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Behavioural Biases in Investment Decisions of Pension Savers: Evidence from the 2nd Pillar of the Pension System in Slovakia

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Abstract The paper investigates the risk aversion and decision-making of pension fund investors within the investment pillar of the Slovak pension system. The default strategy of the investment pillar of the Slovak pension system was based on a conservative, guaranteed bond portfolio, between 2012–2023, which is not an optimal strategy for virtually any investor. A sample of the economically active population under the age of 50 was used to study how personality traits, sociodemographic and economic characteristics influence risk aversion and inertia among pension investors within the context of a bond portfolio default strategy. This represents a unique framework, which to the best of our knowledge, has not been replicated elsewhere. The analysis is based on the sample of 100 respondents. The data were collected by a professional survey agency. The results show that the personality traits of agreeableness and conscientiousness are associated with higher risk aversion, while openness to new experiences is associated with lower risk aversion. Agreeable people were less likely to opt out of the default investment strategy. Individual characteristics, such as gender, age, and mother's education, increased reluctance to opt out of the default investment strategy. On the contrary, individuals whose parents invest were more likely to opt out of the default investment strategy.

Keywords Behavioural biases · Investor behaviour · Public policy · Pension systems

JEL D91 · G41 · H55 · J32

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Introduction

Over the past two decades the growing use of digital devices, the internet and globalisation made investing accessible to and adopted by an increasing number of individuals. Individual investment products have become popular among people without more substantial specialized knowledge or previous trading experience. At the same time, in some countries, pension systems have been set up on an investment basis, or as an investment pillar to complement pay-as-you-go schemes, which can be managed by the pension savers themselves.

Pension systems have also become the focus of behavioural research, which assessed how to improve the decision making of individual investors, to overcome their potential behavioural biases and shortcuts and improve their investment returns. A common way to improve the decision making of pension savers is to set predefined default investment strategies to nudge them to optimally distribute their investment portfolio. However, pension savers normally also have the ability to opt out of the default investment strategy and chose a strategy which corresponds to their preferences.

In recent years, changes in the pension system have been introduced also in Slovakia. The Slovak pension system is based on two key pillars, a pay-as-you-go pillar (i.e., 1st pillar) and an investment pillar (i.e., 2nd pillar). Relevant for this research, the reform is based on the government decision to introduce a default strategy based on a conservative investment strategy that took place in 2012. Prior to 2012, there was no default investment strategy. Investors were able to allocate their funds into portfolios based on their risk preference.[1] Therefore, all investors in the 2nd pillar of the pension system were assigned a conservative, bond-based portfolio.[2] They had the ability to opt out of the default strategy and choose their own investment allocation.

However, even after a decade and widespread public talk about the inadequacy of such a setup, more than 50% of all pension investors did not change their default investment strategy (The Association of Pension Funds, 2022). Due to the existing inertia regarding opting out of the default investment strategy, their investments were adversely affected since the stock market substantially outperformed the bond market. The behavioural approach suggests different reasons why individuals do not correct or update their behaviour in response to changes in their investment portfolio allocation. This can be due to status-quo bias, risk aversion or procrastination.

Considering the importance of adequate resources available to an individual for retirement to sustain themselves and their standard of living during this period of life, it is important to understand the factors affecting the investment decisions of individuals, possible behavioural biases in their behaviour and how they could be addressed. Subsequently, these insights can be used for designing pension systems and, where needed, informing individual investors about ways they can improve their decision-making.

[1] Past reports suggest that after the 2012 pension system reform and the introduction of the default investment strategy, approximately 1.13 million investors were moved to the conservative bond fund, while only about 100,000 investors requested to keep their savings in riskier funds (Pravda, 2024).

[2] In 2023, the unified default strategy was replaced by a default strategy based on the lifecycle of individual pension investors.

The aim of this paper is to study the behaviour of pension investors in Slovakia and their reaction, or the lack of it, to the pension system reform and the setup of the 2nd pension pillar. In particular, the research focuses on assessing whether personality traits, as measured by the Goldberg's Big Five personality framework (Goldberg, 1990, 1992) and sociodemographic and economic characteristics of pension investors played an important role in their decision to stay in the default strategy (i.e., inertia in investment and risk aversion).

Review of Relevant Literature

Behavioural research suggests that individuals do not always act rationally, and their choices often deviate from optimality. This section reviews the literature related to the following strands of research relevant to investment behavior. First, the literature review focuses on behavioral biases in investment decisions such as procrastination, status quo bias, and loss aversion, which affect how pension savers make decisions. In addition, the review focuses on the impact of automatic enrollment and default strategies to explore the long-term impact of nudges and how default strategies affect participation in pension schemes. Further, the literature review focuses on risk aversion and loss aversion, which influence investment decisions and risk tolerance. Finally, the last strand of the research explores sociodemographic and economic characteristics such as age, gender, education, and income level, which also play an important role in investment behavior.

If individuals do not update their choices when conditions change and stick to the default investment strategy, this can be due to various reasons such as procrastination, lack of information or status quo bias (Samuelson & Zeckhauser, 1988). Madrian and Shea (2001) studied the investment behaviour of employees saving in a 401 k company plan in the United States (U.S.) before and after it was changed. The change led to the automatic and immediate enrolment of employees in the 401 k plan, unless an employee decided to opt out of it. The results show that automatic enrolment increased the participation of employees in the 401 k plan. The study also indicates that the majority of savers did not opt out from the default strategy and stuck to the default contribution rate.

Cronqvist et al. (2018) studied the default behaviour of savers in the Swedish pension plan. The authors studied the behaviour of more than 7 million pension savers from 2000 until 2016. During this period, the Swedish government implemented two nudges to improve the pension saving behaviour of individuals. Some savers were assigned to a default investment strategy nudge, while a second group of savers could design their own investment strategy. The authors found that both nudges implemented by the government had a long-lasting impact and pension savers tended to stick with the default investment strategy.

The way that available investment options and information are presented (i.e. framing) has also been documented to affect investment behaviour and investment decisions. The work of Kahneman and Tversky (1979) on prospect theory received much recognition and has been used in a variety of contexts, such as in the design of investment strategies for retirement savings, or to develop nudges focused on improving the investment behaviour of individuals.

Attitudes of individuals towards risk and factors that influence them are also crucial for understanding investors' decisions. Tversky and Kahneman (1991) documented that people are loss averse and feel loss about twice more intensively compared to a gain of the same magnitude. Normally, higher investment risk is associated with higher probability of loss. Thus, loss aversion is an important factor to study, when considering motives of individual investors.

Empirical research also shows that sociodemographic and economic factors (such as age, education, gender, income and marital status) influence investment decisions of individuals. In their research, Watson and McNaughton (2007) documented a substantial impact of age on risk aversion, when older individuals were more risk averse. Jaggia and Thosar (2010) showed that willingness to take on investment risk decreases with the length of the investment horizon and, thus, with the age of the investor.

Research results regarding the impact of investors' knowledge on their investment decisions has been mixed. Watson and McNaughton (2007) found that individuals who had knowledge that risky investments usually lead to higher returns than conservative investments were more likely to invest in risky assets. However, since education can be costly, it is higher income rather than the knowledge attained that influences individual's investment decisions. Riley and Chow (1992) showed that investors with relatively less education were more conservative. On the other hand, Jianakoplos and Bernasek (2007) and Sundén and Surette (1998) found that education had no effect on investors' risk attitudes.

Morin and Suarez (1983) focused on providing empirical evidence on the effect of wealth on relative risk aversion. They used correlation analysis to study the demand for risky assets of Canadian households and examined the impact of the lifecycle on investing. They found that investor's lifecycle plays an important role in their portfolio selection and that risk aversion increases uniformly with age.

Eckel and Grossman (2008) studied the relationship between gender and risk preferences. They documented that men's and women's attitudes showed systematic differences in risk preferences, i.e., women were more risk averse than men. If women systematically differ in their risk preferences and are more sensitive to changes in risk than men, such behaviour could affect all aspects of their decision-making, including career choices and investment decisions. Hersch (1996) suggested that gender differences in the degree of risk aversion and their investment behaviour can be explained by the fact that women usually earn less than men and have a longer life expectancy.

Filippin and Crosseto (2016) carried out a meta-analysis of existing experimental studies on the impact of gender on risk aversion. Based on the analysis of 54 studies that used the method of Holt and Laury (2002) to measure risk aversion, they found that gender differences related to risk aversion occurred with statistical significance in less than 10% of all considered studies.

Research has shown that personality characteristics can also affect investment decisions of individuals. Mayfield et al. (2008) analysed the impact of personality traits (extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience (Goldberg, 1992)) on short-term and long-term investing. They showed

that individuals who are more extroverted tend to invest more in the short-term. On the other hand, individuals with higher neuroticism tend to avoid short-term investments. These results also suggest that risk-averse individuals tend to avoid long-term investments and prefer to invest for the short term. Also, individuals more open to experience have a higher tendency to focus on long-term investment.

Pinjisakikool (2017) used Goldberg's big five personality traits and examined their impact on household financial behaviour and financial risk tolerance. The results show that all five personality traits predicted the level of financial risk tolerance. At the same time, as instrumental variables, they were able to indirectly predict the financial behaviour of households.

Similarly, Aumeboonsuke and Caplanova (2021) analysed the determinants of financial risk tolerance in the financial decision-making of individual investors, particularly the impact of personality traits and mindfulness on individuals' risk aversion. They found that more agreeable and emotionally stable individuals are less risk averse, while conscientious and open-minded individuals are more risk averse. Also, more mindful individuals were prone to be more risk averse. Mindfulness was shown to play an important role as a mediating factor between personality traits and risk aversion. Their results show that emotional stability has a direct negative effect on risk aversion, while positively affecting mindfulness, which has a positive effect on risk aversion. Aumeboonsuke and Caplanova (2021) also found that older people and women were more risk averse, while men and married individuals were less risk averse.

Weber et al. (2002) used a psychometric scale to determine attitudes towards risk in five domains: finance (investing vs. gambling), health and safety, recreation, ethics, and social decisions. In a sample of the U.S. college students, their results show that attitude towards risk depends on the domain considered, with women being risk averse in all domains except for social risk. Their results indicate that gender differences in behaviour and content-based risk-taking lead to differences in perception of risks and benefits of a given activity rather than differences in their attitude towards perceived risk.

Studies also show that investors' perceptions related to expectations of return or tolerance and perception of risk also affect their behaviour in hypothetical trading, i.e., a scenario that is subject to risk. In their research, Hoffmann et al. (2015) asked if investors' perceptions can explain their actual trading and risk attitudes. Using brokerage records, they showed that investors' perceptions and changes were important determinants of investors' trading behaviour and reaction to risk. The results of their research show that investors with higher risk tolerance and an upward revision of expected returns have the tendency to trade more often, have higher turnover, trade larger amounts, and use derivatives.

An experimental study of individual risk behaviour showed that the choice in a binary lottery was systematically correlated with the behaviour of financial markets, i.e., individuals with a higher level of risk aversion were less active if there was more financial market activity (Fellner & Maciejovsky, 2007). The results of their experiment pointed out that women were more risk averse than men and less active on financial markets.

This research contributes to the literature by studying the behaviour of pension savers in a uniquely defined contribution pension scheme setup, where government reform introduced a conservative default investment strategy involving guaranteed bond investment funds. For behavioural interventions in pension saving, nudges are generally used to encourage people to save more and invest more actively (based on our knowledge of the academic literature). The results of this research can also serve as a reminder of the need to design pension system reforms that build on best practices and are not based on fears of short-term performance fluctuations in the financial markets. This study also contributes to the literature by identifying the characteristics of those investors who overcome inertia and change the default investment allocation to one based on their individual preferences.

The paper also contributes to the literature regarding how personality traits affect risk aversion. Nevertheless, policy intervention in Slovakia was based on the default strategy including only a bond portfolio, which was not an optimal strategy for any investor. Given this specific scenario, the paper studies a situation which, to our knowledge of the academic literature, has not been explored before.

Data and Methodology

This section describes the data and the methodology used to determine the impact of personality traits and sociodemographic and economic characteristics on risk aversion and the inertia of pension investors in Slovakia. The Slovak pension system comprises three pillars: a mandatory pay as you go scheme (1st pillar), a regulated contribution investment scheme administered by pension fund management companies (2nd pillar) and a voluntary supplementary contribution scheme administered by pension fund companies (3rd pillar) (Ministry of Labour, Social Affairs and Family of the Slovak Republic, 2023).

This paper focuses on the 2nd pillar of the pension system, since it has an investment element. Pension fund management companies are required by law to provide pension savers with a conservative guaranteed bond fund and an index fund.[3] The 2012 reform moved all pension investors in the 2nd pillar to a conservative guaranteed bond portfolio. Pension investors had an opportunity to opt out and invest in more diversified and riskier funds.[4] However, the majority did not make an active decision to opt out (The Association of Pension Funds, 2022).

[3] There are five pension fund management companies in Slovakia, which apart from the bond and index funds provide pension savers an option to invest in mixed funds and stock funds to diversify their risk profile.

[4] All pension fund companies are required by law to offer a guaranteed bond fund and a non-guaranteed index fund. In addition, the pension fund companies also provide a mixed bond and stock fund and a separate stock fund. These funds were also provided by pension fund companies prior to the 2012 pension system reform. Investors can rebalance their portfolios. There are no constraints on how many times they can do so. Investors can change their portfolio allocation online in their account.

In the 2nd pillar of the pension system, pension savers are customers of a chosen pension fund company. There are five pension fund companies in Slovakia. Upon opening an account with a pension fund company, the pension saver is allocated to the default investment strategy which, during the period 2012–2023, was a conservative guaranteed bond fund. Pension savers can opt out of the default investment strategy and adjust the portfolio allocation based on their risk preferences and investment return expectations and can also rebalance their portfolio. There are no constraints as to how frequently an investor can change their portfolio allocation.

The aim was to determine pension investors' preferred investment strategy. Respondents were asked to identify which investment instruments they allocated their investment to. If they chose allocation to a bond fund, they were asked to specify whether they used the bond fund based on the default investment strategy.[5]

Data

The data used for the analysis was obtained from a survey carried out in cooperation with the survey agency MNFORCE, s.r.o. (self-regulatory organization) The aim of the survey was to identify the behaviour of individuals in connection to their pension savings in the 2nd investment pillar and their additional investment activities, which they engage in on a voluntary basis. The survey also aimed to identify personality traits and sociodemographic and economic characteristics of surveyed individuals, and their attitude towards risk (the survey can be found in the Online Supplemental Appendix (OSA), pp. 1–5). The initial version of the survey was designed by the authors. The survey was then refined in collaboration with MNFORCE leveraging their expertise in data collection.

The sample of respondents is of the economically active Slovak population below 50 years of age investing in the 2nd pension pillar. The sample size is 100 respondents, which is sufficient to obtain statistically relevant results. Since the survey was conducted in collaboration with a professional agency, the data were professionally collected, and the survey sample is of the economically active population of a given age. This ensures the reliability and validity of the data. The sample size is generally adequate for the given analysis. Although hypotheses were not *a priori* formulated, existing literature suggested that personality traits, as well as social, demographic and economic characteristics, would influence individuals' risk aversion and investment behaviour. However, the magnitude of these impacts was not hypothesized.

Slovakia has a population of approximately 5.5 million, with 45% of the entire population below 50 years of age being economically active. There are more than 1.8 million people saving for their retirement in the 2nd pillar of the pension system. This represents about 32% of the entire population and 73% of the population of productive age. Pension savers in the 2nd pillar are 45 years old or younger. This group represents 62% of all pension savers. Nine percent of pension savers are 25 or younger and 31% are between 36 and 45 years old.

[5] Most pension investors who primarily invest in a bond fund do so based on the default, government-set, conservative investment strategy into a guaranteed bond fund.

Table 1 provides summary statistics of the sociodemographic and economic characteristics of the sample of respondents. The data show that 67% of the respondents were women. Therefore, there is an over-representation of women in the data. However, the predominant focus on women facilitates understanding their pension investment behaviour, not only because they tend to devote less attention to investing (Bajtelsmit & Bernasek, 1997), but also because their life expectancy is on average longer than that of men. Moreover, the share of women is also higher than the share of men in Slovakia, with women representing 52% of the country population (Statistical Office of the Slovak Republic, 2022a). The average age of the sample of respondents is approximately 40 years, while the average age of the Slovak population is approximately 41.4 years (Statistical Office of the Slovak Republic, 2022b). The summary statistics show that 45% of respondents completed a high school education with a high school diploma. The same share of respondents holds a university degree, which is slightly higher compared to the Slovak economically active population (Statistical Office of the Slovak Republic, 2023).

Regarding the structure of respondents, 19% of respondents lived in the Bratislava region, which is the most developed region and the capital of Slovakia. The fewest respondents lived in the Trencin region (about 7% of the sample). Most respondents (35%) lived in a city with a population of less than 5,000 inhabitants and 33% of respondents lived in a medium-sized city (population of 20,000 to 99,999 inhabitants). These data are consistent with the population distribution of Slovakia, where most of the population lives in villages and small or medium-sized cities (Statistical Office of the Slovak Republic, 2022a). Furthermore, the data show that in the studied sample, the respondents' mother's educational attainment was higher than the father's educational attainment. In 74% of households, finance was often discussed at home. However, only 27% of respondents' parents actively invest, or invested, and motivated the respondents to do so as well.

To identify and measure pension investors' personality traits, Goldberg's Big Five personality trait framework was used, measuring investors' level of emotional stability, agreeableness, conscientiousness, openness to new experiences, and extroversion (Goldberg, 1990, 1992). This framework has been widely used in research in psychology, but also in other social sciences. Many researchers used it to study the impact of personality traits on decision-making in both economic and non-economic domains (Aumeboonsuke & Caplanova, 2021; Müller & Schwieren, 2020; Pinjisakikool, 2017; Sahinidis et al., 2020).

To determine the characteristics related to individual personality traits, respondents were asked to assess seven statements for each personality trait on a scale from 1 to 5, where 1 meant "*I do not agree at all*" and 5 "*I strongly agree*" with a given statement. The minimum number of points a respondent could obtain in the measurement of one personality trait was 7 and the maximum number was 35 (OSA pp. 1–5). The higher the number of points gained, the more an individual exhibited a given personality trait.

Risk aversion was measured using a risk profile assessment method consisting of six multiple-choice questions (OSA pp. 1–5) focused on respondents' attitudes towards alternative investment options characterized by different risk levels, which

Table 1 Sociodemographic and economic characteristics of the respondent sample

	Percentage
Gender	
Woman	67
Man	43
Age	
Below 25 years	6
26–35 years	28
36–45 years	38
46–55 years	28
Marital status	
Single	28
Married/cohabiting	67
Divorced, widowed	5
Education	
Primary	2
Apprenticeship or secondary vocational education without high school diploma	8
Secondary education with high school diploma	45
University degree	45
Region of residence	
Bratislava	19
Trnava	11
Nitra	9
Trencin	7
Banska Bystrica	10
Zilina	17
Presov	13
Kosice	14
Size of place of residence [number of inhabitants]	
Less than 4,999	35
5,000–19,999	14
20,000–99,999	33
More than 100,000	18
Employment status	
Unemployed	5
Employed	91
Outside the labour market	4
Average net monthly income (in EUR)	
Less than 500	10
501–700	10
701–1,000	31
1,001–1,200	12
1,201–1,500	18
1,501–2,000	6

Table 1 (continued)

	Percentage
2,001–2,500	3
2,501–3,000	1
I do not want to state	9
Mother's educational attainment	
Apprenticeship or secondary vocational education without high school diploma	19
Secondary education with high school diploma	45
Undergraduate degree	4
Postgraduate degree	23
Doctoral degree	6
I do not want to state	3
Father's educational attainment	
Apprenticeship or secondary vocational education without high school diploma	41
Secondary education with high school diploma	35
Undergraduate degree	1
Postgraduate degree	13
Doctoral degree	3
I do not want to state	7
Finance discussed at home	74
Parents were/are active in investing	27
Number of observations, N	**100**

The average age of the respondents was 39.53 years. Data source: Authors' own computations using data from a survey carried out in collaboration with MNFORCE s.r.o. (2022)

represented three risk categories, low, medium, and high, with low risk level being associated with 1 point and high-risk level with 3 points. Therefore, an individual could obtain a minimum of 6 and a maximum of 18 points, with a higher score representing a higher degree of risk aversion. It is assumed that a risk averse investor would prefer investments with a lower risk (more conservative investment strategy).

Methodological specification

The methodology used to measure personality traits and estimate the relationship between personality traits, sociodemographic and economic characteristics and pension savers' level of risk aversion and investment decisions is outlined next. The methodology and empirical strategy used for estimation of the causal relationship between personality traits and risk aversion and the preferred investment strategy of individuals is based on the ordinary least squares (OLS) regression and probit models. Given the nature of the data, the survey tool in STATA was used. To estimate the relationship between personality traits and risk aversion, simple OLS regression was used in Eq. (1)

$$log(Risk\ aversion_i) = \alpha + \beta_1 E_i + \beta_2 C_i + \beta_3 A_i + \beta_4 ES_i + \beta_5 O_i + \gamma X_i + \varepsilon_i \quad (1)$$

where the dependent variable is the natural logarithm of individual *i's* aversion to risk, E_i is the measure of extraversion of an individual i, C_i is the measure of conscientiousness of an individual i, A_i is the measure of agreeableness of an individual i, ES_i is the measure of emotional stability and O_i is the measure of openness to the experiences of an individual i. X_i is a vector of control variables including gender, age, marital status, respondents' average monthly income, employment status, and ε_i is the standard error term. This research is focused on the influence of personality traits on risk aversion, but it is expected that some sociodemographic characteristics will also have an impact on pension investor's risk aversion.

To estimate the relationship between personality traits, sociodemographic and economic characteristics, and inertia regarding opting out of the default investment strategy, i.e., pre-defined investment strategy, the specification in Eq. (2) was used. Since the dependent variable is a binary variable having a value of 1 if an individual i invests conservatively, and otherwise is equal to 0, the data were analysed using probit regression

$$Pr(i\ conservative) = \delta + \theta_1 E_i + \theta_2 C_i + \theta_3 A_i + \theta_4 ES_i + \theta_5 O_i + \sigma X_i + \theta_i \quad (2)$$

where the dependent variable Pr indicates whether an individual i primarily invests in the default conservative guaranteed bond fund (i.e., he is a conservative investor), the explanatory variables are the same as defined in Eq. (1), and θ_i is the standard error term.

Based on existing studies, it was expected that some personality traits would affect investment decisions of individuals, i.e., inertia regarding opting out from the default conservative investment strategy. It was expected that extroverts would invest less conservatively. It was also assumed that sociodemographic and economic characteristics would have an effect on the choice of preferred investment strategy. The correlation matrix (OSA, p. 6, Table 1) shows that the control variables are not mutually correlated.

The assumption of the linearity of the model was tested using the Shapiro–Wilk test to assess the normality of the residuals. The p-value associated with the Shapiro–Wilk test[6] (0.91) suggests that the null hypothesis of normality cannot be rejected, which shows that the residuals are normally distributed, and the assumptions of linear regression are met.

Results

Table 2 provides an overview of the summary statistics of the measure of pension investors' individual personality traits and their risk aversion. The data show that pension investors in the studied sample exhibited the highest average score for

[6] The Shapiro–Wilk test (W) statistic is equal to 0.993 indicating that the data are likely normally distributed. The reported Z-score associated with the W statistic is equal to -1.324, with the transformation of the W statistic used to calculate the Z statistic (i.e., V value) equal to 0.551.

Table 2 Summary statistics of pension investors' measure of personality traits and level of risk aversion

Variables	*Average*	*Standard deviation*	*Minimum value*	*Maximum value*
Emotional stability	21.34	4.38	8	31
Agreeableness	26.21	4.52	16	35
Extroversion	21.17	5.14	8	35
Conscientiousness	25.61	4.97	13	35
Openness to experience	24.10	4.16	11	35
Risk aversion	12.81	2.04	7	17
Number of observations, N	**100**			

The data were collected in 2022. Data source: Authors' own computations using data from a survey carried out in collaboration with MNFORCE s.r.o. (2022)

agreeableness (26.21 points). This suggests that the respondents are in general interested in social harmony, are considerate, generous, or trusting. The lowest average number of points among the measured personality traits was recorded for extroversion (21.17 points), but the data on this characteristic are also most scattered (standard deviation = 5.14) with a minimum score of 8 points and a maximum score of 35 points.

The summary statistics in Table 2 document that individuals in the sample are on average risk averse. The average value of risk aversion is 12.7 points, with a relatively small standard deviation (about 2 points), a minimum score of 7 points, and a maximum score of 17 points. Thus, some pension investors were also relatively risk seeking.

The data in Table 3 show the effect of personality traits, sociodemographic and economic characteristics on risk aversion of respondents. Column 1 presents the estimation results without including control or socioeconomic variables in the regression. The estimation indicates that respondents who are more agreeable are slightly more risk averse by 1 percentage point ($p = 0.089$). Individuals who are more open to new experiences are significantly less risk averse ($p = 0.004$). The remaining three personality traits (emotional stability, extroversion, and conscientiousness) do not have a statistically significant impact on pension investors' risk aversion ($p > 0.10$).

When sociodemographic and economic characteristics are included as control variables in the regression analysis (Column 2), openness to experience remains highly significant with respect to risk aversion ($p = 0.001$). Agreeableness and conscientiousness remain somewhat significant ($p = 0.093$ and 0.077, respectively). Conscientious individuals are on average 1.2% more risk averse.

Considering sociodemographic and economic variables, the obtained estimates are more accurate with a smaller standard deviation. Thus, the inclusion of these characteristics reduced the estimation bias and the effects of unobserved exogenous factors that affect the level of risk aversion.

Moreover, education level significantly affects risk aversion ($p = 0.012$). Respondents with a higher level of attained education are approximately 8% less

Table 3 OLS estimation of the impact of personality traits and sociodemographic and economic characteristics on pension investor's risk aversion

	(1) Column 1	**(2) Column 2**	**(3) Column 3 Expected relationship**
Emotional stability	0.0029 (0.0083)	0.0036 (0.0077)	(+)
Agreeableness	0.0101* (0.0059)	0.0087* (0.0052)	(+)
Extroversion	−0.0040 (0.0039)	−0.0035 (0.0036)	(-)
Conscientiousness	0.0103 (0.0068)	0.0119* (0.0067)	(-)
Openness to experience	−0.0183*** (0.0061)	−0.0192*** (0.0057)	(-)
Gender (Female)		0.0616 (0.0488)	(+)
Age		0.0010 (0.0027)	(+)
Region of residence		0.0087 (0.0065)	(-)
Educational level		−0.0809** (0.0318)	(-)
Parents were/are active in investing		−0.0466 (0.0484)	(-)
Employed individual		0.0739 (0.0748)	(-)
Net monthly income		−0.0137 (0.0113)	(-)
Constant	2.459*** (0.324)	2.662*** (0.277)	
F-statistics	F-value 2.93 P-value 0.0168	F-value 2.22 P-value 0.0174	
Number of observations, N	**100**		

***, **, * statistically significant at 1, 5 and 10% levels. Standard errors are in parentheses. In the model, the following control variables were used: emotional stability, agreeableness, extraversion, conscientiousness, openness to experience, gender, age, region of residence, educational level, parents were/are active in investing, employment status, income, and mother's and father's educational attainment. The expected relationship between the dependent and independent variable is shown in column 3. (– / +) indicates an expected positive or negative relationship. The data were collected in 2022. Data source: Authors' own computations using data from a survey carried out in collaboration with MNFORCE s.r.o. (2022)

risk averse. This confirms the relevance of education for investors' decision-making. However, no other sociodemographic or economic characteristics were found to have a statistically significant effect on risk aversion.

The results of the F-statistics (Table 3) show that the independent variables statistically significantly explain the variation in the dependent variables. In the

probit model (Eq. (1)), the p-value associated with the F-value (0.017) is less than the 5% critical value.

The estimation results in Table 4 show the effect of personality and sociodemographic and economic characteristics on pension investors' inertia regarding staying invested in the default investment strategy (i.e., estimation results of Eq. (2)). In particular, the analysis studies whether individuals remain in the government-set default investment strategy in a conservative guaranteed bond fund, or they opt out and invest in more risky funds. Therefore, their inertia with respect to continuing to adhere to the default investment strategy based on investment in a conservative fund is measured. The results identify individual personality and sociodemographic and economic characteristics of respondents, who are more likely to stay invested in the default investment strategy.

The results in Table 4 show that more agreeable individuals will opt out with a higher probability from the default conservative investment strategy ($p = 0.084$). Individuals with a higher level of agreeableness are less likely to stay in the default investment strategy in the bond fund, and are more likely to choose to diversify their investment portfolio and invest in riskier assets. However, other personality traits were not found to have statistically significant effects on the inertia to stay in the default investment strategy ($p > 0.10$).

Considering sociodemographic variables, Table 4 shows statistically significant differences between genders regarding staying in the default investment strategy. The findings suggest that in the studied sample, women are significantly more likely to stay in the default investment strategy than men ($p = 0.001$). The results show that men will opt out of the default conservative investment strategy with a higher probability. It can be assumed that women may be more affected by status-quo bias which affects their lower tendency to opt out of the default conservative investment strategy. Women may also have a higher tendency to prefer more conservative investment strategies than men (Hinz et al., 1996; Merkoulova a Veld, 2022). Furthermore, older individuals in the studied sample also exhibit significantly higher levels of inertia regarding the default investment strategy than younger individuals ($p = 0.019$).

Individuals living in larger cities are more likely to stay in the default investment strategy than individuals living in smaller cities ($p = 0.058$). This result is not aligned with expectations, since one would assume that individuals living in larger cities would have better access to information and better understanding of investment and finance, which should reduce their inertia regarding the decision to stay in the default investment strategy in conservative guaranteed bond funds, which is not optimal for them in the long run.

Individuals living in households, where finances were frequently discussed are somewhat more likely to stay in the default investment strategy ($p = 0.073$). This finding does not correspond to the assumption that such individuals would have better financial literacy and access to information that would allow them to invest in an optimal investment strategy and overcome investment inertia.

On the other hand, the results show that individuals whose parents are active investors are somewhat less likely to remain in the default investment strategy, i.e., they experience a lower level of inertia ($p = 0.061$). This is aligned with our

Table 4 Probit estimation of the impact of pension investor's personality traits, sociodemographic and economic characteristics on inertia to stay in the default conservative investment strategy (guaranteed bond portfolio)

	(1) **Column 1**	**(2)** **Column 2** **Expected relationship**
Emotional stability	−0.0366 (0.0389)	(+)
Agreeableness	−0.0714* (0.0409)	(+)
Extroversion	−0.0583 (0.0395)	(-)
Conscientiousness	−0.0472 (0.0412)	(-)
Openness to experience	0.0514 (0.0462)	(-)
Gender (Female)	1,289*** (0.390)	(+)
Age	0.0538** (0.0226)	(+)
The size of the place of residence	0.270* (0.140)	(-)
Educational level	−0.372 (0.283)	(-)
Finances were/are a topic in the household	0.820* (0.453)	(-)
Parents were/are active in investing	−0.693* (0.365)	(-)
Single	0.624 (0.398)	(-)
Employed individual	0.844 (0.514)	(-)
Mother's education	0.264* (0.136)	(-)
Constant	−1.337 (2,072)	
F-statistics	F-value 1.79 P-value 0.0526	
Number of observations, N	100	

***, **, * statistically significant at 1, 5 and 10 percent levels. Standard errors are in parentheses. (+) indicates a positive expected relationship. (-) indicates an expected negative relationship. In the model, the following control variables were used: emotional stability, agreeableness, extraversion, conscientiousness, openness to experience, gender, age, the size of the place of residence, educational level, finances were/are a topic in the household, parents were/are active in investing, marital status, employment status, and mother's educational attainment. Pension investor's decision to remain in the default investment strategy was used as a proxy for inertia regarding staying in the default conservative investment strategy. The data were collected in 2022. The expected relationship between the dependent and independent variables is shown in column 2. Data source: Authors' computations using data from a survey carried out in collaboration with MNFORCE s.r.o. (2022)

expectations, since such individuals can be expected to have better knowledge about alternative investment options and, thus, be able to overcome inertia and invest in a portfolio which is optimal for them.

The estimation results also indicate that mother's education has a statistically significant impact on pension investor's choice of investment strategy ($p=0.055$). Respondents whose mother attained a higher level of education are more likely to remain in the default investment strategy and invest in the conservative guaranteed bond fund.

The analytical results show that the p-value (0.053) associated with the F-value is less than the critical value of 10% (Table 4). Therefore, the independent variables in the probit model (Eq. (2)) also explain the variability in the dependent variable. However, in the probit model this significance is lower than in the first OLS model, which indicates that not all relevant factors that affect the investment decisions of pension investors may have been accounted for in the model.

The test of the linearity of the relationship between the independent variables (age, emotional stability, agreeableness, extraversion, conscientiousness, and openness to new experience) and the dependent variable shows that the marginal effect of the independent variables falls within the 95% confidence interval. Thus, the relationship between the independent variables and the inertia with respect to the default investment strategy is linear (OSA, p. 7, Fig. 1).

Discussion and Conclusions

The results show that personality traits and sociodemographic and economic characteristics of individual investors affect their investment decisions. These results facilitate better understanding of individual investment behaviour in the context of their pension investment.

More agreeable and conscientious pension investors in the 2nd pillar of the Slovak pension system tend to be more risk averse. On the other hand, those who are more open to new experiences tend to be less risk averse. Pension investors with a higher level of education tend to be less risk averse. However, investing in a conservative, low-risk bond portfolio is associated with lower long-term return on investment.

The estimation results also show that pension investors who are more agreeable were less likely to stay in the default conservative investment strategy, i.e., they had lower inertia. Gender and age were found to affect investment decisions of pension investors and their choice to stay in the default investment strategy. Older individuals and women tend to stick with the default investment strategy. Thus, their behaviour is characterized by a higher degree of inertia. Reform of the default investment strategy to a riskier investment strategy, or a strategy based on the lifecycle of an individual, can positively impact the portfolio of pension investors, since pension investors, who experienced inertia and did not change their investment strategy in the previous period, would behave in the same way and remain in the default strategy regardless of its setup.

The results also indicate that pension investors living in households, where financial issues are openly discussed, are more likely to remain in the default investment strategy. This finding contradicts the expectation that being more exposed to discussions about finance would lead a to less conservative investor behaviour.

If financial education plays an important role in investment decision-making, Slovakia has a lot of catching up to do. In financial literacy rankings, Slovakia ranks below the Organisation of Economic Co-operation and Development (OECD) average (OECD, 2020). In the 2018 Programme for International Student Assessment's (PISA) financial literacy assessment, Slovak students achieved a score of 481, while the OECD average was 505 points. Therefore, policymakers should also focus on improving the financial literacy of the population by strengthening financial education at different levels of education, and should also provide one-stop-shops for those outside of education. Improving the financial literacy of the population could help individuals to make better investment and financial decisions.

The estimation results show that retirement savers whose parents actively invest are less likely to stay in the default investment strategy. This finding suggests that parents' investment activity can positively influence their children's investment activities and potentially positively affect their returns.

Results showed that a higher level of mother's education increased the probability that the pension investor would remain in the default investment strategy. As discussed in the results section, empirical research shows that women experience greater inertia with regard to changing their default investment strategy. To gain a better understanding of the impact of mother's education on investment decisions of their children, additional information would be needed, e.g., about the topic area of the mother's education.

The research has limitations. A larger sample size would provide more accurate and reliable estimation results. In addition, since the survey was carried out online and not in a controlled environment, external factors could have affected the surveyed individuals' responses. However, since the survey responses were anonymous, it is assumed that the majority of respondents responded truthfully. As highlighted, women are over-represented in the sample. Therefore, the estimation results might not be representative of the investment behaviour of men in the Slovak population.

In addition, the dataset does not provide information about some characteristics which could affect an individual's risk aversion and investment decision making, such as financial literacy of an individual, type of employment, or job. However, it is assumed that parents' investment behaviour and experience are correlated with, and could serve as a proxy for, an individual's knowledge about finance and investment.

The research described in this paper confirms that in investment decision-making, human cognitive biases intricately interweave with the complexity of financial choices. The latent potential of behavioural interventions emerges as a focal point of exploration. This points to the transformative efficacy of public policies and interventions that use behavioural nudges. If appropriately designed, these interventions could contribute to overcoming cognitive intricacies. The appropriate architecture of choice frameworks, introduction of feedback mechanisms, and suitable normative benchmarks, and behavioural interventions inherently possess the capacity to recalibrate individual investment decisions.

In the context of pension savings, behavioural nudges and interventions can be used to improve the investment decisions of individuals and increase their long-term retirement savings. Lessons from the 2012 pension system reform in Slovakia suggest that it is also crucial that policies are not modified based on current market developments, but are instead designed based on best practices and long-term goals, i.e., maximisation of retirement earnings.

The Slovak pension system offers investors an option to invest in four different funds, with different risk categories. This can contribute to the robustness and flexibility of retirement planning and allow for diversification and risk mitigation. Thus, pension savers have an option to tailor their portfolios according to their risk tolerance and investment horizon.

However, as the data and results have shown, the number of investment options does not motivate most investors to change their behaviour (i.e., opt out from the default investment strategy in the studied scenario). On the contrary, a wide choice of investment funds can lead to choice overload and delay investors' decisions to change their portfolio allocation. In addition, pension savers, who lack financial literacy may be unable to make informed decisions, which may lead to them to make suboptimal investment decisions. Therefore, it is important that pension systems have a well-defined default investment strategy, which ensures the potential for adequate returns, e.g. based on the lifecycle of a pension saver. It is also crucial that the financial literacy of citizens be improved so that they are able to better understand and evaluate the available investment options, but also to improve their overall financial decisions. Since the Slovak pension system underwent reform in 2023, which changed the default investment strategy to one following the lifecycle of a pension saver with the option to opt out, future research should study the behaviour of pension savers in reaction to this change in the default strategy.

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