The first column, labeled "Cancer effect," shows the main effect derived from each regression and serves as a weighted average of the estimates in Columns (2) and (3), which detail the contributions of the respective categories to the overall cancer effect. A complete description of the mechanisms categories and data is provided in the text.

Table 7: Impact of Malignant Cancer Diagnosis on Annuity Investment: A Parental-longevity Proxy Analysis by Gender

	Dependent Variable: Full Annuity Dummy		
	(1)	(2)	(3)
	Parental Proxy	Female	Male
Effect Estimation	-0.020	-0.054	-0.035
SE	0.002	0.012	0.008
N	188,525	4,790	10,200
Mean	0.76	0.76	0.79
Controls	Yes	Yes	Yes

Notes: This table presents estimates from the Supplemental Analysis Section. Column (1) displays the marginal effect of using parental longevity as a proxy for survival probability. This proxy is defined based on same-sex parents with low longevity risk characterized as having a parent whose lifespan is below the median in the same-sex parental longevity distribution. The estimates in the table are derived from the full sample of white-collar workers. Columns (2) and (3) present marginal effects derived from an interaction model with gender, as described in Appendix Section E.1. In this model, we interact a pre-claim cancer diagnosis dummy with a gender dummy variable. These columns examine the contributions of females and males to the overall cancer effect presented in Table 3 and serves as a weighted average of the main effect. A description of the sample used in the gender analysis is provided in Section 4.3.



(a) Malignant cancer diagnosis (b) Benign tumor diagnosis

Figure 1: Effects of a cancer diagnosis on retirees' life annuity choices.

Notes: The x-axis represents the time difference between the diagnosis month and the pension-claiming month, with period 0 indicating the month of pension claiming. The y-axis shows the average share of retirees opting for a life annuity in each time period. The estimates are derived from the regression model in Eq. (2), accompanied by their 95% confidence intervals. For a detailed description of the control variables, please refer to Table 3.

Appendices

A Additional Institutional Details

This section offers additional details on the institutional framework of the Swedish pension system, complementing the information provided in Section 2.

In Sweden, four large agreement-based occupational pension plans cover at least 90% of the total workforce. Two of these plans serve public sector employees, while the other two cater to private sector workers—specifically, one for white-collar workers and one for blue-collar workers. This study uses data from Alecta, the default managing company of ITP occupational pension plans for white-collar workers.

The ITP occupational pension is the result of an agreement between PTK (the Council for Negotiation and Co-operation for Salaried Employees), which is a joint organization of 27 member unions, representing 860,000 salaried employees in the private sector in Sweden, and Svenskt Näringsliv (the Confederation of Swedish Enterprise), representing 49 member organizations and 60,000 member companies with over 1.6 million employees.

The ITP plan underwent reform in 2006, and ITP2 was replaced by a new DC component named ITP1. Since the new plan applies only to workers born in 1979 or later, it is not pertinent to this study. The ongoing transition from DB to DC is part of an overall shift in pension provision among all major occupational pension plans in Sweden.

As discussed in Section 2.1.1, this study focuses on the payout decision within the defined benefit component, ITP2. Benefits from ITP2 are based on the final wage prior to retirement, with a basic replacement rate of 10% of the final wage, defined by the income ceiling in the public pension system. The income ceiling is indexed to the average income level in Sweden using the income base amount (IBA). The ceiling is set at 7.5 IBA, which in 2023 corresponded to a monthly pre-tax income of SEK 46,438 (approximately USD 4,320).

The ITP2 life annuity benefit is calculated according to the following equation, where w_i

denotes the wage portion related to the IBA i:

$$ITP2 = 0.1w_{<7.5\ IBA} + 0.65w_{7.5-20\ IBA} + 0.325w_{20-30\ IBA.}$$

The ITP2 pension encompasses a survivor's benefit, referred to as *Familjepension*, which is calculated as 32.5% of the annual earnings that fall between 7.5 IBA and 20 IBA, and 16.25% of annual earnings ranging from 20 IBA to 30 IBA. This benefit is disbursed for the lifetime of the registered partner. Approximately one-third of the white-collar workers within our sample earn above the 7.5 IBA threshold. By design, the survivor's benefit is tailored for individuals with higher income levels.

When a life annuity payment is converted to a fixed-term payout, the managing company—Alecta in this case—uses a conversion factor based on actuarial assumptions regarding average life expectancy at the time of claim and the expected rate of return on the pension capital. The conversion factors are independent of gender, marital status, and health status. For example, consider an individual entitled to a monthly life annuity of SEK 2,500 (with 1 SEK = 0.11 USD), calculated using the abovementioned ITP2 formula. If the conversion factors at age 65 between the life annuity and the 5-, 10-, 15-, and 20-year payouts are 3.73, 2.02, 1.46, and 1.21, respectively, the retiree can instead choose a 5-year option paying SEK 9,325 ($3.73 \times 2,500$), a 10-year option paying SEK 5,050 ($2.02 \times 2,500$), a 15-year option paying SEK 3,650 ($1.46 \times 2,500$), or a 20-year option paying SEK 3,025 ($1.21 \times 2,500$).

B Supplemental Evidence on Identification Assumptions

This section addresses questions regarding whether annuitants and non-annuitants are fundamentally different, both when a cancer shock is considered as well as regardless of the diagnosis. For instance, if one group differs in their financial background or working in an occupation that requires a strong understanding of financial concepts, their decision could

be driven by this prior knowledge rather than the health shock. Moreover, there may be concerns that those who did not choose the fixed-term payout aligned their decision with their own longevity expectations.

To address this concern, we analyze mortality and education characteristics for annuitants and non-annuitants across the following groups: those diagnosed *before* retirement, those diagnosed *after* retirement, and those never diagnosed with cancer. The corresponding estimates are presented in Table B.1.

Panel A of Table B.1 shows that the mortality rates of annuitants and non-annuitants diagnosed with cancer *after* retirement are identical (as shown in Columns (2) and (5)). This consistency holds for mortality within two years, five years, and up to death by 2015. This evidence shows that when individuals experience a longevity risk shock after the annuity decision is no longer reversible, there is no difference in mortality between annuitants and non-annuitants. This is indicative of a similar information set that dictates the annuity decision of these groups who have no critical prior knowledge that affects their decision. Similarly, comparing annuitants and non-annuitants who were never diagnosed with cancer (Columns (3) and (6)) reveals no significant differences in mortality rates.

Reinforcing the adverse selection effect, the table also reveals that among individuals diagnosed with cancer *before* retirement, mortality rates are higher for non-annuitants compared to annuitants (Columns (1) and (4)). This is expected, as the annuity decision was still reversible at the time of diagnosis, and individuals self-selected into fixed-term annuities based on the cancer diagnosis, which provided them with private knowledge of their longevity risk. Such evidence underscores the significant role that a pre-retirement diagnosis plays in shaping annuity decisions and causing adverse selection.

To delve into differences in financial understanding, we used educational backgrounds in financially related majors, such as finance, economics, business administration, accounting, taxation, or teacher training in these subjects, as a proxy for financial knowledge. We further use industry codes to examine whether individuals with financial-related occupations have a better understanding of financial concepts that may influence their decision to choose a

Table B.1: Comparison Between Non-annuitants and Annuitants

	Non-Annuitants			Annuitants		
	(1) Diagnosed before retirement	(2) Diagnosed after retirement	(3) Never diagnosed	(4) Diagnosed before retirement	(5) Diagnosed after retirement	(6) Never diagnosed
Panel A. Mortality rates						
Dead within 2 years	0.09	0.05	0.01	0.05	0.05	0.01
	(0.29)	(0.22)	(0.10)	(0.22)	(0.22)	(0.10)
Dead within 5 years	0.16	0.14	0.04	0.10	0.12	0.03
	(0.37)	(0.35)	(0.18)	(0.3)	(0.33)	(0.16)
Died by 2015	0.11	0.11	0.02	0.07	0.11	0.02
	(0.32)	(0.31)	(0.14)	(0.26)	(0.31)	(0.14)
Panel B. Financial knowledge						
Financial-related education	0.13	0.12	0.12	0.12	0.13	0.12
	(0.33)	(0.33)	(0.33)	(0.33)	(0.33)	(0.32)
Financial-related occupation	0.09	0.09	0.09	0.10	0.10	0.09
	(0.29)	(0.29)	(0.29)	(0.30)	(0.30)	(0.28)
N	4,234	3,736	41,425	10,711	11,381	118,100

fixed-term payout given their diagnosis. Using the NACE codes of industry, we identified occupations that have a financial orientation.[40]

As shown in Panel B, both measures indicate similarities in financial knowledge among annuitants and non-annuitants, whether they were diagnosed before retirement, after retirement, or never diagnosed with cancer. This evidence ease the concerns by which annuitants with cancer are less capable to understand the consequences of their decisions.

[40]The occupations and NACE codes are: other monetary financial intermediation (6419), "holding" activities (6420), funds and similar financial entities (6430), various other financial services except insurance and pension funding activities (6499), life insurance (6511), non-life insurance (6512), reinsurance (6520), pension funding activities (6530), other support services to financial services except insurance and pension funding activities (6619), risk and damage evaluation (6621), activities conducted by insurance agents and brokers (6622), fund management activities (6630), trade with own real estate (6810), renting and management of own or leased real estate (6820), real estate agencies (6831), property management on a contract basis (6832), accounting, bookkeeping, auditing and tax consulting (6920), consultancy activities regarding business organization (7022), administration of financial markets (6601), security and commodity contracts brokerage (6602), other financial service activities, n.e.c., including derivatives and commodity exchanges and clearing (6603), activities auxiliary to financial service activities, except insurance and pension funding (6701), activities auxiliary to insurance and pension funding (6702), real estate activities with own or leased property (6801), real estate activities on a fee or contract basis (6802), accounting, bookkeeping and auditing activities; tax consultancy (6920), management consultancy activities (6903), and rental and leasing activities (7700).

C Creation of Cancer-specific Life Tables

To quantify the financial implications of individuals' annuity decisions we calculate the expected present discounted value (EPDV) of life annuity and compare it with the EPDV of the five-year payout option for different types of cancer (see Section 5.2 in the paper). To compute these EPDVs, we developed life expectancy tables for each cancer type. Specifically, we select all individuals in Sweden who were diagnosed with first-time malignant cancer between the ages of 62 and 68 from 1997 to 2015, using the National Patient Register described in Section 4. This cohort includes 123,872 individuals, roughly half of whom died within the study period. We then apply a Gompertz distribution, a continuous probability model widely used for aging and survival characterized by an exponentially increasing failure rate, and adjust it for different cancer types to calculate survival probabilities and model mortality.

Figure C.1 displays the proportion of individuals surviving at each age for different cancer types, based on estimates from the adjusted Gompertz model. The "General Population' curve is derived from Swedish population survival statistics from 2009–2013, serving as a benchmark for comparison. Each line represents a specific cancer type, showing how survival probabilities vary by age. The graph illustrates the varying mortality risks associated with each cancer type, with some showing a steeper decline in survival proportions compared to others, and highlighting the differences in type severity and progression.

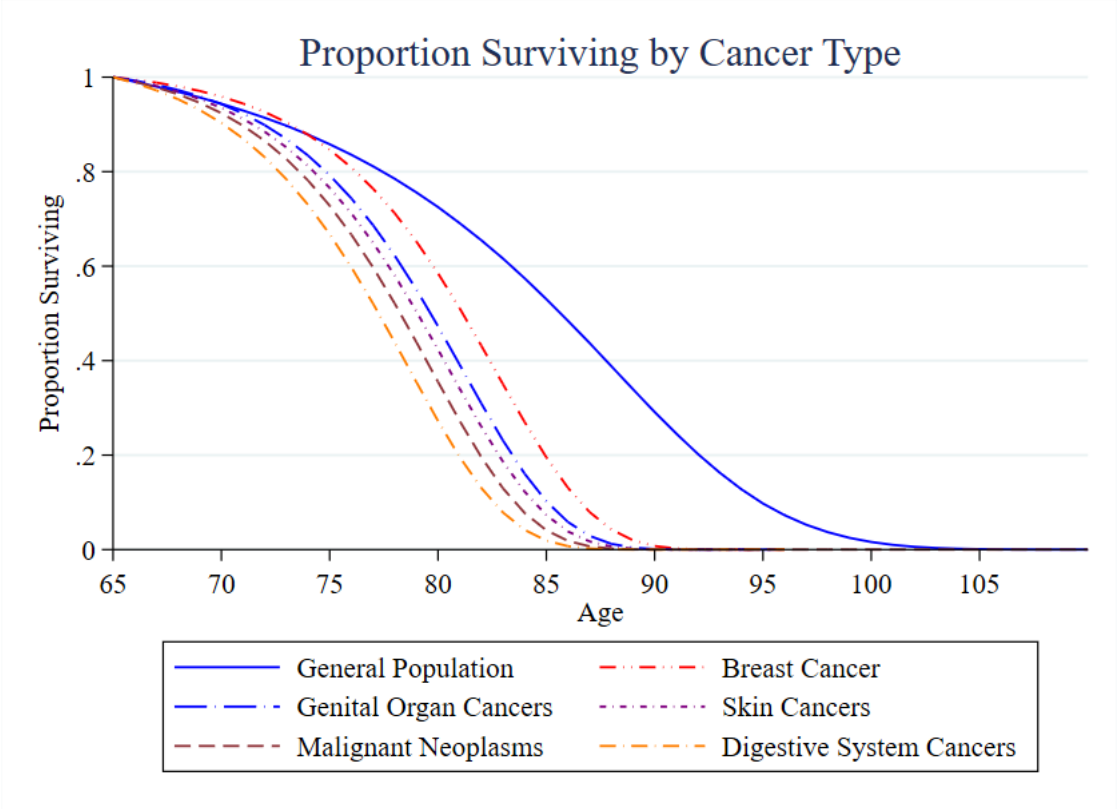


Figure C.1: Age-specific survival proportions by cancer type and general population.

Notes: The survival curves were calculated based on the *entire* Swedish population.

D Laboratory Experiment Instructions and Details

In this section, we provide further details about the laboratory experiment outlined in Section 6.1.1. Below we provide a translation of the instructions that participants saw on their screens during the experiment, along with the decision screens.

D.1 Laboratory experiment instructions

Decision-making experiment—Informed consent

Greetings!

You are about to participate in a financial decision-making experiment. The experiment consists of several stages as described below. Payment for the experiment will

be calculated as per the description provided (in addition you will be paid 30 NIS for participating). The payment is subsidized with thanks from research budgets from the Hebrew University and Tel Aviv University. The following instructions and research questions are both part of the experiment. For any further questions or clarifications, please reach out to us at any point.

The experiment contains five parts:

1. Reading the instructions
2. General questions
3. A computerized experiment
4. Answering a questionnaire
5. Getting paid for the experiment

The survey questions address your personal beliefs, and there are no right or wrong answers. Please choose the answer that is the most appropriate for you. Although we would appreciate you answering all the questions, you are allowed to skip those that raise any discomfort without a penalty on your side. The experiment is anonymous and the data collected will be used for research purposes only, while maintaining complete confidentiality. Filling out the questionnaire will be considered as consent from your side to participate in the experiment, but you can end your participation at any time, without any consequences. If you are interested, we will be happy to share with you the results of our research, once the project is completed. For questions and additional information about the research and its findings, please contact the research team.

Thank you for your cooperation!

START THE EXPERIMENT

Part A – instructions

The choice:

- For your participation in this experiment, you will be immediately allocated an amount of 50 NIS (30 NIS, which is considered payment for attending and participating and will be given to you in any case). Please note, however, the

following instructions: the total amount of payment that you will eventually receive will be calculated in accordance with your performance in the experiment. The eventual total payment may be more or less than 50 NIS, but no less than 30 NIS.

- Assume that you have now reached retirement age, and you must decide the way you would like to obtain your pensions savings.
- Assume that you have worked your entire life and saved 2,000,000 "Zuz" up until today (the final amount in "Zuz" will be converted to NIS at the end of the experiment by a given rate that will be explained later).
- Please note that annuity payments are calculated as 1/200 of the total amount that you have allocated for annuitization (the meaning of the conversion rate of 200 is that if you chose to withdraw an annuity of 1,000 NIS, the amount that would be allocated for the annuity payments is $200 * 1,000 = 200,000$ and the rest will be available to withdraw as a lump-sum amount of $2,000,000 - 200,000 = 1,800,000$ NIS at the day of retirement).
- Your life expectancy in the experiment (number of months in which an annuity will be paid) will be raffled during the experiment and explained later.
- You are due to consume a certain amount, as explained later.
- The system will use the monthly annuity payments and your capital obtained as a lump sum to fund the amount to be consumed (as explained above).
- If the monthly payments are not enough to fund the consumption and you foresee running out of capital (the amount you withdrew) following chosen funded amount to be consumed, you will end up getting a reward of 30 NIS just for your participation.
- If you will not run out of capital, or have a positive balance from the monthly annuity amounts, it will be converted to NIS at the end of the experiment according to a set rate that will be explained later.

<u>The raffle:</u>

- At this stage, the number of life periods will be drawn for you (to be used in this experiment). It will be a round number between 0 and 400.
- The capital you have chosen will be given to you in a single payment, and the additional annuity will be given to you throughout all the life periods in this experiment, even if the amount of "Zuz" you have accumulated so far will run out.
- Your spending amount will be raffled randomly according to one of the three possibilities: 3,000, 6,000, or 9,000 "Zuz". If the annuity you chose does not cover the consumption amount that had been raffled, for each life period, the difference will be paid from the lump-sum amount you chose, and if that amount is not sufficient, you will end the experiment with only 30 NIS as a reward.

The payment:

Payment after the experiment is based only on your own results during the experiment. After the end of the experiment, you will receive the amount of the following payments: A+B+C+D or just A.

- A—reward for participation (NIS 30)
- B—participation bonus (NIS 20), if you did not end up spending all the "Zuz" you have saved (from the distribution of the lump sum and the monthly annuity).
- C—the difference between the monthly annuity income and the monthly spending, divided by 50,000.
- D – the remainder of the lump sum (capital) you have requested, after it was used (if it was needed to cover the monthly payments), divided by 50,000. Please note that if you have spent all the "Zuz" you saved (from both annuity and capital), the additional participation bonus will be subtracted, and you will be left with only 30 NIS (A).

CONTINUE

Questions to make sure that the instructions are clear:

- The following examples are for illustrative purposes only and are not a recommendation for any kind of strategy to be used by the participants.
- You may use a calculator.
- The experiment will not let you continue with the experiment until you answer the question correctly.
- If you need assistance, please contact the experimenter.

Example

- If you choose to allocate all your savings for annuity, what is the monthly annuity that you would get? [redacted]
- Let's say that the raffle determined that you have a monthly consumption of 3,000 "Zuz" and the game will last for 300 periods. What would be the monthly deficit/excess balance in your account? [redacted]
- How much will you get at the end of the game?
- [redacted] NIS for participation
- [redacted] NIS participation bonus
- [redacted] NIS, which is the difference between the monthly annuity payments and spending for consumption times the number of periods and then divided by 50,000.
- No capital (lump sum)
- [redacted] NIS Total

Part B – General questions

1. Birth year
2. Gender
3. Marital status
4. Number of children
5. Birth country of your father

6. Do you smoke (more than three cigarettes a day on a regular basis)?
7. Have you smoked regularly in the past (more than five cigarettes a day)?
8. Education (number of years in a formal setting)?
9. Did you take classes about economics, business management, or statistics while studying in high school?
10. Academic institution (in which you earned your most recent degree)?

Part C

Decision making—version 1—High life expectancy - No default

Given the explanation provided above (meaning you've accumulated 2,000,000 "Zuz" in your account), which you now must divide between capital and annuity, what is the amount of lump sum (to be given only once immediately) that you will choose?

For any questions or concerns, please contact the experimenter.

CONTINUE

Participants were provided with this task twice.

Part D—Additional questions

1. The average total monthly salary for an employee in Israel (as of January 2023) is 12,471 NIS. Is this your average salary or more (for a full-time job 100%)?
2. In general, what is the status of your health condition?
3. Do you have any health or physical issues? We are referring to any potential problem you've been dealing with for more than six months.
4. (If you answered "yes" to question 13) does this problem bother you while performing day-to-day activities?
5. Do you partake in any extreme sport activities (like bungee jumping or surfing), or any other risky activity?
6. In general, do you consult more than one financial consultant while making a financial decision?

7. Using numbers from 0 to 10, where 0 stands for "no chance" and 10 stands for "full certainty," please answer the following questions
   (a) What are the chances that you estimate that you'll survive to age 85?
   (b) What are the chances that you estimate that you'll survive to age 95?
8. Using numbers from 0 to 10, please evaluate the level of discomfort and sorrow that you'd feel if you were to be left without sufficient funding for your retirement period, where 0 stands for little and 10 stands for great discomfort and sorrow.
9. Assume that you're about to get an amount of 3,000 NIS deposited to your personal checking account immediately. However, we will offer an amount of money in a year from today. What is the minimum amount you're willing to get in a year from now, instead of the 3,000 today?
10. Using a scale from 0 to 100, where 0 means "not willing to take any risks at all" and 100 means "very willing to take risks," how willing are you to take risks?
11. To what extent do you feel that you have a good understanding of financial matters?
12. How important is it to you to leave an inheritance for your heirs?

CONTINUE

Thank you for your participation. The total amount you've earned from the experiment is as follows: AMOUNT HERE

CONTINUE

Other conditions:

- Under the "low longevity" conditions, participants were informed on the instruction page the following information. At this stage, the number of life periods will be drawn for you (to be used in this experiment). It will be a round number *between 0 and 200*.
- Under the "default" conditions, the field where the annuitization choice was

entered (on the decision screen) included a default amount of 10,000, representing a full annuitization choice.

D.2 Additional Experimental Evidence

Design validation

Table D.1 presents a comparison between the treatment groups, with coefficients reflecting values relative to Treatment Group 1. This table validates the randomization of participants into the treatment groups, showing that the groups are similar in terms of gender, marital status, field of study, and health. This evidence supports the random assignment of participants. However, despite randomization, there is a significant age difference between the groups and a discrepancy in years of education for Treatment Group 4. While these differences were unintended, we include these variables as controls in the regressions to ensure a clear comparison.

Table D.1: The Impact of Default and Cancer using the Laboratory Experiment.

	(1) Female	(2) Married	(3) Econ major	(4) Good health	(5) Age	(6) Years of Educ
Treatment=2	0.0488	-0.0732	0.0244	0.0732	-2.366**	-0.0976
	(0.111)	(0.0690)	(0.106)	(0.0414)	(0.846)	(0.493)
Treatment=3	0.0110	-0.0517	0.0563	0.0256	-1.784**	-0.488
	(0.110)	(0.0686)	(0.105)	(0.0412)	(0.841)	(0.490)
Treatment=4	0.0732	-0.122	0.0244	0.0488	-2.000**	-1.171**
	(0.111)	(0.0690)	(0.106)	(0.0414)	(0.846)	(0.493)
Baseline mean	0.570	0.109	0.661	0.964	26.39	14.05
Number of observations	165	165	165	165	165	165

Notes: *Econ Major* is a dummy variable that equals 1 if the student's major is economics and 0 if it is not. *Good Health* is a dummy variable that equals 1 if the student's self-reported health status is good or very good. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Detailed results of rounds

The tables below describe the results of the experiment separately for each round.

Table D.2: Round 1: Impact of Default and Cancer on Annuity Choice

Panel A.	Dependent Variable: Full Annuity Dummy					
	All		Default		No Default	
	(1)	(2)	(3)	(4)	(5)	(6)
Low longevity=1	-0.0638	-0.0596	-0.0244	0.0131	-0.101	-0.165*
	(0.0686)	(0.0674)	(0.105)	(0.118)	(0.0869)	(0.0860)
Baseline mean	0.261	0.261	0.329	0.329	0.193	0.193
Controls	No	Yes	No	Yes	No	Yes
Number of observations	165	165	82	82	83	83
R^2	0.00528	0.178	0.000673	0.203	0.0164	0.310

Panel B.	Dependent Variable: Amount Allocated for Annuity					
	All		Default		No Default	
	(1)	(2)	(3)	(4)	(5)	(6)
Low longevity=1	-937.4**	-1020.0**	-853.7	-571.3	-1013.7*	-1290.2**
	(435.1)	(423.1)	(627.9)	(664.6)	(604.4)	(626.6)
Baseline mean	7180.9	7180.9	7453.7	7453.7	6911.4	6911.4
Controls	No	Yes	No	Yes	No	Yes
Number of observations	165	165	82	82	83	83
R^2	0.0277	0.214	0.0226	0.302	0.0336	0.256

Notes: The estimates are derived from regressions that incorporate data from the first round of the experimental task for each participant. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D.3: Round 2: Impact of Default and Cancer on Annuity Choice

Panel A.	Dependent Variable: Full Annuity Dummy					
	All		Default		No Default	
	(1)	(2)	(3)	(4)	(5)	(6)
Low longevity=1	-0.135**	-0.118**	-0.0976	-0.0575	-0.172**	-0.175**
	(0.0489)	(0.0497)	(0.0654)	(0.0750)	(0.0729)	(0.0779)
Baseline mean	0.115	0.115	0.0976	0.0976	0.133	0.133
Controls	No	Yes	No	Yes	No	Yes
Number of observations	165	165	82	82	83	83
R^2	0.0445	0.155	0.0270	0.186	0.0642	0.234

Panel B.	Dependent Variable: Amount Allocated for Annuity					
	All		Default		No Default	
	(1)	(2)	(3)	(4)	(5)	(6)
Low Longevity=1	-925.2**	-1029.0**	-628.0	-300.8	-1216.5**	-1543.1**
	(304.9)	(298.2)	(449.4)	(467.3)	(417.3)	(424.7)
Baseline mean	6923.9	6923.9	7021.3	7021.3	6827.7	6827.7
R^2	0.0355	0.171	0.0119	0.257	0.0504	0.221
Controls	No	Yes	No	Yes	No	Yes
Number of observations	330	330	164	164	166	166

Notes: The estimates are derived from regressions that incorporate data from two rounds of the experimental task for each participant. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

E Mechanisms

E.1 Regression model for mechanism analysis

To examine the heterogeneous responses to a malignant cancer diagnosis among individuals with varying (1) levels of attention, (2) financial literacy, and (3) risk preferences (adding to the mechanisms discussed in Section 6), we estimate the following regression model:

$$\text{Prob}(\text{Life annuity} = 1) = \Phi\left(\mu + \delta D_i + \lambda R_i + \gamma R_i D_i + \phi X_i + \zeta_i\right), \tag{E.1}$$

where R_i is an indicator for each examined mechanism. Specifically, R_i equals 1 if retiree i has a large pension account balance, claims the pension at the default age of 65, holds a degree in a financially related field, or is risk-loving. The remaining components of the model follow the structure outlined in Section 3, Eq. (2).

From this binary-choice model, we compute the marginal effects to quantify how each mechanism shapes the health shock impact on the annuity decision. This approach helps identify the underlying drivers of the adverse-selection effect.

E.2 Alternative definitions

This section complements the results presented in Section 6 by offering additional findings based on alternative definitions to examine the mechanisms driving the adverse-selection effect. Specifically, we explore the following: an additional measure of attention to the annuity decision, supplementing the evidence from Section 6.2, an alternative measure of financial literacy, building on Section 6.3, and a different proxy for risk preferences, which directly enhances the results discussed in Section 6.4.

E.2.1 Attention

Panel A of Table E.1 uses a proxy for attention based on a classification of accounts into "small" and "large," with accounts below or above the median, respectively. This comparison rests on the notion that individuals with smaller accounts are less impacted by a cancer diagnosis (particularly given the default option), as they place less attention on the outcome

to begin with(Benartzi et al., 2011; Bütler & Teppa, 2007; Hagen, 2015; Hurwitz & Sade, 2024). The results in the table support the argument that the response to a cancer diagnosis is more pronounced among individuals with larger pension funds. This evidence aligns with the discussion in Section 6.2, suggesting that the modest adverse-selection effect is partly explained by inattention, which amplifies the impact of the default option.

E.2.2 Financial literacy

Panel B of Table E.1 utilizes information about individuals' educational background to assess their financial literacy. It analyzes the response to a malignant cancer diagnosis among individuals with and without a university degree as a proxy for financial literacy. Individuals might not fully grasp or be aware of the financial implications of their decisions, and this lack of knowledge could result in them choosing life annuities regardless of changes in their survival probabilities.

The analysis in the table shows that while the effect of the diagnosis is stronger among individuals with a university degree compared to those without one, the overall effect among both groups is still minor. This finding supports the argument that financial illiteracy and education are not main mechanisms influencing the observed responses.

E.2.3 Risk preference

Panel C of Table E.1 employs an alternative proxy for risk preferences, following the approach of Kerr, Kerr, and Dalton (2019) and Levine and Rubinstein (2017, 2018), who suggest that individuals with a higher propensity for risk-taking are more likely to pursue entrepreneurship as a career. Specifically, this proxy considers an incorporated self-employed individual as an indicator of entrepreneurship (Levine & Rubinstein, 2017, 2018). We define individuals who were incorporated self-employed (hereafter, entrepreneurs) at least once between the years of 2007 and 2014 as risk-tolerant individuals and all other individuals as risk-averse.[41]

There may be a concern that the entrepreneurs in our sample are not fully represen-

[41] The wealth volatility proxy presented in Section 6.4 is significantly higher among the group classified as entrepreneurs relative to non-entrepreneurs.

tative of the broader entrepreneur population. However, it is important to note that our data includes individuals insured by ITP2, meaning they were employed for at least one of the years covered in our sample. We argue that this selection strengthens rather than weakens our findings. By including individuals who are relatively less risk-tolerant, our results can be viewed as a conservative estimate of the true effect. If more risk-tolerant individuals were included, the results would likely be even more pronounced. Additionally, our econometric design mitigates concerns related to characteristics correlated with selection into entrepreneurship, which are assumed to be evenly distributed between those diagnosed pre- or post-retirement.

The findings in Panel C of Table E.1 align closely with the findings in the main text (see Section 6.4). Specifically, the estimates show that the entire response to a malignant cancer diagnosis comes from risk-averse individuals, while risk-tolerant individuals did not alter their demand for life annuities after the diagnosis, prior to retirement. Yet, the overall response of the risk-averse is similar to the one of the analysis sample. This evidence indicates that risk preferences are not the primary driver of the effect. One may expect risk-averse individuals typically to value the protection that annuities offer against longevity risk. However, their response to a cancer diagnosis mirrors that of the general population, indicating that risk preferences alone do not explain the muted response.

In addition to the wealth volatility and entrepreneurship risk preference proxies, we examine additional measures of risk preferences, such as the standard deviation of log wealth and the ratio of the standard deviation of wealth changes to average wealth. The results remain consistent across these alternative proxies (available from the authors upon request).

Table E.1: Exploring the Mechanism of a Malign Cancer Diagnosis on Annuity Investments using Additional Measures

	Dependent Variable: Full Annuity Dummy		
Panel A. Attention: Pension capital			
	Cancer effect	"Small" accounts (Q1 & Q2)	"Large" accounts (Q3 & Q4)
Any malign cancer	-0.041	-0.030	-0.049
SE	0.007	0.011	0.008
Baseline mean	0.78	0.70	0.85
N	14,990	7,343	7,647
Panel B. Education			
	Cancer effect	With University Degree	Without University Degree
Any malignant cancer	-0.041	-0.048	-0.038
SE	0.007	0.011	0.009
Baseline mean	0.78	0.81	0.76
N	14,990	10,059	4,931
Panel C. Risk Preferences: Entrepreneurship			
	Cancer effect	Risk averse	Risk loving
Any malignant cancer	-0.041	-0.043	-0.016
SE	0.007	0.007	0.027
Baseline mean	0.78	0.78	0.74
N	14,990	13,949	1,041

Notes: This table presents marginal effects from an interaction model in which a pre-claim cancer diagnosis dummy is interacted with individual characteristics. The first column, labeled "Cancer effect", shows the main effect.

F Additional Tables and Figures

Table F.1: The Effect of a Health Shock on Annuity Investment for Individuals Diagnosed ±24 and ±12 Months Pre- and Post-Retirement

	(1) Diagnosis ±24 Months Around Retirement Cancer diagnosis effect	(2) Diagnosis ±12 Months Around Retirement Cancer diagnosis effect
Malign cancer	-0.040	-0.042
SE	0.008	0.012
N	10,385	5,373
Controls	Yes	Yes

Notes: This table reports the effects of receiving a first-time cancer diagnosis on annuity decision. The coefficients shown are the marginal effects from a logit estimation of Eq. (2) and are based on the sub-sample of all participants who were diagnosed with malignant cancer 24 and 12 months around retirement.

Table F.2: The Effect of a Health Shock on Annuity Investment: Including Parental Longevity Controls and Among Healthy Individuals.

	(1) Parental Longevity Control	(2) Healthy Individuals
Malign cancer	-0.044	-0.044
SE	0.008	0.007
N	11,063	13,653
Controls	Yes	Yes
Benign cancer	-0.018	-0.023
SE	0.008	0.007
N	10,091	14,047
Controls	Yes	Yes

Notes: Column (1) includes a control variable for the age of death of the same-sex parent. The parental longevity restrictions outlined in Section 7.1 are applied in addition to the main sample restrictions for the cancer diagnosis analysis. Column (2) restricts the sample to individuals without any prior hospitalizations. For further details refer to the notes in Table 3.

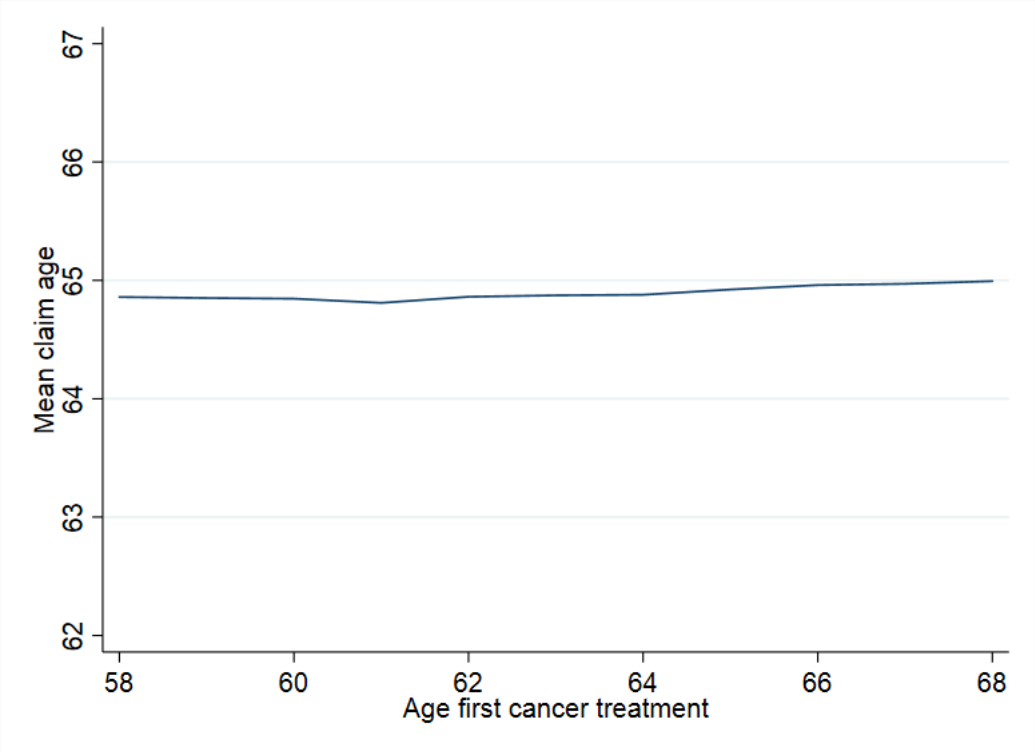
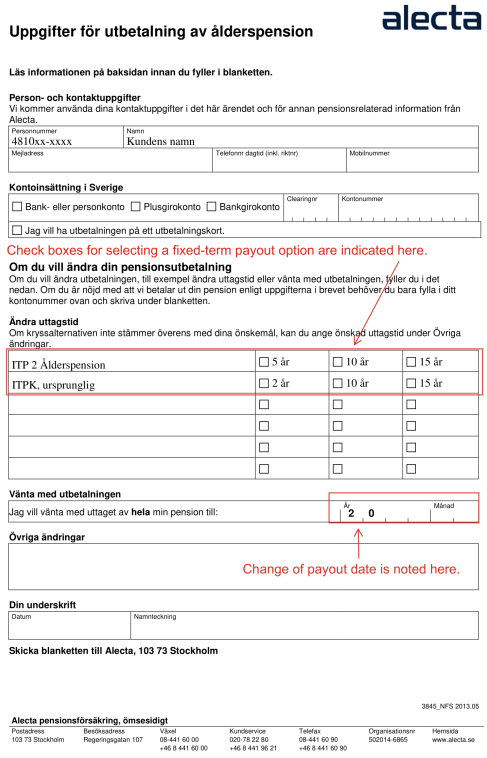


Figure F.1: Mean claim age by age of first-time cancer diagnosis.

Figure F.2: Excerpts from Alecta's pension application letter.



Uppgifter för utbetalning av ålderspension

alecta

Läs informationen på baksidan innan du fyller i blanketten.

Person- och kontaktuppgifter
Vi kommer använda dina kontaktuppgifter i det här ärendet och för annan pensionsrelaterad information från Alecta.

Personnummer	Namn	
4810xx-xxxx	Kundens namn	
Mejladress	Telefonnr dagtid (inkl. riktnr)	Mobilnummer

Kontoinsättning i Sverige

☐ Bank- eller personkonto ☐ Plusgirokonto ☐ Bankgirokonto | Clearingnr | Kontonummer

☐ Jag vill ha utbetalningen på ett utbetalningskort.

Check boxes for selecting a fixed-term payout option are indicated here.

Om du vill ändra din pensionsutbetalning
Om du vill ändra utbetalningen, till exempel ändra uttagstid eller vänta med utbetalningen, fyller du i det nedan. Om du är nöjd med att vi betalar ut din pension enligt uppgifterna i brevet behöver du bara fylla i ditt kontonummer ovan och skriva under blanketten.

Ändra uttagstid
Om kryssalternativen inte stämmer överens med dina önskemål, kan du ange önskad uttagstid under Övriga ändringar.

ITP 2 Ålderspension	☐ 5 år	☐ 10 år	☐ 15 år
ITPK, ursprunglig	☐ 2 år	☐ 10 år	☐ 15 år
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐

Vänta med utbetalningen

Jag vill vänta med uttaget av **hela** min pension till: | År: 2 0 | Månad

Övriga ändringar

Change of payout date is noted here.

Din underskrift

Datum	Namnteckning

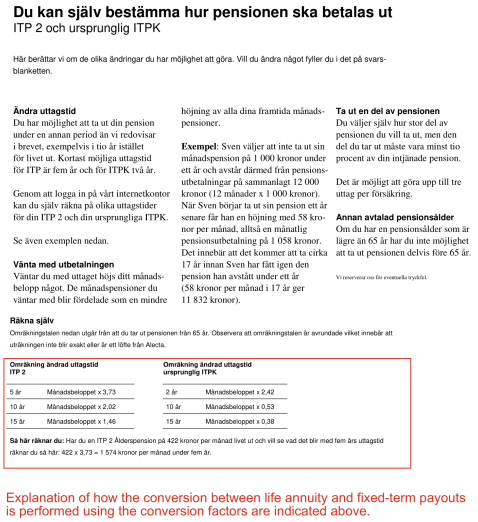
Skicka blanketten till Alecta, 103 73 Stockholm

3845_NFS 2013.05

Alecta pensionsförsäkring, ömsesidigt

Postadress	Besöksadress	Växel	Kundservice	Telefax	Organisationsnr	Hemsida
103 73 Stockholm	Regeringsgatan 107	08-441 60 00 +46 8 441 60 00	020-78 22 80 +46 8 441 96 21	08-441 60 90 +46 8 441 60 90	502014-6865	www.alecta.se

(a) Page 4 of Application Letter



Du kan själv bestämma hur pensionen ska betalas ut
ITP 2 och ursprunglig ITPK

Här berättar vi om de olika ändringar du har möjlighet att göra. Vill du ändra något fyller du i det på svarsblanketten.

Ändra uttagstid
Du har möjlighet att ta ut din pension under en annan period än vi redovisar i brevet, exempelvis i tio år istället för livet ut. Kortast möjliga uttagstid för ITP är fem år och för ITPK två år.

Genom att logga in på vårt internetkontor kan du själv räkna på olika uttagstider för din ITP 2 och din ursprungliga ITPK.

Se även exemplen nedan.

Vänta med utbetalningen
Väntar du med uttaget höjs ditt månadsbelopp något. De månadspensioner du väntar med blir fördelade som en mindre höjning av alla dina framtida månadspensioner.

Exempel: Sven väljer att inte ta ut sin månadspension på 1 000 kronor under ett år och avstår därmed från pensionsutbetalningar på sammanlagt 12 000 kronor (12 månader x 1 000 kronor). När Sven börjar ta ut sin pension ett år senare får han en höjning med 58 kronor per månad, alltså en månatlig pensionsutbetalning på 1 058 kronor. Det innebär att det kommer att ta cirka 17 år innan Sven har fått igen den pension han avstått under ett år (58 kronor per månad i 17 år ger 11 832 kronor).

Ta ut en del av pensionen
Du väljer själv hur stor del av pensionen du vill ta ut, men den del du tar ut måste vara minst tio procent av din intjänade pension.

Det är möjligt att göra upp till tre uttag per försäkring.

Annan avtalad pensionsålder
Om du har en pensionsålder som är lägre än 65 år har du inte möjlighet att ta ut pensionen delvis före 65 år.

Vi reserverar oss för eventuella tryckfel.

Räkna själv
Omräkningstalen nedan utgår från att du tar ut pensionen från 65 år. Observera att omräkningstalen är avrundade vilket innebär att uträkningen inte blir exakt eller är ett lötte från Alecta.

Omräkning ändrad uttagstid ITP 2		Omräkning ändrad uttagstid ursprunglig ITPK	
5 år	Månadsbeloppet x 3,73	2 år	Månadsbeloppet x 2,42
10 år	Månadsbeloppet x 2,02	10 år	Månadsbeloppet x 0,53
15 år	Månadsbeloppet x 1,46	15 år	Månadsbeloppet x 0,38

Så här räknar du: Har du en ITP 2 Ålderspension på 422 kronor per månad livet ut och vill se vad det blir med fem års uttagstid räknar du så här: 422 x 3,73 = 1 574 kronor per månad under fem år.

Explanation of how the conversion between life annuity and fixed-term payouts is performed using the conversion factors are indicated above.

(b) Page 7 of Application Letter

Notes: This figure shows two excerpts from Alecta's pension application form that is sent out approximately three months prior to an individual's 65$^{\text{th}}$ birthday. The application form consists of 7 pages. Changing from the default life annuity to alternative fixed-term payouts is done on page 4, as well as a change of payout time (age). Page 7 provides more detailed information on the economic implications of choosing a fixed term payout instead of a life annuity– i.e. through the conversion factors. The remaining pages provide information on the monthly payments under the default options and more general information to the retiree about payout decisions and Alecta, and are available upon request.