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COORDINATION TRAPS AND BEHAVIORAL INTERVENTIONS: STATED WILLINGNESS-TO-CHANGE MANDATORY PENSION FUND CATEGORY

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Abstract

Drawing on political economy and behavioural economics, this paper models fund category choices as a coordination game in which cognitive biases – status quo dependence, default reliance, and decision inertia – trap individuals in Pareto-dominated equilibria. Using primary survey data from a non-representative online convenience sample of 259 employed Croatian citizens and an embedded randomised experiment (N = 206), the study examines three nudging interventions: social norms, framing effects, and framing combined with loss aversion. An ordinal regression model adjusted for baseline willingness shows no statistically significant differences between the three nudge conditions and the control group in stated willingness to change (all $p > .48$). Point estimates are positive and increase with intervention intensity. The paper contributes to the literature by linking coordination traps to behavioural intervention design and documenting the absence of statistically significant effects of the tested interventions on stated willingness to change in the observed sample.

Keywords: behavioural economics, political economy, nudge, experiment, pension system

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1. INTRODUCTION

The choice of the optimal category of mandatory pension fund, into which contributions from gross wages are paid in, is among the most important financial decision an individual makes over his life time. Nevertheless, individuals often delay or delegate these decisions, influenced by cognitive biases including procrastination (Akerlof, 1991; Börsch-Supan et al., 2023), complexity aversion (Smith, 2002), and default dependence (Madrian & Shea, 2001; Choi et al, 2004). One additional and neglected factor is the existence of coordination traps (Schelling, 1960). Political economy defines these traps as situations in which individuals are in equilibrium considering their decision, but this equilibrium is Pareto dominated by another existing equilibrium (Bueno de Mesquita, 2016).

To set the theoretical foundations of the study, this paper combines two branches of economic theory. First, by examining the effects of public policy on individual economic outcomes new political economy uses game theory approach to model individuals' decisions that result in Pareto dominated or dominating equilibrium in financial decisions. And second, behavioral economics puts forward the idea that pension communication interventions, in a situation where information acquisition is of particular relevance, could achieve Pareto improvement. Randomized survey experiment can test whether nudging interventions have a positive, negative or zero effect on individuals' stated willingness-to-change category of mandatory pension fund. While behavioural economics builds upon information constraints and cognitive biases, political economy adds with political constrains in the analysis of individuals (optimal) choices.

The paper makes three contributions. The first is institutional and specific to Croatia. The paper documents, on primary data, how passive and how poorly informed second-pillar members are. It also documents a measurement problem that the Croatian literature has not reported before. A non-trivial share of respondents hold beliefs about their own assigned category that are inconsistent with the legal rule in force when they were first employed. To the authors' knowledge, no other study examines 2019 reform (change in the default rule, i.e. assigning new members *ex officio* to a category A fund) using primary survey data. The second contribution is theoretical. The paper states what would have to be true for the second-pillar category choice to be a coordination trap rather than an individual decision under a default. It then derives the threshold equilibrium of the corresponding global game. The third contribution is empirical. The paper tests whether behavioural interventions change the stated willingness-to-change category among members below 55 who hold category B or C.

Examining behavioural biases affecting the selection of mandatory pension fund categories and evaluating the effectiveness of nudging interventions (e.g., social norms, framing effects, and loss aversion) designed to improve willingness-to-change this paper pursues two objectives. First, it examines the cognitive biases affecting individuals when choosing a mandatory pension fund

category. Second, it assesses the effectiveness of nudging interventions in increasing individuals' stated willingness-to-change categories of mandatory pension funds. From the stated objectives the following hypothesis was derived: The application of nudging interventions increases the likelihood of stated willingness-to-change funds in favour of a more optimal choice. The analysis is based on primary data collected through an online survey with an embedded randomized experiment administered to employees across various sectors.

The paper is structured as follows. Following the introduction, the second chapter presents the theoretical framework and a literature review with a short presentation of the mandatory pension scheme system in Croatia. The following chapter presents the methodology used in this study, as well as the data. The fourth chapter presents the results of the conducted analysis followed by a discussion of the findings in the fifth chapter. The paper concludes with limitations and implications of the conducted empirical exercise as well as suggestions for future research.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Political economy literature classifies coordination games and traps as one of the three most important social dilemmas in public policy (Bueno de Mesquita, 2016). One can define a social dilemma as a situation involving a conflict of individual rationality and collective optimal outcome. Hardin's (1968) model of the tragedy of commons, that initiated scholars' interest in social dilemmas, formalized the prisoner's dilemma in the context of common goods and public policy. As a direct answer to Hardin's pessimism Ostrom (2000) provided empirical and theoretical proof that communities can themselves develop institutions that solve the dilemma of common goods. More importantly, Ostrom (1998) offered integration of behavioural economics with the theory of collective action (Olson, 1965) in political economy as the answer to the problem of social dilemmas. Since coordination games describe situations in which individuals / players all benefit if they take coordinated actions, it is often the case that they have multiple equilibria. Thus, it is possible for players to be caught in coordination trap – playing a Pareto dominated equilibrium even though all would agree that some other equilibrium is more desirable. Due to various cognitive biases like status quo (de Haan & Linde, 2018), default (Thaler & Sunstein, 2008) and/or inertia (Madrian & Shea, 2001) short-run interventions can move players to a Pareto improving equilibrium.[1]

[1] Hummel and Maedche (2019) conducted a meta-analysis of 100 studies measuring 317 effect sizes. The analysis of different types of nudges shows that default options are the most effective, with significantly larger effects compared to other types of interventions. Furthermore, de Haan and Linde (2018) show that prior experience with well-designed default options can lead individuals to be more likely to choose default options, even when the alternatives are random.

The coordination trap can be formally modelled through game theory, and this paper builds on Morris and Shin (2001) approach. Two players are deciding whether to invest. There is a safe action (*NotInvest*) and there is a risky action (*Invest*) which gives a higher payoff. Payoffs are given by the following matrix:

Player i \ Player j	Invest	NotInvest
Invest	$\theta - 1 + \ell, \theta - 1 + \ell$	$\theta - 1 + \ell, 0$
NotInvest	$0, \theta - 1 + \ell$	$0, 0$

where ℓ represents the proportion of other players choosing to invest and there is incomplete information about θ (state of fundamentals). Namely, player *i* observes a private signal $x_i = \theta + \varepsilon_i$. Each ε_i is independently normally distributed with mean 0 and standard deviation σ. It is assumed that θ is randomly drawn from the real line, with each realization equally likely. This implies that a player observing signal *x* considers θ to be distributed normally with mean *x* and standard deviation σ. Private signal determines the action taken by the player. i.e. determines its strategy. A natural kind of strategy under consideration is one where a player takes risky action only if she observes a private signal above some cut off point k:

$$s(x) = \begin{cases} Invest, if\ x > k \\ NotInvest, if\ x \leq k \end{cases}$$

The unique strategy surviving iterated deletion of strictly dominated strategies has each player investing if they observe a signal above $\frac{1}{2}$, and not investing if they observe a signal below $\frac{1}{2}$. A full description of the coordination game model is presented in the Appendix.

Consider an insured person deciding whether to hold the equity-heavy category A (*Invest*) or to remain in the default-assigned category B or C (*NotInvest*). At first sight the payoff to holding A depends only on that person's own horizon and on the realized return of the fund, which is set on capital markets and is unaffected by whether a colleague also holds A. The complementarity is political rather than financial, and it operates through three channels.

First, the political sustainability of the funded pillar. The second pillar in Croatia has repeatedly been the object of proposed and partly enacted parametric change, and its fiscal treatment interacts with the sustainability of the first pillar (Rebić & Arčabić, 2023). The larger the share of members who have made an active, informed choice, the larger the constituency with a salient stake in the funded pillar and, plausibly, the higher the political cost of adverse discretionary change. A member's expected long-run payoff from holding an equity-heavy portfolio A therefore depends on the aggregate share of active members through the probability that the rules are altered before retirement. Second, the supply of information. Pension companies and intermediaries invest in comparative, category-level communication in proportion to the share of members who are responsive to it. Where almost nobody switches, the private return to producing comparative information is low and the information environment stays thin, which in turn depresses switching. Information provision and active choice are mutual

complements. Third, descriptive norms. Where active choice is rare, choosing actively is itself informative about one's type and carries a perceived reputational and psychological cost; where it is common, that cost falls (Cialdini et al., 1990).

Each channel makes one member's payoff from choosing A increasing in the proportion of others choosing A. This is precisely the structure of a global game with strategic complementarities, and it is what licenses the use of the Morris and Shin (2001) apparatus below. The complementarity is an assumption in the paper. The important question remains how to inflate ℓ thus pushing our observed player to follow strategy *Invest*? In other words, one is interested in nudging (Thaler & Sunstein, 2003) – steering individuals toward decisions that are likely to improve their lives. Since human decisions and behaviours are influenced by cognitive biases, routines, and habits, which often lead individuals to act inconsistently with their rational interests, the idea is to identify and implement an intervention that leads individuals to a socially optimal equilibrium.[2] There are various mechanisms through which nudging operates, including the use of default options, framing of messages, application of social norms, gamification, etc (Abumalloh et al., 2024).

Alongside nudging, this study builds on the concept of cognitive biases – systematic errors in human judgment and decision-making – out of which the paper focuses on loss aversion, framing and social norms effect. As a central element of the prospect theory, loss aversion occurs when losses have a stronger emotional impact than gains of the same magnitude relative to a reference point (Kahneman & Tversky, 1979). In other words, information that highlights that (not) making a certain decision – choosing an optimal fund category – can earn or cost an individual the same amount of money in the future resonates differently to individuals. Framing – adapting the wording but not the content of communication – is often reported as a more nuanced approach that builds on the concept of prospect theory and loss aversion (Tversky and Kahneman, 1981). Emphasizing negative frames or losses positively influences retirement investment choices (Bateman et al., 2015), steers participants' decision regarding annuity or investment in a desired direction (Agnew et al., 2008) and increases their stated willingness-to-save for retirement (Montgomery et al., 2011). Overall, framing influences the take-up rates of financial incentives for retirement saving (Saez, 2009), saving amounts (Ülkümen and Cheema, 2011), and retirement timing (Merkle et al., 2017). Third cognitive bias – social norms effect – is based on individuals' tendency to align their behaviour with what they perceive as the behaviour of the majority or socially acceptable conduct. Descriptive social norms refer to what most people do or consider normal, while injunctive social norms refer to what ought to be done, i.e., what is socially approved or disapproved (Cialdini et al., 1990). They are frequently used in nudging strategies to encourage behaviour aligned with individuals' long-term interests, e.g. pension decisions. Literature reports that interventions like peer effects (Beshears et al. 2015), as well as

[2] Critics highlighting the risk of manipulating individuals for private gain (Leonard, 2008), commercial manipulation or other questionable purposes (Hansen, 2016) and that there is no such thing as a "neutral" presentation of choices (Johnson et al., 2012).

automatic enrolment (Thaler & Sunstein, 2008; Beshears et al. 2010), automatically escalating contributions (Thaler and Benartzi 2004) have effects on increasing enrolment and contribution rates in pension plans. The idea of this paper is simple and straightforward: find and provide a nudge (information) that pushes players to a Pareto dominating equilibrium, i.e. *Invest-Invest* field of the matrix. However, one needs to have in mind that behavioural economics literature has still not settled on the effects of providing information in the case of pension decisions. Positive effects, i.e. increased savings have been reported by Eberhardt et al. (2018), Dolls et al. (2016) and Karlan et al. (2016) while Carter and Skimmyhorn (2018) found no effect on savings behaviour. Additionally, nudging effects are often short-lived and strongly depend on the environment. Overall, one can conclude that the development in this research area depends on causal identification, out-of-sample validation and the integration of survey, experimental, administrative and high-frequency data into theoretically disciplined models (Hadžić & Tatić, 2026).

This paper's environment is the Croatian pension system which is based on three pillars. The first and second pillars represent mandatory pension insurance, while the third pillar represents voluntary pension insurance. The first pillar is based on intergenerational solidarity, while the second and third pillars represent a system of individually capitalized savings. Every employee is a member of one of four mandatory pension funds, regardless of whether they selected the fund themselves or were assigned to it *ex officio* by REGOS – the Central Register of Insured Persons, which keeps the records of insured persons and their individual pension accounts (HANFA – Croatian Financial Services Supervisory Agency, 2019). Mandatory pension funds in the second pillar, according to Article 78 of the Act, are divided into three categories A, B, and C which differ in terms of age restrictions, investment strategies, and portfolio structure (Hrvatski sabor, 2014). Category A carries the highest investment risk, as a larger share of its assets is invested in equities and therefore offers higher expected long-term returns. Category B involves moderate risk and expected returns, while category C carries the lowest risk and expected returns. After the introduction of three categories of mandatory pension funds, the law stipulated that insured individuals who did not select a fund within six months were automatically assigned to category B funds (Hrvatski sabor, 2014). A subsequent legislative change effective from 1 October 2019 (Hrvatski Sabor, 2018a, 2018b) introduced a new default rule, allowing REGOS to assign individuals who fail to choose a fund within one month to category A funds.[3] Each insured person may change their pension fund category or

[3] REGOS carries out these assignments on the first day of each month for insured individuals whose one-month period for selecting a fund expired during the previous month. Therefore, the relevant date for the application of the new default rule is the date of assignment rather than the date of first employment. For example, individuals who entered employment in August 2019 had one month to select a fund, after which they were included in the next regular assignment on 1 October 2019 and were therefore subject to the new default rule.

pension company if they are dissatisfied or reconsider their choice, subject to certain restrictions (REGOS, n.d.).

The optimal category in mandatory pension insurance is defined as the fund category most suitable for an individual, given their age, years remaining until retirement, risk tolerance, and financial goals. Since individuals differ in their risk preferences and financial plans which are not observed in the data and cannot therefore be incorporated into the classification, the presumed optimal category for the purposes of this paper is defined based on the insured individual's age as follows:

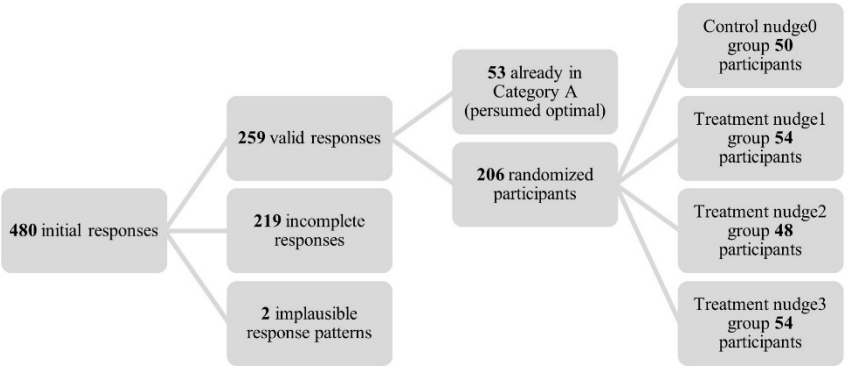
- Category A – insured individuals up to the age of 55
- Category B – insured individuals aged 55 to 60
- Category C – insured individuals aged 60 and above
- If insured individuals older than 55 remain in category A, or those older than 60 remain in category B, this is also considered optimal given existing legal provisions.

The classification reflects the legal possibility for insured individuals to choose Category A until ten years before retirement and, once enrolled in Category A, to remain in it until five years before retirement provided that the required request is submitted in due time. Assuming retirement at age 65, this corresponds to ages 55 and 60, respectively. Accordingly, individuals aged 55 to 60 are considered to be in the presumed optimal category if they are in Category B, while those who remain in Category A are also considered to be in the presumed optimal category because such continued membership is permitted under the applicable legal framework. From age 60 onward, Category C is considered the age-based presumed optimal category. However, individuals may legally remain in Category B until retirement, and such cases are therefore also treated as consistent with the presumed optimal classification.

3. DATA AND METHODS

The research is based on primary data collected through a survey questionnaire (in Appendix) conducted among employees in the Republic of Croatia during the period from May 12 to May 30, 2025. The survey was distributed via the social media platforms LinkedIn and Facebook, as well as through email. Although the sample is not representative, the use of digital platforms enabled the collection of responses from participants across different age groups and regions of Croatia. Participation in the survey was anonymous and voluntary, and respondents were informed about the purpose of the research prior to completing the questionnaire.

Figure 1 Participant flow



Source: Authors' own calculations

A total of 480 responses were collected; however, to ensure data quality, a data-cleaning process was conducted, reducing the number of valid responses to 259.[4] Of these, 53 respondents were already in category A of the mandatory pension fund, under the assumption that they were already in the presumed optimal category, were excluded from the experimental part of the survey. These respondents completed the survey up to the last part of the survey, which was the experimental part. This resulted in a final sample of 206 respondents who participated in the experimental (nudge intervention) section. The questionnaire consisted of a total of 24 questions. The survey was created using the GuidedTrack platform. To complement the analysis, secondary data on insured individuals and mandatory pension funds, publicly available on the website of HANFA, were also used. Each respondent answered 12 questions related to pension savings and the chosen category of the mandatory pension fund, 6 questions assessing financial literacy, and 6 questions on demographic characteristics. Respondents included in the experimental section were presented with one additional question related to the nudge intervention. The numerical statements in the treatment texts were experimentally manipulated and were not presented as verified estimates. Participants were debriefed immediately after the experimental section and informed that the numerical claims were not necessarily accurate.

The design of the survey was the following. First set of questions – open-ended, closed-ended, multiple and binary responses – were directed on retirement savings and respondents' choice of mandatory pension fund category. In the second part of the survey, participants were asked to assess their own financial literacy, followed by five tasks / questions on interest rates, inflation, and financial instruments in order to evaluate their actual financial literacy. Prior to the first

[4] Responses were excluded due to their incompleteness (the survey was not finished) and implausible response patterns (assumed to reflect inattentive or low-effort answering).

question, respondents were provided with a definition of financial literacy as "the possession of awareness, knowledge, and behaviors necessary to make appropriate financial decisions." The questions were inspired by a survey authored by Allgood and Walstad (2016). The third part of the survey examined respondents' demographic characteristics, including gender, age, income level, education, place of residence, and household information. The final part of the survey focused on the nudge intervention. Respondents were randomly assigned into four groups, one of which served as the control group.[5] Each group was presented with a text to read; three groups received texts designed to influence their decision-making by targeting specific behavioural biases (loss aversion, framing and social norms effect), while the control group received a neutral text without intentional intervention. Prior to the experimental section, respondents already in the presumed optimal category were excluded from the experiment and completed the survey after the demographic section, whereas the remaining respondents proceeded to the experimental (nudge) section. All necessary ethical committee requirements were met in the implementation of the survey.

All analyses were performed in program language R using relevant base and package-specific functions. The Stuart–Maxwell test was used for paired categorical data to assess changes in marginal distributions before and after intervention.

An intention-to-treat approach was used: all participants who received a group assignment (nudge0-nudge3) were retained in the analysis. The primary estimand is the effect of nudge assignment on post-treatment stated willingness-to-change, adjusted for pre-treatment baseline willingness.

Ordinal cumulative link models were estimated to examine the effect of nudging interventions on post-treatment stated willingness-to-change the mandatory pension fund category, with post-treatment willingness-to-change as the outcome, nudge condition and pre-treatment baseline willingness as predictors. Baseline willingness was mean-centered at the scale midpoint (score 3). Estimated marginal means from the primary model were used to compute pairwise contrasts of each nudge condition against control, with both unadjusted and Holm-adjusted p-values reported for multiplicity.

Two complementary models were estimated. The primary (pre-specified) model regressed post-treatment willingness-to-change on experimental condition and baseline willingness. A secondary repeated-measures cumulative link mixed model incorporated both pre- and post-treatment measurements per respondent, with condition, time, and their interaction as fixed effects and a random intercept for participants, directly testing whether the change in willingness-to-change over

[5] Upon entering the experimental section, an algorithm randomly allocated each respondent to a group, while maintaining approximately equal group sizes. Minor differences in group sizes resulted from respondents dropping out before completing the survey. It is important to note that group assignment for each new respondent was independent of whether previous respondents had completed the survey, ensuring continuous allocation despite slight imbalances.

time differed between nudge conditions and control. Exploratory models additionally included financial literacy (correct_ans) and its interaction with condition, and frequency of retirement-related thinking (think), to assess moderation and secondary predictors.

Model 1 (primary):
willingness_post ~ experiment + baseline_willingness_centered

Model 2 (moderation):
willingness_post ~ experiment × correct_ans + baseline_willingness_centered

Model 3 (secondary):
willingness_post ~ experiment + correct_ans + think + baseline_willingness_centered

where:

- *experiment* = nudge condition (nudge1 – social norms, nudge2 – framing effect, nudge3 – framing effect with loss aversion), reference category = nudge0 (control)
- *baseline_willingness_centered* = initial stated willingness to change, mean-centered on the scale midpoint (3) to yield an interpretable intercept
- *correct_ans* = number of correct answers on the financial literacy test (0–5)
- *think* = frequency of thinking about retirement (Never, Rarely, Occasionally, Often, Very often), reference category = Occasionally

As a robustness check, a repeated-measures ordinal mixed-effects model was estimated, with willingness-to-change (pre and post, one row per time point per participant) as the outcome, a treatment × time interaction as the parameter of interest, and a random intercept per participant.

To formally test whether financial literacy moderates the nudge effect, a nudge × financial literacy interaction term was added to the primary model, and compared against the model without the interaction using a likelihood-ratio test.

The coefficient $\beta_i$represents the change in the log-odds of the outcome for a one-unit increase in the predictor, holding all other variables constant. By exponentiating the coefficient, the corresponding odds ratio (OR) and its 95% confidence interval are obtained, which are commonly used for interpreting binary logistic regression results. The odds ratio represents the ratio of the odds of the outcome occurring for a one-unit change in the predictor. An OR > 1 indicates increased odds, OR < 1 indicates decreased odds, while OR = 1 indicates no change in odds. OR is calculated as following (Hosmer et al, 2013):

$$OR_i = e^{\beta_i}, \qquad 95\%\ CI_i = \exp\left(\beta_i \pm 1.96\ SE\ (\beta_i)\right)$$

To ensure the reliability of the regression estimates, multicollinearity among predictors was assessed using the Variance Inflation Factor (VIF). Model comparison used the Akaike Information Criterion (AIC), introduced by Akaike (1974), understood strictly as a measure of relative fit and not as evidence of causal correctness.

4. EMPIRICAL RESULTS

The study was conducted through a survey of employed citizens in Croatia (N = 259), with 206 participants taking part in the experimental section that included nudging interventions based on social norms, framing effects, and loss aversion. In the conducted survey, one-third of respondents (34%) were male (n = 87), with the recorded median age being 40 years. The median year of employment is 2012, meaning that half of the respondents entered employment within the last thirteen years. The analysis of household structure according to place of residence shows a dominance of urban areas since the majority of respondents (n = 200) live in cities. Regarding household composition, the largest share of respondents lives with a partner (n = 102), while a considerable number live within extended family households or shared living arrangements (n = 78). Together, these two categories account for more than two-thirds of the total sample. The largest proportion of respondents holds a higher education degree (n = 147), representing more than half of the sample. This is, similar to distribution of urban population in the total sample, a consequence of conducting an online survey. The distribution of respondents' monthly income shows that the largest proportion falls within the middle- and upper-income groups. The most represented category is income between €1,000.01 and €1,500.00 (n = 89), followed by respondents earning above €2,000.00 (n = 80) and those in the €1,500.01–€2,000.00 range (n = 66). The educational structure of the sample, characterised by a high share of highly educated respondents, is consistent with the income distribution.

Questions on risk perception and retirement savings show that almost one-third of respondents never (8%) or rarely (21%) consider retirement, while the largest share (46%) thinks about it only occasionally. These findings suggest that retirement, as a long-term financial goal, is not a central component of financial planning for many individuals, which is a finding consistent with the literature (Thaler & Benartzi, 2004) on the tendency to delay decisions related to the distant future. The results further indicate that slightly less than half of respondents (45%) do not allocate any additional savings beyond the statutory system. Regarding risk tolerance, the results show that the majority of respondents report a moderate level of risk tolerance (49%). A particularly concerning finding is that a substantial share of respondents lacks information about the options within the mandatory pension system. Although knowledge of basic rules should form the basis for informed financial decision-making, the results show that as many as 60% of respondents were unaware that pension fund categories can be changed once per year, while fund switching is possible every 15 days. An even more pronounced issue is observed in relation to knowledge of the risk and return profiles of different pension fund categories, where only 23% of respondents correctly identified category A as the highest-risk and highest-return category. These results point to a substantial gap in financial literacy related to pension funds. These results are not surprising since Vehovec (2011), more than a decade ago, advocated the need to increase both financial and pension literacy in Croatia. Barbić et al. (2016) reported that individuals in Croatia scoring higher on financial literacy tests have a positive

attitude towards retirement planning and that financial literacy is statistically the single most important predictor of investing funds in the third pension pillar. A decade later, this study reports a more depressive outlook within a sample that is more educated compared to the general population. The consequences of the established lack of knowledge and awareness are straightforward. They may lead to suboptimal decisions and may negatively affect long-term pension outcomes.

Table 1 Selection of Mandatory Pension Fund Category According to Respondents' Answers

	Self-selected category at first employment				**TOTAL**	
Selected category	Yes		No			
A	14	19%	21	11%	35	13.5%
B	24	33%	37	20%	61	23.6%
C	1	1%	0	0%	1	0.4%
Not sure	34	47%	128	69%	162	62.5%
TOTAL	**73**	**100%**	**186**	**100%**	**259**	**100%**

Source: Authors' own calculations

Table 1 shows that only 73 respondents (28%) reported that they had independently chosen the category of the mandatory pension fund. This finding confirms the presence of the *default* (Madrian & Shea, 2001) and *status quo* (Samuelson & Zeckhauser, 1988) bias among our sample, as most individuals passively remain in the assigned category without active intervention. Among those who made an independent choice, the majority selected category B (33%) while notably 47% of respondents reported being unsure which category they belong to, indicating a lack of awareness regarding their own decisions and pension savings arrangements. A specially concerning fact is that among the 128 respondents who were assigned to a pension fund category by REGOS *ex officio* and were unsure of their category, at least 15 respondents provided incorrect answers regarding their assigned category at the time of first employment. According to legal regulations in force at the time of their employment, REGOS automatically assigns individuals employed until July 2019 to category B however, 9 respondents claimed that they were in category A. Likewise, individuals employed from August 2019 onwards should have been assigned to category A *ex officio*, however 6 respondents stated that they were assigned to category B by REGOS, which is not legally possible unless they had made an active choice.

Participants responses indicate several key reasons why individuals decide to change their mandatory pension fund category. The most frequently mentioned reason is the influence of new information – e.g. additional knowledge about pension funds or the possibility of switching categories – obtained from financial experts as well as from close social networks. Overall, the results indicate that the decision to change pension fund category is not purely financial, but rather

shaped by a combination of information availability, personal preferences, external recommendations, and ease of action. The descriptive analysis also examined the reasons why respondents did not subsequently change their pension fund category. The results show that a significant number of respondents were not aware of the possibility of switching pension fund categories, with as many as one hundred participants explicitly stating this reason. Many additionally reported insufficient knowledge about differences between fund categories thus indicating that low levels of financial literacy and limited interest in retirement planning significantly contribute to decision inertia (Madrian & Shea, 2001; Choi et al, 2004**)**. On the other hand, a degree of disengagement and lack of motivation is also evident, as reflected in responses such as "I have not thought about it," "I keep postponing it," or "There is still time," indicating that for some respondents' retirement is perceived as a distant future event, leading to procrastination in financial decision-making. This pattern is consistent with present-biased preferences and procrastination in intertemporal decision-making, as individuals tend to postpone beneficial financial decisions to the future (O'Donoghue & Rabin, 1999).

The analysis of respondents' financial literacy – adapted from Allgood and Walstad (2016) – show that the largest share of respondents underestimated their knowledge, with 112 participants (43%) achieving a better test score than they had expected. Participants were asked to rate their financial literacy on a scale from 1 to 5 and were subsequently tested through five tasks covering basic concepts such as interest rates, inflation, bond returns, and risk comprehension. The number of correct answers to the financial literacy questions shows that the largest group of respondents, 97 (37%), answered 4 out of 5 questions correctly. The highest number of correct responses, a total of 233, was recorded for the first question, while the third question was the most challenging, but it should be noted that only the third question included four response options. In other words, these results indicate that respondents have a better understanding of basic financial concepts, such as inflation, while questions requiring comprehension of more complex financial mechanisms, such as the impact of interest rates on bond prices, represent a greater challenge.

Table 2 Optimal Categories of Mandatory Pension Funds

	Does the respondent think they are in the optimal category?		**Does the respondent know which category is optimal?**		**Is the respondent actually in the optimal category?**	
	PERCEPTION		KNOWLEDGE		STATUS	
Yes	54	21%	53	21%	61	24%
No	22	8%	47	18%	39	15%
Not sure	183	71%	159	61%	-	-
Unknown	-	-	-	-	159	61%

Source: Author's own calculations

In order to examine respondents' relationship to the optimal category, their answers from the survey were analysed and compared with the presumed optimal category for their age. Table 2 refers to the full sample of 259 valid respondents, as these questions were administered before the experimental section. Thus, the 53 respondents who were subsequently excluded from the experiment because they were already in Category A are included in Table 2. It presents three dimensions of respondents' relationship to the presumed optimal category: perception ("Does the respondent believe they are in the optimal category?"), knowledge ("Does the respondent know which category is optimal?"), and actual status ("Is the respondent actually in the optimal category?"). First, their current category was verified, including whether they had changed category, who had done so, and which category they selected if they had changed. The majority of respondents, a total of 183, are unsure whether they are in the presumed optimal category, meaning that they are not certain which category is appropriate for them given their current age and category. When observing their knowledge – i.e., whether they know which category is presumed optimal for them based on current age, regardless of their actual category – only 53 respondents know their presumed optimal category. Regarding actual status, 61 respondents are in the presumed optimal category, while for 159 respondents the status is unknown because they do not know their current category. A mismatch is observed between perception, knowledge, and actual status regarding the presumed optimal category, with a large number of respondents being either unsure or unable to correctly assess their situation.

Of the 259 valid respondents, 53 were already in Category A and were therefore not included in the experimental analysis. The experimental part was designed to examine whether the nudges could encourage respondents to change their pension-fund category towards the presumed optimal category based on their age and the applicable legal provisions. Respondents already in Category A were excluded because they were already in the highest-risk category and therefore had no higher category towards which the nudge could encourage a change. The intention was not to encourage these respondents to move to a lower-risk category when they were already in the presumed optimal category according to the study benchmark. In contrast, respondents in Categories B and C were retained because they could still potentially move to another category that is presumed optimal or more appropriate for their age under the applicable rules. This also applies to respondents already classified as being in the presumed optimal category: being in the presumed optimal category does not preclude a willingness-to-change to another category, as individual risk preferences and financial objectives are not observed. Thus, the presumed optimal category is treated as a benchmark for the direction of the intended change rather than as a universally preferred or welfare-maximizing choice.

Table 3 Primary ordinal model (odds ratio)

Predictor	Coefficient (log-odds)	OR	95% CI
nudge1 vs nudge0	0.153	1.16	[0.53, 2.58]
nudge2 vs nudge0	0.396	1.49	[0.67, 3.34]
nudge3 vs nudge0	0.474	1.61	[0.74, 3.51]
Baseline willingness (centered)	1.869	6.48	[4.50, 9.64]

Source: Authors' own calculations

The primary model shows that baseline willingness-to-change is, as expected, the dominant predictor of post-treatment willingness-to-change (OR = 6.48, 95% CI [4.50, 9.64]) – participants who started higher on the scale tended to remain higher. None of the three nudge conditions differed significantly from the control group: odds ratios were directionally positive and increased with the apparent intensity of the manipulation, but all confidence intervals were wide and included 1 (no effect).

As an additional specification, we estimated a model controlling for financial literacy and frequency of thinking about retirement. The results remained consistent with the primary model: none of the three nudge conditions differed significantly from the control group.

Table 4 Financial literacy moderation model

Predictor	Estimate	SE	z	p
nudge1 vs nudge0	-1.037	1.263	-0.821	.412
nudge2 vs nudge0	-1.850	1.317	-1.405	.160
nudge3 vs nudge0	-2.219	1.516	-1.463	.143
Financial literacy	-0.239	0.266	-0.901	.368
Baseline willingness (centered)	1.842	0.196	9.404	<.001***
nudge1 vs financial literacy	0.352	0.352	0.999	.318
nudge2 vs financial literacy	0.655	0.369	1.776	.076 **.**
nudge3 vs financial literacy	0.766	0.418	1.832	.067 **.**

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1;

Source: Authors' own calculations

The treatment by financial literacy interaction terms were not statistically significant, and the likelihood ratio test comparing the interaction model with the model without interactions was also non-significant ($\chi^2(3) = 4.62$, $p = .202$).

Table 5 Direct treatment-vs-control contrasts

Contrast	Estimate	SE	z	p (Dunnet-adjusted)	p (Holm-adjusted)	95% CI
nudge1 - nudge0	0.152	0.402	0.379	.941	.705	[−0.80, 1.10]
nudge2 - nudge0	0.396	0.410	0.966	.634	.692	[−0.57, 1.36]
nudge3 - nudge0	0.474	0.395	1.198	.484	.692	[−0.46, 1.41]

Source: Authors' own calculations

Direct contrasts of each nudge condition against control confirm that none of the differences reach statistical significance, whether or not multiplicity is corrected for (all Holm-adjusted $p \geq .69$).

Table 6 Repeated-measures ordinal mixed model

Term	Estimate	SE	z	p
Time (post vs. pre), control group	1.408	0.534	2.638	.008 **
nudge1	0.986	0.906	1.088	.277
nudge2	1.286	0.932	1.380	.168
nudge3	1.694	0.916	1.850	.064 .
Time x nudge1	-0.210	0.698	-0.301	.764
Time x nudge2	0.136	0.712	0.191	.848
Time x nudge3	0.110	0.696	0.158	.874

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1;

Source: Authors' own calculations

As a robustness check, a repeated-measures ordinal mixed model confirms the primary finding: while willingness-to-change increased over time in the control group ($p = .008$), none of the treatment × time interaction terms were statistically significant (all $p > .76$).

The appendix table "Changes in Stated Willingness-to-change Mandatory Pension Fund Category by Experimental Groups" presents changes in respondents' stated willingness-to-change their mandatory pension fund category before and after the experiment, categorized as "Negative change," "No change," and "Positive change," across experimental groups. In the control group (nudge0), most respondents did not change their stated willingness-to-change (78%). A positive change indicates that after the experiment respondents were more stated willing to change their mandatory pension fund category than they were before, while a negative change indicates reduced stated willingness-to-change after the experiment. In the first experimental group (nudge1) 28% of respondents showed a positive change, while the second (nudge2) and third (nudge3) experimental groups recorded the highest share of positive changes (33% in both groups) among

all experimental groups. Overall, 29% of all respondents increased their stated willingness-to-change their mandatory pension fund category after the nudge intervention. These descriptive proportions are consistent with the direction of the hypothesized effect, but, as the between-group tests show, the differences across groups are not statistically distinguishable from chance.

To examine whether respondents' stated willingness-to-change their mandatory pension fund category was affected after being exposed to an experimental nudge intervention, the Stuart–Maxwell test was applied to the transition matrix. This test evaluates the hypothesis that the distribution of responses before the experiment is equal to the distribution after the experiment. Rejection of the null hypothesis suggests that changes are asymmetric, meaning that respondents are more likely to shift their answers in one direction (e.g., towards higher categories) than in the opposite direction. On the overall transition matrix, the test showed a statistically significant change in respondents' stated willingness-to-change distribution ($\chi^2 = 33.497$), indicating that the marginal distribution of stated willingness-to-change differed between the pre- and post-treatment measurements. This within-sample change does not identify a treatment effect; the relevant between-group comparisons are reported separately. A separate analysis was also conducted for each experimental group. The results show that the control group (nudge0) did not exhibit a statistically significant change ($\chi^2 = 7.8276$), which is consistent with expectations since this group was not exposed to any intervention. Although the first experimental group (nudge1 = social norms) shows a trend of change, it is not statistically significant at the 5% level ($\chi^2 = 8.10$). In contrast, the second (nudge2 = framing effect: $\chi^2 = 9.78$) and third (nudge3 = loss aversion + framing effect: $\chi^2 = 11.97$) experimental groups showed statistically significant changes. However, a statistically significant within-group change does not by itself establish that a group differs from control – that requires a direct between-group comparison, which is reported and found to be non-significant.

To examine whether the experimental groups differ in terms of the distribution of changes in stated willingness-to-change the mandatory pension fund category, a contingency table analysis was conducted. The results of the Pearson chi-square test indicated that the differences were not statistically significant ($\chi^2(6) = 5.1819$). However, given that some expected cell counts were below 5, Fisher's exact test was additionally performed, which also confirmed that there were no statistically significant differences between the groups ($p = 0.5036$). These results indicate that the type of experiment, i.e. the intervention, did not have a significant effect on the direction of change in respondents' answers. The differences between the experimental interventions are not sufficiently large to be considered statistically significant. This null result is consistent with the direct treatment-vs-control contrasts from the primary ordinal model reported above. The results showed no issues of multicollinearity across the models, with VIF values well below 5 in every model.

5. DISCUSSION

The paper continues by examining recorded results of descriptive statistics of cognitive biases and nudging interventions through the prism of the theoretical framework of coordination traps and behavioral interventions. The low share of respondents who independently chose their category, the high share who do not know their own category, and the mismatch between perception, knowledge and status in Table 2 are the paper's most robust findings. They establish a low-information, low-activity equilibrium in the Croatian second pillar. What they do not establish is the mechanism behind it.

At least five mechanisms are consistent with the same evidence, and the study cannot discriminate among them. First is cognitive bias that encompasses status quo bias (Samuelson & Zeckhauser, 1988), default dependence (Madrian & Shea, 2001; Choi et al., 2004) and present bias (O'Donoghue & Rabin, 1999) who predict exactly this pattern. Second is rational inattention. Acquiring and processing information about category returns has a cost and if the perceived benefit is small relative to that cost, inaction is optimal rather than biased (Sims, 2003). Under this reading, the same behaviour requires no departure from rationality and no policy intervention beyond reducing the cost of information. Transaction and procedural costs are the third mechanism. A category change is executed at REGOS, is permitted once per calendar year, and is procedurally distinct from changing the pension company. These frictions are small but not zero, and small frictions are known to have large effects on take-up. Trust and perceived benefit represent the fourth mechanism. Repeated public debate about the parameters of the second pillar may reduce the perceived reliability of any long-horizon calculation, in which case inaction reflects a belief about institutional risk rather than a failure of attention. The shallowness of the Croatian capital market (Marić et al., 2024) plausibly reinforces this claim. The final mechanism revolves around heterogeneous risk preferences. Respondents reporting low risk tolerance may hold category B or C appropriately, in which case what the age-based rule scores as inconsistent is in fact a considered choice.

However, this paper approached individuals' decision by moving away from a rigid assumption of rationality. Namely, it identified several cognitive biases – status quo, default and inertia – that together could account for the existing Pareto dominated outcome. After that, it employed three nudging interventions within a randomized survey experiment, in order to determine which signal could act as the most likely to push individuals into a Pareto dominating equilibrium, i.e. increase their stated willingness-to-change pension fund category. Having in mind that pension savings are a long-horizon decisions, the implicit assumption was that individuals need to follow *Invest* as the dominating strategy within game theory approach. More importantly, political economy literature (Bueno de Mesquita, 2016) stresses that short-run interventions aimed at communicating the right information are all that is necessary to achieve and maintain equilibrium in the long term. Once individuals find themselves in a Pareto dominating equilibrium, they do not have any incentives to deviate from it.

To formally test whether financial literacy moderates the nudge effect, an interaction term (nudge condition × financial literacy) was added to the primary model. A likelihood-ratio test comparing models with and without this interaction was not statistically significant, indicating no strong evidence that financial literacy moderates the effect of nudge condition on stated willingness. Individual interaction coefficients for nudge2 ($p = .076$) and nudge3 ($p = .067$) were marginal, and the estimated literacy slope increased monotonically with nudge intensity, a pattern consistent with literacy-dependent responsiveness to stronger framing manipulations. Given the modest sample size per condition, this analysis may be underpowered to detect a true interaction, and the pattern should be treated as exploratory.

Overall, the results of the study indicate a complex relationship between financial literacy, respondents' stated willingness-to-change the category of the mandatory pension fund and the effects of nudge interventions. Although the sample consists of highly educated respondents with relatively stable incomes, it was found that many respondents have gaps in knowledge and awareness regarding their own pensions. In other words, Samuelson & Zeckhauser's (1988) *status quo* bias can easily be applied to our sample since roughly the same percentage of individuals (28%) in our sample switched from their initial fund allocation. This asymmetry of value – the disutility of giving up an object which is greater than the utility associated with acquiring it (Kahneman & Tversky, 1979) – lies behind the decision of individuals who cling to initial allocations even when rebalancing is costless and clearly beneficial. The psychological mechanism lying behind could be also connected to the endowment effect (Kahneman et al., 1991) which the paper did not test for directly. Nonetheless, the initial results on *default* bias are in line with the most influential papers in the field that showed individuals inertia in fund allocation (Madrian & Shea, 2001) present across multiple companies and more importantly its double-edged nature: locking people into suboptimal allocations (Choi et al, 2004). Moreover, descriptive analysis of respondents' financial literacy pointed to underestimation on the side of the participants. Due to a rather shallow financial market in Croatia, it would be a stretch to connect these results to ones reported by Cronqvist & Thaler (2004) who have proven that *status quo* inertia among individuals in Sweden produced better outcomes compared to active choice driven by overconfident individuals. The paper's underlying premise is that cognitive biases, independent of higher-than-expected level of financial literacy, locks individuals in a Pareto dominated equilibrium in the observed sample.[6]

[6] In order to prove that a simple calculation is provided based on the state intervention during 2019. The importance of 2019 state intervention which automatically assigned newly employed individuals to an presumed optimal category (category A) reduced the risk of suboptimal decisions and potential long-term losses in returns. Namely, if an individual invested 100 EUR in categories A, B and C on 1 October 2019, with the results being adjusted for inflation using the CPI index, her real return equals 27,66% in category A, 5,05% in category B and -16,84% in category C. MIREX indices for each category were used from 1 October 2019 until 1 September 2025. This public policy intervention illustrates the use of default options as a behavioural policy tool, whereby individuals entering the labour market for the first time are pre-assigned to a designated pension fund category. The comparison of historical real returns

Data on respondents' perception, knowledge and actual status (Table 2) of an optimal category of mandatory pension fund for themselves point to a low level of pension literacy (Vehovec, 2011). Solely insisting on increasing the level of financial (and even pension) literacy – which is evidently the case in the last 10 and more years in Croatia – does not yield expected results. To put it more directly, this public policy strategy shifts the burden of responsibility exclusively to the individual, while completely ignoring the possibilities of public intervention or nudging by both public institutions and private companies in financial sector. Moreover, presented results extend the finding of Anđelinović et al. (2023) in two ways. They move the evidence from students to the employed population. And they link the knowledge gaps to one specific, dated legal reform (2019 change in the default rule).

Upon the confirmation of existing cognitive biases affecting individuals when choosing a mandatory pension fund category, the paper assessed the effectiveness of nudging interventions in increasing individuals' stated willingness-to-change categories of mandatory pension funds. When nudge conditions are compared directly against control none reached statistical significance. In other words, these short-run interventions do not causally shift stated willingness-to-change. Point estimates were directionally consistent with the hypothesis and increased with the apparent strength of the manipulation, which is suggestive but not conclusive given the sample size and the width of the resulting confidence intervals. In other words, presented findings differ from the mainstream results reported in the literature. Survey-based experiment with members of a Dutch occupational pension plan reports a positive effect that framing has in annuity demand (Bockweg et al., 2018). Also, Eberhardt et al. (2018) show that loss frames are most successful with uncertain decision outcomes (e.g. Block and Keller 1995) which is not the case with this study. While the direction of the estimated effects is broadly consistent with the wider literature on the effectiveness of nudges in financial decision-making (Thaler & Sunstein, 2008; Zentai & Kovács, 2024), the present results do not provide statistically significant confirmation of this effect in the observed sample. Despite the relatively high educational level of the sample, financial literacy was not a significant predictor of improved stated willingness-to-change the pension fund. A formal interaction test likewise found no statistically significant moderation of the nudge effect by financial literacy, though the direction of the (non-significant) interaction terms suggests this question merits a larger, adequately powered follow-up study. The frequency of thinking about retirement has a complex effect, where respondents who think about retirement "very often" or "rarely" show lower odds of improvement compared to the reference category, possibly due to already having reached a presumed optimal category or lower motivation for change.

across categories is descriptive and does not provide a causal estimate of the effect of the reform on pension outcomes.

6. CONCLUSION

This paper investigated the impact of cognitive biases and nudge interventions on participants' stated willingness-to-change the category of the mandatory pension fund. Drawing on political economy and behavioural economics, the paper models individuals' fund category choices as a coordination game in which cognitive biases – status quo dependence, default reliance, and decision inertia – lock participants in Pareto-dominated equilibria. The first research objective, confirming the presence of cognitive biases in pension fund category selection, was supported by the descriptive and status-quo-bias evidence reported above. The second objective, establishing the effectiveness of nudge interventions was not statistically confirmed, since direct comparisons of nudge conditions against control did not reach significance, although estimated effects were directionally positive and scaled with intervention intensity. The results show that *status quo* bias, decision inertia, and default-option bias represent strong barriers to active decision-making. Most respondents did not independently choose their pension fund, and a significant proportion of respondents did not know which category they belonged to. Using primary survey data from 259 employed Croatian citizens and an embedded randomized experiment, the paper tests the effectiveness of three nudging interventions – social norms, framing effects, and framing combined with loss aversion – on participants' stated willingness-to-change their mandatory pension fund category. The combined loss-aversion-and-framing condition (nudge3) produced the largest point estimate among the three interventions, but this difference from control was not statistically significant given the available sample size, and the confidence interval is wide enough to be compatible with a range of effect sizes from negligible to moderately large. A formal interaction test found no statistically significant evidence that financial literacy moderates the nudge effect, though the pattern of estimated interaction terms is worth investigating in a larger sample. These results are best read as suggestive rather than confirmatory evidence that loss-framed communication can shift individuals toward welfare-improving pension decisions. Presented results do not confirm the hypothesis that short-run interventions causally shift stated willingness-to-change mandatory pension fund category.

Three important public policy implications can be drawn from these results. First, automated allocation mechanisms have proven effective in overcoming *status quo* bias and should therefore be maintained and further developed. Second, it was observed that respondents show a lack of awareness of their own decisions, limited understanding of fund risk, and a tendency to passively maintain the status quo. Therefore, it is necessary to ensure greater transparency and simplicity of pension-related information, combined with education and targeted nudge interventions. Third, future policies should consider the ethical dimension, as interventions must preserve freedom of choice while ensuring clear communication and an easy ability to change decisions. The practical contribution of the study lies in providing preliminary, directionally suggestive evidence that nudge interventions may increase citizens stated willingness to make active and

potentially more beneficial decisions regarding pension savings. The limitations of the study stem from the use of an online sample and the implementation of only a single survey-based intervention, which limits the generality of the results and prevents the assessment of long-term effects.

For future research, a more detailed analysis of different types of nudge interventions in the context of pension savings is recommended, along with longitudinal tracking of their effects and an examination of variations across different socioeconomic groups. This would enable the development of more precise and effective public policy tools that combine institutional measures and behavioural approaches with the aim of increasing financial security in old age and ensuring a better life.

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APPENDIX

Table A1 Survey questonnaire

PENSION SAVINGS AND SELECTED PENSION FUND CATEGORY QUESTIONS
1. How often do you think about your retirement? a) Never b) Rarely c) Occasionally d) Often e) Very often
2. Do you save or invest money for retirement in addition to the first and second pension pillars? a) Yes b) No
3. How would you describe your willingness to take financial risk when investing? a) Very low b) Low c) Moderate d) High e) Very high
4. In which year were you first employed? Year: enter number
5. In which month of that year were you first employed? a) January b) February c) March d) April e) May f) June g) July h) August i) September j) October k) November l) December m) I don't remember
6. Did you personally choose your pension fund and category when you were first employed? a) YES – I chose it myself b) NO – REGOS assigned it by default
7. Are you aware that you can change the pension fund category once per calendar year, and the mandatory pension fund every 15 days? a) YES b) NO
8. To what extent are you currently considering changing your pension fund category? a) I am not considering it at all – I do not want a change b) I sometimes think about it, but I am not ready to change yet c) I moderately think about it – I am still not sure what I want d) I think about it a lot – I am not sure yet, but I am close to a decision e) Very intensively – I have decided to change the category soon
9. Which category of the mandatory pension fund was assigned when you were first employed? a) A b) B c) C d) I am not sure
10. Do you know which category carries the highest risk and potentially the highest return? a) A b) B c) C d) I am not sure
11. Which category do you think would be optimal for you, considering the number of years you have until retirement? a) A b) B c) C d) I am not sure
12. Have you subsequently changed the category of your mandatory pension fund yourself? a) YES b) NO
if **YES**: **12.1. Which category did you choose when making the change?** a) A b) B c) C d) I am not sure
12.2. What was the reason for the change? a) New information b) Dissatisfaction with the returns of the previously selected category c) Dissatisfaction with the risk level of the previously selected category d) Recommendation from a financial expert e) Recommendation from a colleague/friend/family member f) Change in personal goals g) Other…
if **NO**: **12.3. Why did you not change the category of the mandatory pension fund?** a) I am satisfied with the returns b) I was not aware that I could change the category c) I have no desire to change d) Other…
FINANCIAL LITERACY
13. In your opinion, how would you rate your financial literacy on a scale from 1 to 5? a) 1 b) 2 c) 3 d) 4 e) 5
14. Suppose you have 100 euros in a savings account with an annual interest rate of 2%. How much do you think you would have in the account after 5 years if you left the money to grow? a) More than 102 euros b) Exactly 102 euros c) Less than 102 euros

15. Imagine that the interest rate on your savings account is 1% per year and inflation is 2% per year. After 1 year, how much would you be able to buy with the money in the account? a) More than today b) The same as today c) Less than today
16. If interest rates rise, what usually happens to bond prices? a) They will increase b) They will decrease c) They will stay the same d) There is no relationship between bond prices and interest rates
17. A 15-year mortgage usually requires higher monthly payments than a 30-year mortgage, but the total amount of interest paid over the life of the loan will be lower. a) True b) False
18. Buying shares of a single company usually provides a safer return than investing in a stock mutual fund. a) True b) False
DEMOGRAPHIC QUESTIONS
19. What is your gender? a) Male b) Female
20. What year were you born? *Enter number*
21. What is the highest level of education you have completed? a) Primary school b) Secondary education c) Undergraduate degree d) Graduate degree e) PhD
22. Which category best describes your monthly income? a) < 750,00 € b) 750,000 € - 1000,00 € c) 1000,01 € - 1500,00 € d) 1500,01 € - 2000,00 € e) > 2000,00 €
23. How would you describe the area where you live? a) Urban b) Rural c) Suburban
24. Who do you live with in your household? a) Alone b) With a partner c) With parents d) With roommates/friends e) Extended family/community f) Other
Note: Individuals who initially selected category A and independently switched to category A are excluded here.
NUDGE
Group: Control group (nudge0) The pension system in the Republic of Croatia is based on three pension pillars from which a user, once eligible, can receive their pension. Pension insurance in the first and second pillars is mandatory, while the third pillar is voluntary.
Group: Social Norms – social norms effect (nudge1) Although a smaller share of citizens has not taken any steps regarding the selection of the optimal pension fund category, most are aware of its importance. According to available data, as many as **74%** of people with your age and financial profile have chosen the pension fund category that is optimal for them.
Group: Framing effect (nudge2) You may not have considered how much you can gain by choosing the optimal pension fund category. With the right choice, the value of your savings can be up to **30% higher** annually compared to remaining in a suboptimal category.
Group: Framing effect & Loss aversion (nudge3) You may not have considered how much money you lose annually by staying in a less optimal pension fund category. By not choosing the optimal category, you could **lose up to 30% of your savings** annually compared to the optimal choice.
25. To what extent are you currently considering changing your pension fund category? a) I am not considering it at all – I do not want a change b) I sometimes think about it, but I am not ready to change yet c) I moderately think about it – I am still not sure what I want d) I think about it a lot – I am not sure yet, but I am close to a decision e) Very intensively – I have decided to change the category soon

Source: Questionnaire designed by the authors

Table A2 Baseline characteristic by experimental group

Baseline characteristic	Control (N = 50)	Social Norms (N = 54)	Framing (N = 48)	Framing & Loss aversion (N = 54)	p-value	Overall (N = 206)
Age (years)	40.0 (33.0, 51.0)	38.5 (29.0, 48.0)	40.5 (29.0, 50.0)	39.5 (28.0, 46.0)	0.687	40.0 (29.0, 49.0)
Gender					0.524	
Male	12 (24.0%)	18 (33.3%)	17 (35.4%)	14 (25.9%)		61 (29.6%)
Female	38 (76.0%)	36 (66.7%)	31 (64.6%)	40 (74.1%)		145 (70.4%)
Education					0.829	
Secondary education	8 (16.0%)	13 (24.1%)	13 (27.1%)	15 (27.8%)		49 (23.8%)
Undergraduate degree	10 (20.0%)	12 (22.2%)	7 (14.6%)	6 (11.1%)		35 (17.0%)
Graduate degree	29 (58.0%)	27 (50.0%)	26 (54.2%)	31 (57.4%)		113 (54.9%)
PhD	3 (6.0%)	2 (3.7%)	2 (4.2%)	2 (3.7%)		9 (4.4%)
Monthly income					0.206	
< 750,00 €	2 (4.0%)	1 (1.9%)	0 (0.0%)	0 (0.0%)		3 (1.5%)
750,01 € - 1000,00 €	1 (2.0%)	6 (11.1%)	7 (14.6%)	5 (9.3%)		19 (9.2%)
1000,01 € - 1500,00 €	14 (28.0%)	24 (44.4%)	13 (27.1%)	22 (40.7%)		73 (35.4%)
1500,01 € - 2000,00 €	19 (38.0%)	12 (22.2%)	13 (27.1%)	13 (24.1%)		57 (27.7%)
> 2000 €	14 (28.0%)	11 (20.4%)	15 (31.3%)	14 (25.9%)		54 (26.2%)
Place of residence					0.110	
Suburban	11 (22.0%)	12 (22.2%)	12 (25.0%)	3 (5.6%)		38 (18.4%)
Rural	4 (8.0%)	5 (9.3%)	1 (2.1%)	5 (9.3%)		15 (7.3%)
Urban	35 (70.0%)	37 (68.5%)	35 (72.9%)	46 (85.2%)		153 (74.3%)
Household					0.500	
Alone	8 (16.0%)	9 (16.7%)	13 (27.1%)	5 (9.3%)		35 (17.0%)
With a partner	17 (34.0%)	21 (38.9%)	17 (35.4%)	19 (35.2%)		74 (35.9%)
With parents	2 (4.0%)	3 (5.6%)	2 (4.2%)	7 (13.0%)		14 (6.8%)
With roommates/friends	2 (4.0%)	3 (5.6%)	0 (0.0%)	1 (1.9%)		6 (2.9%)
Extended	18 (36.0%)	15 (27.8%)	15 (31.3%)	18 (33.3%)		66 (32.0%)
Other	3 (6.0%)	3 (5.6%)	1 (2.1%)	4 (7.4%)		11 (5.3%)
Thinking about retirement					0.736	
Never	7 (14.0%)	6 (11.1%)	2 (4.2%)	4 (7.4%)		19 (9.2%)
Rarely	10 (20.0%)	12 (22.2%)	12 (25.0%)	12 (22.2%)		46 (22.3%)
Ocasionally	23 (46.0%)	21 (38.9%)	24 (50.0%)	25 (46.3%)		93 (45.1%)
Often	5 (10.0%)	11 (20.4%)	9 (18.8%)	8 (14.8%)		33 (16.0%)
Very often	5 (10.0%)	4 (7.4%)	1 (2.1%)	5 (9.3%)		15 (7.3%)
Save/invest outside the first and second pension pillars					0.844	
No	27 (54.0%)	25 (46.3%)	23 (47.9%)	25 (46.3%)		100 (48.5%)
Yes	23 (46.0%)	29 (53.7%)	25 (52.1%)	29 (53.7%)		106 (51.5%)
Willingness to take financial risk when investing					0.919	
Very low	5 (10.0%)	5 (9.3%)	3 (6.3%)	6 (11.1%)		19 (9.2%)
Low	15 (30.0%)	17 (31.5%)	18 (37.5%)	14 (25.9%)		64 (31.1%)
Moderate	26 (52.0%)	28 (51.9%)	23 (47.9%)	27 (50.0%)		104 (50.5%)
High	3 (6.0%)	2 (3.7%)	4 (8.3%)	6 (11.1%)		15 (7.3%)
Very high	1 (2.0%)	2 (3.7%)	0 (0.0%)	1 (1.9%)		4 (1.9%)
Objective financial literacy score	4.0 (2.0, 4.0)	4.0 (3.0, 4.0)	4.0 (3.0, 4.0)	4.0 (3.0, 4.0)	0.901	4.0 (3.0, 4.0)

Self-rated financial literacy					0.264	
1	3 (6.0%)	3 (5.6%)	1 (2.1%)	1 (1.9%)		8 (3.9%)
2	8 (16.0%)	16 (29.6%)	8 (16.7%)	5 (9.3%)		37 (18.0%)
3	23 (46.0%)	20 (37.0%)	19 (39.6%)	22 (40.7%)		84 (40.8%)
4	14 (28.0%)	11 (20.4%)	18 (37.5%)	23 (42.6%)		66 (32.0%)
5	2 (4.0%)	4 (7.4%)	2 (4.2%)	3 (5.6%)		11 (5.3%)
Current pension fund category					0.707	
A	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.9%)		1 (0.5%)
B	10 (20.0%)	12 (22.2%)	12 (25.0%)	11 (20.4%)		45 (21.8%)
C	1 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)		1 (0.5%)
I am not sure	39 (78.0%)	42 (77.8%)	36 (75.0%)	42 (77.8%)		159 (77.2%)
Category perceived as optimal					0.343	
A	3 (6.0%)	1 (1.9%)	4 (8.3%)	6 (11.1%)		14 (6.8%)
B	11 (22.0%)	10 (18.5%)	9 (18.8%)	6 (11.1%)		36 (17.5%)
C	0 (0.0%)	3 (5.6%)	3 (6.3%)	5 (9.3%)		11 (5.3%)
I am not sure	36 (72.0%)	40 (74.1%)	32 (66.7%)	37 (68.5%)		145 (70.4%)
Baseline willingness to change pension fund category					0.474	
1	35 (70.0%)	31 (57.4%)	26 (54.2%)	31 (57.4%)		123 (59.7%)
2	6 (12.0%)	13 (24.1%)	12 (25.0%)	9 (16.7%)		40 (19.4%)
3	8 (16.0%)	8 (14.8%)	9 (18.8%)	9 (16.7%)		34 (16.5%)
4	0 (0.0%)	2 (3.7%)	0 (0.0%)	2 (3.7%)		4 (1.9%)
5	1 (2.0%)	0 (0.0%)	1 (2.1%)	3 (5.6%)		5 (2.4%)

Source: Authors' own calculations

Table A3 Changes in Stated Willingness-to-change Mandatory Pension Fund Category by Experimental Groups

	Negative change		**No change**		**Positive change**		**TOTAL**	
nudge0	1	2%	39	78%	10	20%	**50**	**100%**
nudge1	4	7%	35	65%	15	28%	**54**	**100%**
nudge2	3	6%	29	61%	16	33%	**48**	**100%**
nudge3	3	6%	33	61%	18	33%	**54**	**100%**
TOTAL	**11**	**5%**	**136**	**66%**	**59**	**29%**	**206**	**100%**

Source: Authors' own calculations

Table A4 Stuart-Maxwell test

Data	**Chi-square χ^2**	**Degrees of Freedom (df)**	**p-value**
All groups	33.497	4	9.449e-07
nudge0	7.8276	4	0.0981
nudge1	8.0955	4	0.08814
nudge2	9.781	4	0.04428
nudge3	11.967	4	0.0176

Source: Authors' own calculations

Coordination game model

Let the population of insured persons be a continuum of measure one, indexed by *i*. Each *i* chooses an action *a* from *{Invest, NotInvest}*, where *Invest* denotes actively holding the age-consistent, equity-heavy category and *NotInvest* denotes remaining in the assigned default. The following symbols are used.

Symbol	Meaning	Empirical counterpart in this study
i	Index of an insured person in a continuum of measure one	Survey respondent
θ	State of fundamentals: individual net advantage of holding the age-consistent, equity-heavy category, expressed net of the value of the safe action	Not observed; depends on horizon, risk tolerance and the return differential between categories
ℓ	Proportion of the population choosing *Invest*	Not observed; the social-norms message supplies a (constructed) claim about it
x_i	Private signal of θ received by person i	Respondent's information; measured by survey questions 7 and 10
ε_i	Signal noise, $\varepsilon_i \sim N(0, \sigma^2)$, independent across i	Not observed
σ	Standard deviation of the signal noise	Not manipulated; not estimable from data
k	Threshold above which a person takes the risky action	Latent cut-off; the five-point willingness item is a coarsened measure of $x_i - k$
k^*	Equilibrium threshold	Derived below as $k^* = 1/2$
$\Phi(\cdot)$	Standard normal cumulative distribution function	—

The payoff to *NotInvest* is normalised to zero. The payoff to *Invest* is:

$$\pi(Invest|\,\theta, \ell\,) = \theta - 1 + \ell \qquad \pi(NotInvest) = 0\ .$$

Written as a two-player representation of the population game, the payoff matrix is:

Player i \ Player j	Invest	NotInvest
Invest	$\theta - 1 + \ell, \theta - 1 + \ell$	$\theta - 1 + \ell, 0$
NotInvest	$0, \theta - 1 + \ell$	$0, 0$

Two features of this matrix should be noted. First, ℓ is the proportion of the population choosing *Invest*, so a player's own payoff is increasing in others' actions, i.e. this is the strategic complementarity. Second, the game has multiple equilibria under complete information whenever $0 < \theta < 1$: both (*Invest*, *Invest*) and (*NotInvest*, *NotInvest*) are Nash equilibria, and the former Pareto dominates the latter when $\theta > 0$. This multiplicity is the "trap".

Complete information is not, however, a plausible description of the Croatian second pillar, in which 60% of our respondents did not know that the category may

be changed at all. Following Carlsson and van Damme (1993) and Morris and Shin (2001), suppose instead that θ is drawn from an improper uniform prior on the real line and that player i observes only a private signal $x_i = \theta + \varepsilon_i, \varepsilon_i \sim N(0, \sigma^2)$, independent across i.

A player observing x therefore holds the posterior $\theta \mid x \sim N(x, \sigma^2)$. Attention is restricted to threshold strategies:

$$s(x) = Invest \; if \; x > k; \qquad s(x) = NotInvest \; if \; x \leq k.$$

Conditional on the true state θ, the proportion of players who invest under the threshold k is $\ell(\theta, k) = 1 - \Phi((k - \theta)/\sigma)$, where Φ is the standard normal distribution function. A player observing exactly $x = k$ must be indifferent, so the equilibrium threshold k^*solves:

$$\mathrm{E}[\theta - 1 + \ell(\theta, k^*) | \; x = k^*] = 0$$

Because the posterior over θ given $x = k^*$ is symmetric around k^* and $\ell(\theta, k^*)$ is, viewed from that posterior, uniformly distributed on $[0,1]$ – the standard "Laplacian belief" property of global games with an uninformative prior – the expectation of ℓ equals $1/2$. The indifference condition reduces to $k^* - 1 + 1/2 = 0$, so $k^* = 1/2$.

The threshold is unique and survives iterated deletion of strictly dominated strategies as $\sigma \to 0$ (Carlsson & van Damme, 1993). The equilibrium is the risk-dominant one: incomplete information selects it out of the two Pareto-ranked equilibria of the complete-information game. It follows that whenever $\theta \in (0, 1/2)$ the population coordinates on *NotInvest* even though *Invest* is Pareto superior. That interval is the coordination trap.

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KOORDINACIJSKE ZAMKE I BIHEVIORALNE INTERVENCIJE: IZRAŽENA SPREMNOST NA PROMJENU KATEGORIJE OBVEZNOG MIROVINSKOG FONDA

Sažetak

Polazeći od bihevioralne i političke ekonomije, izbor kategorije fonda modelira se kao koordinacijska igra u kojoj kognitivne pristranosti – sklonost zadržavanju statusa quo, oslanjanje na zadane opcije i inertnost – zadržavaju pojedince u Pareto-dominiranim ravnotežama. Na uzorku od 259 zaposlenih hrvatskih građana, uz ugrađeni randomizirani eksperiment (N = 206), testirane su tri bihevioralne intervencije: društvene norme, učinak uokvirivanja te uokvirivanje u kombinaciji s averzijom prema gubitku. Ordinalna regresija s prilagodbom za početnu spremnost pokazuje da se nijedna tretirana skupina statistički značajno ne razlikuje od kontrolne skupine prema iskazanoj spremnosti na promjenu (sve p > 0,48), iako su procjene pozitivnog smjera i rastu s intenzitetom intervencije. Rad donosi dvostruki doprinos: povezuje logiku koordinacijske zamke s oblikovanjem intervencija te pokazuje da primijenjene intervencije ne mijenjaju iskazanu spremnost građana na promjenu kategorije fonda u promatranom uzorku.

Ključne riječi: bihevioralna ekonomija, politička ekonomija, gurkanje, eksperiment, mirovinski sustav.

JEL klasifikacija: D91, G23, G41, H55.