Lifetime Annuity – Insurance or Risky Investment?

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ABSTRACT

The roots of the annuity puzzle, recognized as an unexpectedly low demand for lifetime annuities compared to theoretical predictions, are the subject of an ongoing research debate. In this study, we present empirical evidence that may cast new light on this issue. Utilizing data from a nationwide survey combined with a non-incentivized experiment on pension attitudes, we investigate the dual nature of individuals' risk perception associated with lifetime annuity products. A wide range of control variables is employed to ensure the robustness of the results. We find a significant relationship between the demand for lifetime annuities and one's relative risk attitude in two areas. Consequently, lifetime annuity buyers are likely to be risk-averse but, at the same time, risk-tolerant when it comes to financial matters. We argue that individuals view lifetime annuities not just as a hedge against longevity risk but also as an investment vehicle with uncertain future payouts.

1   Introduction

Due to the ongoing population ageing, the adequacy of public pension benefits in the Western World is steadily declining. For this reason, individuals need to seek other financial sources to complement their old-age income, and private pension plans are one of them. Whether these programs successfully protect against old-age poverty depends both on the value of assets accumulated during the working age and the protocol for assets' withdrawal. In this study, we focus on this latter stage.

Usually, in private pension plans, participants select the assets' decumulation method at their discretion, and a lifetime annuity may be one of the options. This consists of a series of payments made while the beneficiary is alive (Gerber, 1997, 12:35). A lifetime annuity enables income smoothing and eliminates the risk of outliving the assets. It is unsurprising then, in the seminal Yaari's (1965) model, agents find it optimal to annuitize their whole wealth. However, the empirical evidence shows that individuals rarely purchase lifetime annuities voluntarily. Therefore, the longevity risk is not hedged, which may result in adverse social outcomes.

The literature provides a list of potential factors that lead to the observed low annuitization, yet we offer a new hypothesis, hoping to contribute to this debate. In this study, we follow the concept known from the behavioral works, which is that risk attitude is a multidimensional phenomenon, thus making a claim that it also matters in the case of annuitization decisions. We argue that individuals simultaneously perceive a lifetime annuity as a hedge against longevity, and also as an investment with an uncertain stream of future payments. Consequently, what drives the demand for lifetime annuity is not a unidimensional risk attitude, but rather the relative risk attitude in the two investigated domains. We support the hypothesized relationship by employing the data from the dedicated survey on individuals' pension attitudes, which was based on a nationwide, representative sample.

The remainder of the paper is organized as follows: the next section surveys the literature on risk attitudes and lifetime annuity demand drivers to highlight the contribution of our work. After that, we briefly outline the design of the Polish pension system with a special focus on the lifetime annuity issues. Then, we describe our measurement instruments and the sample under investigation. Next, we report the empirical outcomes. The final section offers concluding remarks and directions for further research.

2   Literature Review

The dominant view regarding the role of risk attitude for lifetime annuity demand comes from Yaari's (1965) seminal model: rational and risk-averse

individuals, without the bequest motive find it optimal to annuitize their whole wealth. Davidoff *et al.* (2005) find the sufficient conditions of annuitization even less restrictive, yet still, risk-averse individuals should be more willing to annuitize relative to risk-tolerant ones. This theoretical postulate has been widely confirmed on empirical grounds (Bütler and Teppa, 2007; Chalmers and Reuter, 2012), but still, low annuity rates observed in the societies suggest that risk attitude cannot be a single driver of annuitization. Consequently, a significant amount of academic research has been dedicated to identifying the factors responsible for the unexpectedly low demand for lifetime annuities compared to theoretical predictions. This phenomenon is commonly referred to as the *annuity puzzle* (Benartzi *et al.*, 2011).

One key remaining factor is the presence of a bequest motive, which can restrain individuals from annuitization. This stylized fact has been confirmed in the US (Ameriks *et al.*, 2011), the UK (Inkmann *et al.*, 2011), and in a cross-country study (Horneff *et al.*, 2014). Furthermore, the literature has identified several other factors that discourage individuals from annuitizing, including their perception of their own relatively short life expectancy (Hagen, 2015), a low inclination for delayed gratification (Cappelletti *et al.*, 2013; Bütler and Teppa, 2007), having alternative sources of retirement income (Hagen, 2015), limited financial expertise (Brown *et al.*, 2017), and a general lack of trust in financial institutions (Goedde-Menke *et al.*, 2014). Additionally, traditional demographic variables such as being married, male, having lower income, and less education have also been found to be correlated with low annuity demand.[1] Therefore, when investigating the role of risk attitude in annuitization, it is essential to consider a variety of controls to ensure the robustness of the results.

However, some studies seek an explanation for the annuity puzzle by directly contesting one of the most fundamental assumptions of Yaari's (1965) model regarding the impact of risk attitude. Brown *et al.* (2008), under a non-incentivized experimental setting, found that subjects were more likely to opt for lifetime annuities when these contracts were framed as insurance against a drop in consumption (using the words 'spend' and 'payment' in the description; hereafter *insurance perspective*) rather than as an investment product (using the words 'investment' and 'earnings' and emphasizing the high initial investment value; hereafter *investment perspective*). In a later experiment, Bockweg *et al.* (2018) combined these two perspectives with gain and loss frames and found that the impact of framing mix may vary with respect to gender, age, risk attitude, and debt position.[2] In the theoretical

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[1]See Alexandrova and Gatzert (2019) for a comprehensive review.

[2]Interestingly, Brown *et al.* (2021) provided evidence that the growing complexity of annuity product descriptions diminishes annuity demand. Additionally, Hagen *et al.* (2022) found that nudging particular payout decisions may have unintended effects on labor supply, encouraging individuals to retire earlier.

model by Bommier and Le Grand (2014), high risk-aversion, coupled with the bequest motive, even leads to a negative demand for lifetime annuities. Lastly, in the empirical study conducted by Guillemette *et al.* (2016), individuals who are more risk-tolerant exhibit a higher willingness to purchase lifetime annuities. Following the aforementioned works, Guillemette *et al.* (2016) speculate that, depending on how lifetime annuities are presented, individuals may focus more on the high upfront cost of such a contract. This particular feature distinguishes lifetime annuities from other insurance products (e.g., auto casco insurance), where premiums are much lower relative to eventual compensation. Consequently, one may think of a lifetime annuity similarly to an equity purchase, where the upfront investment is high, the stream of future payments is unknown, and the contract is 'lost' in case of the buyer's death.

The mixed outcomes on the role of risk attitude may be attributed to their limited focus on one of the aforementioned perspectives of lifetime annuity risk. In contrast, the literature on behavioral patterns finds risk attitude to be a multidimensional phenomenon (Weber *et al.*, 2002), implying that an individual's risk attitude should be measured separately across various domains. In particular, this multidimensionality has also been recognized in the insurance market. Cutler *et al.* (2008) found that different measures of risk preferences correlated differently with various types of insurance products. For this reason, Hagen *et al.* (2024) used financial domain risk indicators to approximate the risk preference of lifetime annuity buyers. However, we argue that since annuities can be seen as both a hedge against longevity and a potentially risky investment product, we need to employ indicators from two risk domains simultaneously. Therefore, we hypothesize that what matters is the relative attitude towards these two distinct risk factors.

3   Pension System and Lifetime Annuities in Poland

Similar to other European countries, the public pension system in Poland operates under the defined contribution (DC) rule. This involves recording contributions on individual accounts, and the value of the lifetime pension benefit depends on the sum of contributions paid, along with the accrued interest rate, and the expected lifetime. Consequently, this system is generally designed to be actuarially fair, but there is one fundamental trade-off that needs to be clearly stated. From the perspective of an aging society, this system prevents the working generation from experiencing a steady increase in the value of pension contributions paid (since the contribution rate is defined, i.e., fixed). However, it also leads to a steady decline in the value of pension benefits received due to the rising old-age dependency ratio, unless the system lifts up its parameters, such as the statutory retirement age or the contribution rate.It is expected then that the gross replacement rate of benefits will fall from

54% to 25% in Poland, and similar declines are observed in other European countries that have adopted the DC rule (European Commission, 2021).

The Polish public system is based on two pillars. The first mandatory pillar operates on a non-financial defined contribution (NDC) basis. This implies that members' contributions are recorded on individual accounts, which can be treated as claims by the government. In the second pillar, which is now voluntary (the participants may decide whether to contribute solely to the first or split their mandatory contributions between the first and second pillar), individual accounts have also been established, but members here collect financial assets (FDC). The second pillar is comprised of open pension funds managed by private companies.

When the pension reform was introduced in 1999, the government intended to offer participants two streams of lifetime benefits from the two pillars. However, as the system was approaching the moment when the first pension benefits were to be paid from the FDC, the government decided that 10 years before reaching the retirement age, the assets would betransferred gradually from pension funds to the Social Security Office, which administers the first pillar. Consequently, the Social Security Office became the sole institution offering lifetime benefits in the public system. This regulatory decision was controversial for numerous reasons. Needless to say, even the open pension funds or the financial sector institutions in general were not very keen to offer lifetime benefits, being apprehensive of numerous risks related to this product, such as uncertainty regarding population mortality risk or likely adverse selection[3] (Qiao and Sherris, 2013; Szczepański and Brzęczek, 2022).

It is not surprising that in the third pension pillar, which comprises voluntary or quasi-voluntary pension plans, the offer a lifetime stream of income in exchange for the accumulated assets is very scarce and unpopular among the potential buyers. Typically, financial institutions offer lump sum payments or some form of annuity certain during the payout phase, which does not bear the aforementioned risks.

However, over the last decade, a few companies have begun to offer some form of equity release (reverse mortgage or home revision), which provides a lifetime stream of cash benefits for seniors in exchange for real estate. Nonetheless, this market remains very niche. The financial literacy of likely buyers is usually low, and their trust in financial institutions is limited. On the other hand, the present value of the benefits offered to seniors under

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[3]However, some studies in the annuities market indicate the opposite, suggesting that advantageous selection is also possible. Illanes and Padi (2019) found a correlation between the bequest motive and longevity, which makes long-living individuals less likely to purchase annuities. De Donder *et al.* (2023) recommend that, since longevity is linked to better health status, bundling annuities with long-term care insurance could address the adverse selection challenge.

an equity release framework is usually below 50% of the real estate value (Kowalczyk-Rólczyńska, 2018).

In summary, the current options for hedging longevity risk in the private market in Poland are extremely limited, prompting numerous experts to advocate for changes in this area (Tyrowicz and Rutkowski, 2019). Given the continual decrease in pension benefits provided by the public system, this leads us to believe that the lifetime annuity market will expand. Consequently, research on the likely determinants of individuals' annuitization decisions is necessary to facilitate this process, and we hope our research will contribute to it.

4   Methods

To verify the hypothesized relationship, we needed to address two fundamental challenges. Firstly, in Poland, the market for private lifetime annuities is virtually non-existent. Therefore, we lacked actual data on real-life decisions and, instead, had to collect data on hypothetical ones. Often, to simulate the financial decisions of individuals, an experimental methodology with monetary payoffs is employed. Its primary advantage lies in ensuring incentive compatibility. However, in our case, simulating a lifetime annuity contract would be exceedingly challenging. The uncertainty of future payments typically poses one of the most significant methodological obstacles in incentivized experiments. If a participant is presented with a choice of a certain payment right now versus any payment two years from now, will they ever consider the latter? How can a researcher guarantee a payment that arrives so far in the future, ensuring that participants have no doubts about it? With this in mind, it is not surprising that many experiments are simply non-incentivized, estimating discount rates based on hypothetical questions. In Frederick *et al.* (2002, 378) review of experiments related to time preferences, out of 34 experiments reported, only 9 used financial incentives. Thus, for the aforementioned practical reasons, we are confined to non-incentivized experiments. Therefore, we decided to utilize the following survey question Y as a proxy of lifetime annuity demand:

Y: *Imagine you are 65 and you have 52,000 PLN in your private account, which you intend to spend for your pension needs. Mark the preferred option*[4]:

1. *withdraw 500 PLN monthly for ten years, which amounts to 60,000 PLN over this period,*

2. *withdraw 310 PLN monthly, for a lifetime.*

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[4]We exclude respondents aged 65 or more because, to test our hypothesis, we need to maintain the *ex-ante* nature of the decision problem.

Table 1: Thinking about retirement (Z) – Age distribution.

Age	18–29	30–39	40–49	50–59	60–64
No	69.4%	61.1%	53.3%	38.2%	36.1%
Neither yes nor no	11.8%	17.8%	18.9%	16.4%	15.6%
Yes	18.8%	21.2%	27.8%	45.5%	48.4%

Source: own elaboration.

The first option is an annuity certain, while the second is a lifetime annuity. The present value (PV) for both options is approximately equal[5], alongside a 3% yearly discount rate to reflect market conditions at the moment, when the interviews were carried.

For many young respondents, this question may pertain to an unimaginably distant future. Therefore, we cannot be certain whether the collected responses accurately reflect likely behavior, or in other words, whether respondents seriously consider the stated decision problem. For this reason, we utilize the following survey item Z to evaluate the probable credibility of the gathered data for annuity demand.

Z: Do you agree with the following statement: I often think about what my life will look like in retirement.

Similar survey items have been employed in various studies related to pension awareness (Elder, 1999; Alessie *et al.*, 2011). As Buchholtz *et al.* (2021) state, thinking about retirement is unpleasant (imagining themselves as ill and inefficient) and requires imagining difficult decisions that should be made. It is rather uncontroversial to assume that older individuals are more likely to seriously think about their future in retirement, however, there remains uncertainty regarding the specific age threshold. As a result, we have undertaken an examination of our data (Z) to establish this threshold (Table 1).

As expected, the proportion of positive responses to this question increases with the age of the respondents. Furthermore, we observe a significant increase in the percentage of positive responses among individuals aged 50 and older. However, it is noteworthy that other studies, such as those by Morgan and Eckert (2004) and Ogunbameru and Bamiwuye (2004), and Rickwood and White (2009), have highlighted the age of 40 as a significant threshold in the context of perceptions about old age. Therefore, we focus our analysis on respondents aged 50 and over, but to ensure the robustness of our findings, we also estimate models for the subsample of respondents aged 40 and above and present the results in the Appendix.

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[5]According to unisex expected lifetime tables published by Statistics Poland in 2019. https://stat.gov.pl/en/latest-statistical-news/communications-and-announcements/list-of-communiques-and-announcements/life-expectancy-for-both-sexes-combined,295,6.html

The second methodological challenge arises from measuring the relative risk attitudes toward two distinct factors. Consequently, we had to employ two separate proxies to assess risk attitudes in these two domains. To do this, we utilized two standard statements (X_1 and X_2) in which respondents, using a 1-7 Likert type scale, self-assess their tolerance for risk in general and in financial matters, respectively.

X_1: *Do you agree with the following statement: I am a person ready to make risky decisions.*

X_2: *Do you agree with the following statement: I am a person ready to make risky financial decisions.*

Again, we have an unincentivized self-assessment measure. Nevertheless, Dohmen *et al.* (2011), upon analyzing the data from a survey complimented by the field experiment, found that these ordinal variables represented by survey questions (X_1 and X_2) and paid lottery choices led to similar conclusions regarding the risk attitude of individuals. Moreover, Dohmen *et al.* (2011) noted that the single best risk measure in any given context is the measure incorporating this specific context, for example, smoking cigarettes is most strongly correlated with the measure of health risk-taking. In our research, we assume that X_1 reflects risk-taking from an *insurance perspective*, as the general wording of this statement should also encompass existential risks (in our case, old-age poverty) that individuals mostly would like to hedge. At the same time, X_2 refers to risk-taking from an *investment perspective*, which fits the second aforementioned risk perspective of lifetime annuity.

Finally, we introduce the relative risk propensity measure (X_3), which is defined by the following formula:

$$X_3 = X_2 - X_1 \tag{1}$$

Its interpretation is intuitive and simple. Whenever its value is rising (falling), it means that an individual's tolerance for financial risk grows (falls) relative to risk tolerance in the general domain. We hypothesise that higher X_3 values should be correlated with higher demand for a lifetime annuity.

Our modelling strategy then becomes a two-step procedure to ensure the robustness of our findings. In the first step, we run an analysis for three pairs of variables: an annuitization decision (Y) and a single measure of risk propensity (X_1 or X_2 or X_3).

Next, we examine the relationship between lifetime annuity demand and its potential determinants by estimating the following binary logistic regression:

$$P(Y = 1) = \frac{\exp\left(b_0 + risk\,propensity\,variable + \sum_{i=4}^{15} b_i x_i\right)}{1 + \exp\left(b_0 + risk\,propensity\,variable + \sum_{i=4}^{15} b_i x_i\right)} \tag{2}$$

where risk propensity variable means X_1 or X_2 or X_3.

This time, to verify the relationship between risk attitude and annuity demand, we employ a set of controls (Table 2).

The hypothesized impact of these controls for annuitization decisions has been mostly discussed in the literature review, but here we would like to make a few additional comments:

- Bequest motive (X_7): asking about having kids is frequently used as a proxy for the bequest motive (Kopczuk and Lupton, 2007).

- Real estate (X_{10}): property ownership means having a valuable asset that may be converted into cash during old age. For this reason, we expect here a negative sign.

- Financial investments (X_{11}): people who confirmed using financial investment products may be more financially literate or have higher financial risk tolerance, hence should be more likely to buy lifetime annuities. On the other hand, having a large stock of assets may provide a sufficient hedge against longevity risk, and consequently may lower the preference for annuitization. Yet, we are unsure about the expected sign for this variable.

- Expected lifetime (X_{12}): Hagen (2015) claimed that individuals form their expectation of how long they are likely to live by taking into account the longevity of their relatives. We speculate that those respondents who admit to having long-lived relatives should demand lifetime annuities more.

- Trust in annuity provider (X_{14}): Actually, the key provider of lifetime annuity insurance in Poland is the Social Security Office, which is a part of the public pension system. For this reason, we have added this question to our control set.

- Demand for commitment (X_{15}): according to Beshears *et al.* (2020), individuals who are aware of their self-control problems may prefer savings products with restricted liquidity. We hypothesize that an annuity, where early withdrawals are constrained, may also be in higher demand by this type of respondent. To the best of our knowledge, this effect has not been investigated so far in the annuity context.

We believe that employing a broad set of controls should enhance the validity of our findings regarding the impact of risk attitude on annuitization.

Table 2: Control variables description.

Symbol	Variable name	Phenomenon	Variables type	Values	Expected impact (sign)
X_4	Male	Gender	Binary	0 – no (female), 1- yes (male)	–
X_5	Age	Age	Ordinal	1 - 18-24, 2 – 25-29, 3 – 30-34, 4 – 35-39, 5 – 40-44, 6 – 45-49, 7 – 50-54, 8 – 55-59, 9 – 60-64	+
X_6	Marriage	Being married	Binary	0 - no, 1- yes	–
X_7	Bequest motive	Number of kids	Quantitative (discrete)	Integer value	–
X_8	Education	Tertiary education	Binary	0 - no, 1- yes	+
X_9	Economics status	Household's economic status self-assessment	Ordinal	1-7 Likert type scale, where 1- very low and 7- very high	+
X_{10}	Real estate	Property ownership	Binary	0 - no, 1- yes	–
X_{11}	Financial investments	Having financial investments	Binary	0 - no, 1- yes	+/–
X_{12}	Expected lifetime	Having longevity relative	Binary	0 - no, 1- yes	+
X_{13}	Time preference	Propensity to wait: non-incentivised experiment	Binary	0 - no (early reward), 1- yes (late reward)	+
X_{14}	Trust in annuity provider	Trust in the Social Security office	Ordinal	1-7 Likert type scale, where 1- very low and 7- very high	+
X_{15}	Demand for commitment	Demand for a financial product with restricted liquidity: non-incentivised experiment	Binary	0 - no, 1- yes	+

Source: own elaboration.

Table 3: Sociodemographic structure.

	Full sample (respondents aged 18 and more)	Subsample A (respondents aged 50-64)		Subsample B (respondents aged 40-64)	
n	1069	249		432	
	Mean	Mean	*% dif*	Mean	*% dif*
Male	0.4773	0.5030	5.4	0.4857	1.8
Marriage	0.5992	0.7617	27.1	0.7477	24.8
Tertiary education	0.3300	0.2888	12.5	0.2002	39.3
Economic status	4.18	4.17	0.2	4.02	3.8

Source: own elaboration.

Note: % dif – absolute percentage difference in means between individuals aged <18- and more>and the specific subsample.

5 Data

The data comes from a dedicated questionnaire survey that explored various aspects of pension-related decisions and their likely determinants. This survey was conducted in November 2019 using the Computer-Assisted Personal Interviewing (CAPI) method and involved 1,069 adult individuals aged 18 years and above in Poland. The survey was administered by a reputable research agency.[6]

The study was carried out on a nationwide, representative sample, taking into account spatial dispersion – the voivodship, and the type of residential area (e.g., village, small town). Within each household, a respondent was selected randomly using the Kisch grid, and 105 interviews were subsequently verified after completion (accounting for 9.8% of the interviews).

According to the aforementioned methodological concerns, we have decided to focus on the two subsamples: individuals aged 50–64 (subsample A) and those aged 40–64 (subsample B, robustness check in the Appendix).

The mean values for the basic sociodemographic characteristics used in our modelling are summarized in Table 3 (Appendix, Table A1).

We observe that the differences between the full sample and the subsamples are small in terms of economic status but most pronounced in the categories of

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[6]The selection criteria included meeting the certification requirements (ESOMAR and PKJPA, Polish quality certificates for questionnaire research) and ensuring sufficient quality in data collection with rigorous post hoc verification. The study's sampling frame was based on the TERYT database, used by Statistics Poland for representative surveys. This comprehensive approach ensured the data's high quality and its representativeness of the adult Polish population.

Table 4: Basic statistics for Subsample A.

	Subsample A	Subsample A: annuity certain $(Y = 0)$	Subsample A: lifetime annuity $(Y = 1)$
X_1 mean	3.53	3.54	3.52
X_2 mean	3.30	3.16	3.43
X_3 mean	-0.2308	-0.3765	-0.0820
$Cor(X_1 X_2)$	0.721	0.687	0.741
n	*249*	*122*	*125*

Source: own elaboration.

Note: Two respondents did not answer the question about the preferred annuity type.

married individuals and those who have completed tertiary education. However, this outcome is expected, given the specific age groups within our subsamples.

6   Empirical Results

We begin the analysis by briefly examining the mean values of the core variables in our study (Table 4).

We observe that for X_1 and X_2 these means are lower than 4, falling below the mid-point on the employed Likert scale. This suggests that, in general, respondents display a slight aversion in both risk domains. We also note that the mean values of X_1 are higher than those of X_2, indicating that people are more inclined to accept risk in the general domain relative to the financial domain. However, for individuals who choose the lifetime annuity $(Y = 1)$ risk tolerance in general domain (X_1) is lower, and risk tolerance in financial domain (X_2) is higher comparing to the average values of these variable for those who pick up annuity certain $(Y = 0)$. This preliminary result grounds our intuition about the role of two conflicting risk perspectives in annuitization decisions. It is also noteworthy that, similar to Dohmen *et al.* (2011), the correlation coefficient (d-Sommers) between the two measures of risk appetite in various domains is high.

In the next step, we run an analysis to investigate whether X_1 or X_2 or X_3 possess any predictive power in explaining the variation in the demand for the lifetime annuity (Y). We verify it using a chi-square test.

According to the chi-square test, it becomes evident that neither X_1 nor X_2 has any predictive power in explaining the variability of Y. On the other hand, there is a highly significant relationship between X_3 and Y. However, the nature of this relationship remains unknown. To determine whether individuals with a higher relative risk propensity are more likely to choose annuitization,

Table 5: Chi-square test results for Subsample A.

	Chi-square	p
X_1	7.684	*0.262*
X_2	7.261	*0.297*
X_3	23.220	*0.003*

Source: own elaboration.

we run a U Mann-Whitney test. Here, we find the test statistics to be positive (2.5604) and significant ($p = 0.0105$). This should be interpreted as that mean relative risk propensity (X_3) for individuals who pick up lifetime annuity ($Y = 1$) is higher than a mean X_3 for respondents who pick up annuity certain ($Y = 0$), which provides further evidence that supports our hypothesis.

However, as discussed earlier, numerous other factors can potentially influence annuitization. Their analysis is necessary to provide evidence that the observed relationship between X_3 and Y is not spurious. Therefore, we estimate the models with a comprehensive set of control variables (Table 6).

The models' statistics confirm their accuracy. The Hosmer-Lemeshow test indicates a proper fit to the data for every model specification (*p-value* above 0.1), and according to the confusion matrix, our models correctly classify at least 61% of individuals who choose a lifetime annuity and more than 68% of those who prefer certain annuities.

The signs of the estimated coefficients for X_1 and X_2 indicate that individuals are more likely to demand lifetime annuities when they are either more risk-averse in general or more risk-tolerant in the financial domain. However, these estimates lack statistical significance. Therefore, we conclude that neither of them, when considered separately, holds substantial meaning for annuitization decisions.

On the other hand, when we substitute the risk proxy with X_3, which represents the difference between X_2 and X_1, we find that the estimated parameter becomes significant. Furthermore, its sign aligns with the hypothesised relationship: as an individual's relative risk propensity (X_3) increases, the demand for lifetime annuities (Y) grows.

It is also worth analyzing the results for the set of control variables. Most of them were found to be insignificant, but we have a few notable exceptions. Certainly, trust in the Social Security Office, which is the sole provider of lifetime annuities in Poland, holds significant meaning. It supports the intuition that this type of insurance, often involving long-lasting contracts, cannot exist without a high degree of confidence.

Unsurprisingly, lifetime annuities are in higher demand among better-educated individuals and those with fewer children, likely due to the limited bequest motive. Additionally, we find that the attitude, which we label as the

Table 6: Binary logistic regressions for three model specifications. Subsample A.

Variable		Model 1		Model 2		Model 3	
		Estimate	p-value	Estimate	p-value	Estimate	p-value
X_1	General risk propensity	−0.080	0.420	–	–	–	–
X_2	Financial risk propensity	–	–	0.030	0.758	–	–
X_3	Relative risk propensity	–	–	–	–	0.264	0.090
X_4	Male	0.212	0.542	0.116	0.739	0.122	0.719
X_5	Age	−0.148	0.479	−0.150	0.471	−0.124	0.560
X_6	Marriage	1.150	0.007	1.114	0.009	1.133	0.008
X_7	Bequest motive (number of kids)	−0.316	0.037	−0.328	0.028	−0.293	0.053
X_8	Education	0.873	0.066	0.853	0.070	0.995	0.040
X_9	Economics status	−0.140	0.218	−0.164	0.144	−0.138	0.221
X_{10}	Real estate	0.197	0.644	0.198	0.643	0.129	0.764
X_{11}	Financial investments	0.812	0.062	0.770	0.078	0.707	0.106
X_{12}	Expected lifetime	0.274	0.429	0.266	0.442	0.274	0.432
X_{13}	Time preference	0.425	0.222	0.396	0.251	0.521	0.143
X_{14}	Trust in annuity provider	0.339	<0.001	0.323	0.001	0.323	0.001
X_{15}	Demand for commitment	0.737	0.038	0.715	0.044	0.676	0.059
	Constant	−0.719	0.678	−0.782	0.652	−1.041	0.554
	Hosmer-Lemeshow	8.076	0.426	7.800	0.453	8.896	0.351
	R-Nagelkerke	0.232		0.229		0.245	
	Confusion matrix in %	69.6 (70.2; 66.9)		64.9 (68.3;61.4)		69.0 (72.2;65.9)	

Source: own elaboration.

Note: For the confusion matrix, the first value denotes the proportion of all correctly classified observations. This includes the share of correctly classified annuity certain choices (the first value in bracket) and the share of correctly classified lifetime annuity choices (the second value in bracket).

demand for commitment, becomes a significant predictor. This suggests that people who are aware of their self-control problems tend to opt for annuitization more frequently. This finding should have some meaning for annuity pricing and potential marketing campaigns, as it demonstrates that some individuals view the lack of liquidity as an advantage.

We also observe an intriguing outcome – in our sample, married individuals were more likely to choose longevity protection. Most studies show the opposite effect. However, mixed results regarding the role of being married have also been found in Beshears *et al.* (2014) and Hagen (2015). This aspect, therefore, requires further research attention.

Last but not least, the analysis conducted for subsample B (see Tables A2 and A3 in the Appendix), serving as a robustness check, does not alter any of these findings.

7   Conclusions

We have demonstrated that the risk perception of a lifetime annuity has at least two significant dimensions: an annuity as a hedge against outliving the assets, and an annuity as an investment with an uncertain stream of payouts. Hence, lifetime annuities should be demanded the most by individuals who are simultaneously low risk-tolerant in general and high risk-tolerant in financial domains. Moreover, risk attitude in neither of these two domains can separately explain the annuitization decisions. What matters is the relative propensity to risk-taking. Given the fact that, in the sample, individuals on average have higher risk tolerance in the general domain relative to risk tolerance in financial domain, this may explain the *annuity puzzle* – phenomenon observed cross-country. Therefore, based on this finding, we can provide some policy recommendations that should support the development of the private lifetime annuity market.

The government should consider offering additional benefits in exchange for annuitization, such as tax relief or facilitated access to public services, similar to the support frequently provided to encourage participation in private pension plans. Additionally, policymakers may introduce behavioral interventions like default options that guide individuals toward more financially secure retirement choices, including the selection of lifetime annuities.

Potential annuity providers can also play a role in facilitating annuitizations. Insurance companies should expand their product offerings to include hybrid annuity options that offer some flexibility in terms of payouts. For example, if the annuitant passes away in the early years of the contract, the remaining capital could be inherited. This shift would help mitigate the perception of lifetime annuities as highly risky in financial terms.

Last but not least, our supplementary results underscore the importance of trust. Regulating the annuity market to ensure transparency and consumer protection becomes a necessary condition for the development of the annuity market. This can foster trust in lifetime annuities and encourage more individuals to consider them as a desirable retirement option.

A Appendix

Table A1: Basic statistics for Subsample B.

	Subsample B	Subsample B: annuity certain $(Y = 0)$	Subsample B: lifetime annuity $(Y = 1)$
X_1 mean	3.64	3.71	3.65
X_2 mean	3.34	3.25	3.44
X_3 mean	−0.3013	−0.4657	−0.1088
$Cor(X_1 X_2)$	0.665	0.606	0.717
n	432	221	205

Source: own elaboration.
Note: six respondents did not answer the question about the preferred annuity type.

Table A2: Chi-square and U Mann-Whitney test results for Subsample B.

	chi-square	p	U Mann-Whitney	p
X_1	10.782	*0.095*	–	–
X_2	7.880	*0.247*	–	–
X_3	38.811	*< 0.001*	3.6303	*0.0003*

Source: own elaboration.

Table A3: Binary logistic regressions for three specifications. Subsample B.

	Variable	Model 1		Model 2		Model 3	
		Estimate	p-value	Estimate	p-value	Estimate	p-value
X_1	General risk propensity	−0.181	0.016	–	–	–	–
X_2	Financial risk propensity	–	–	0.013	0.850	–	–
X_3	Relative risk propensity	–	–	–	–	0.326	0.001
X_4	Male	0.042	0.859	−0.040	0.865	−0.064	0.785
X_5	Age	0.117	0.183	0.129	0.138	0.119	0.177
X_6	Marriage	0.676	0.022	0.562	0.053	0.583	0.046
X_7	Bequest motive (number of kids)	−0.232	0.048	−0.230	0.045	−0.226	0.054
X_8	Education	0.194	0.485	0.201	0.464	0.229	0.415
X_9	Economics status	0.137	0.090	0.093	0.236	0.121	0.126
X_{10}	Real estate	−0.137	0.658	−0.096	0.755	−0.105	0.733
X_{11}	Financial investments	0.353	0.232	0.323	0.269	0.333	0.264
X_{12}	Expected lifetime	0.489	0.036	0.455	0.049	0.416	0.076
X_{13}	Time preference	0.514	0.031	0.458	0.052	0.611	0.012
X_{14}	Trust in annuity provider	0.235	< 0.001	0.201	0.003	0.200	0.003
X_{15}	Demand for commitment	0.576	0.018	0.515	0.032	0.520	0.032
	Constant	−2.488	0.002	−2.803	< 0.001	−2.797	< 0.001
	Hosmer-Lemeshow	3.740	0.880	10.343	0.242	2.715	0.951
	R-Nagelkerke	0.145		0.126		0.163	
	Confusion matrix in %	64.8 (72.0; 56.7)		60.9 (67.7;53.4)		64.8 (69.8; 59.2)	

Source: own elaboration.

Note: For the confusion matrix, the first value denotes the proportion of all correctly classified observations. This includes the share of correctly classified annuity certain choices (the first value in bracket) and the share of correctly classified lifetime annuity choices (the second value in bracket).

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