

Financial literacy and voluntary savings for retirement: Novel causal evidence

Andrej Cupák ^{a, b}, Gueorgui I. Kolev ^{c, *}, Zuzana Brokešová ^d

^a *National Bank of Slovakia, Research Department, Imricha Karvaša 1, Bratislava, Slovakia*

^b *LIS: Cross-National Data Center in Luxembourg, 11 porte des Sciences, Esch-Belval,
Luxembourg*

^c *Middlesex University London, Department of Economics, Business School, The Burroughs,
London NW4 4BT, United Kingdom*

^d *University of Economics in Bratislava, Department of Insurance, Faculty of National Economy,
Dolnozemska cesta 1, Bratislava, Slovakia*

** Corresponding author. E-mail: joro.kolev@gmail.com*

Abstract

We utilise recent Household Finance and Consumption Survey microdata to report first causal effects of financial literacy on voluntary private pension schemes participation for a Central and Eastern European (CEE) country, namely Slovakia. Savings for retirement in the supplementary pension schemes are positively associated with financial literacy after controlling for a set of relevant socio-economic variables. One additional correctly answered financial literacy question leads to a 5.6 percentage points increase in the probability of having a voluntary pension savings plan in our ordinary least squares estimates. The causal impact of financial literacy increases to 19.5 percentage points when we address potential endogeneity problems by novel to the literature instrumental variables.

JEL classification: D14; D91; I2.

Key words: Retirement savings; Financial literacy; Endogeneity; Instrumental variables; Survey data.

1 Introduction

The post-productive age period represents a substantial part of an individual's life in the majority of developed countries, where retirees on average spend around two decades in their retirement (OECD, 2015). Moreover, life expectancy is estimated to increase further in the future. Increasing longevity along with decreasing fertility will likely challenge the sustainability of unfunded pay-as-you-go (PAYG) pension systems in the majority of developed economies (e.g. Aslanyan, 2014). Due to the reduced benefits of state pensions, wealth accumulation for retirement in private pension schemes is of increasing importance.¹

Shifting the responsibility for retirement well-being to individuals presents a long-term challenge and a difficult task for policymakers. Voluntary saving in supplementary private pension schemes has been a relatively new concept for individuals in the majority of Central and Eastern European (CEE) countries. In the case of Slovakia, even after two decades of its existence, participation rates of individuals in this pillar have remained rather low.² Better understanding of determinants of the individuals' participation in such schemes based on a microdata analysis is therefore essential.

Extant literature has identified financial literacy as an important factor impacting personal finance and wealth accumulation in general, and individual pension savings behaviour in particular. In this article, we study what determines individuals' private pension savings schemes participation in Slovakia. Following leads from the extant literature, which does not cover CEE countries, we pay particular attention to the importance of financial literacy. To do so, we utilise

¹ Reforming pensions in developing and transition countries is comprehensively reviewed by Hujo (2014).

² As a reaction, Slovak government carried out another pension reform in 2005 by introducing a mandatory second pillar – the occupational pension scheme because of the deficit of the public pay-as-you-go system. We describe the Slovak pension system in more detail in Appendix A.

recent Household Finance and Consumption Survey microdata specifically assembled by the National Bank of Slovakia to answer questions such as the ones we are addressing in this article.

To the best of our knowledge, we are the first study to harness survey paradata to generate instrumental variables (IVs) for financial literacy to correct for measurement error problems previously shown in the literature. Researchers in the previous studies have instrumented financial literacy mostly by financial experience and education of relatives/peers, education in the field of economics or finance, or total number of universities/schools per region (see Lusardi and Mitchell, 2014, for a comprehensive overview). We instrument the financial literacy of survey respondents with interviewers' assessments of respondents' abilities to understand financial questions in the survey and with interviewers' assessments of respondents' abilities to translate monetary values from Slovak crowns to recently introduced euros.³ Particularly, the second instrument is relevant for the Slovak case, as many households acquired their assets prior to 2009, when the Euro was launched as a new currency and still tend to express values in the former currency. We show that individuals with lower levels of financial literacy have a worse ability to make such conversion as well as to understand questions in the survey.

Our IVs are mostly designed to deal with measurement error biases. Measurement error is the most important econometric problem marring the causal estimates of the impact of financial literacy on pension savings behaviour (Lusardi and Mitchell, 2014). Studies using instrumental variables techniques to estimate the effect of financial literacy on outcomes such as pension savings observe that the IV estimates of the effect of financial literacy are typically much larger than the ordinary least squares (OLS) estimates. In regressions estimating the impact of financial

³ In fact, we are aware of only one particular study recently conducted by Crossley et al. (2017) suggesting using interviewers' paradata to correct for bias in financial literacy in surveys, however, not in the instrumental variable framework.

literacy on outcomes such as pension savings decisions, there are broadly speaking three types of potential endogeneity each leading to its own bias with a *different* sign. Measurement error in financial literacy leads to attenuation bias (bias toward 0) in the OLS estimates of the effects of financial literacy on behaviours and outcomes. Reverse causality running from outcomes to financial literacy, e.g., people making more (and presumably better) financial decisions acquiring more financial literacy, would lead OLS regressions to *overstate* the causal effect of financial literacy. Omitted variables that are positively correlated with both financial literacy and outcomes would similarly lead to *upward* bias in the estimates. Observing that IV estimates are typically much larger compared to OLS estimates puts forward measurement error as the major culprit for bias in OLS regressions.

Our data demonstrate that only 17% of the non-retired adult individuals can correctly answer all financial literacy questions asked in the survey. While respondents generally understand the concepts of interest rates, inflation, and portfolio diversification, they mostly struggle with the question on riskiness. The lowest levels of financial literacy can be observed among low-income, unemployed and old-aged respondents. In the same sample, 16% and 19% of individuals voluntarily save for their retirement in the supplementary private pension schemes without and with employers' contributions, respectively.

Saving for retirement in the supplementary pension schemes is positively related to the individual's financial literacy after controlling for a set of relevant socio-economic variables. One additional correctly answered financial literacy question (equal to roughly one standard deviation increase, the standard deviation of our financial literacy score measuring the total number of correctly answered question is equal to 0.86) leads to a 5.6 percentage points increase in the probability of having a voluntary pension savings plan without employers' contributions in our ordinary least squares estimates. The causal impact of financial literacy increases to 19.5

percentage points when we address potential endogeneity by novel to the literature instrumental variables in our instrumental variable regressions. The positive and statistically significant causal impacts of financial literacy on voluntary retirement savings schemes participation of individuals is robust to estimations using different age sub-samples and also to different specifications of financial literacy.

Our study is the first to report the causal effects of financial literacy on voluntary pension scheme participation rates for a CEE country. Our findings inform policy and suggest how policymakers can promote the voluntary retirement saving behaviour of individuals in Slovakia and in CEE countries. The rest of the paper unfolds as follows. Previous literature is summarised in Section 2. Section 3 offers a description of the microdata employed including the measure of financial literacy and its distribution across individuals. In Section 4, econometric estimation and empirical results are presented while the last, Section 5, concludes and discusses policy implications.

2 Previous literature and theoretical background

Besides standard socio-economic factors important for the life-cycle profiles of wealth such as age, education, income, or labour status⁴, financial literacy has been shown in the empirical literature as an important ingredient of informed choices and sound financial behaviour of households and individuals including retirement savings.

For example, the causal impact of financial literacy on household wealth accumulation has been demonstrated by Behrman et al. (2012). Researchers have also shown that financial literacy and exposure to financial education or training is positively associated with retirement

⁴ A non-exhaustive list of examples includes Bernheim et al. (2001), Browning and Crossley (2001), or Ameriks et al. (2003).

saving and planning (e.g. Lusardi and Mitchell, 2007; Bernheim and Garrett, 2003; Banks, 2010; Van Rooij et al., 2012; Brown and Weisbenner, 2014). To make sound decisions in retirement planning and investment, one has to be familiar with the concepts of risk diversification, relation between risk and return, including the role of interest rates as well as possessing a knowledge of how various financial assets work (Lusardi and Mitchell, 2017). As Lusardi (2008) and Van Rooij et al. (2007) conclude, individuals with higher financial knowledge regarding these issues are more likely to have planned for their retirement as well as invest much of their retirement funds into sophisticated assets. This, in the long run, enables them to generate higher returns along with lowering the non-systematic risks (Mitchell and Lusardi, 2015).

In another stream of the literature, Cardak and Wilkins (2009), Christelis et al. (2010), Van Rooij et al. (2011), or Guiso and Viviano (2015) study the importance of financial literacy and cognitive abilities in stock market participation and risky asset holdings. Furthermore, Gaudecker (2015) shows that financially literate households and investors tend to have better diversified portfolios and suffer smaller losses from underdiversification. Regarding the debt side, borrowers with poor financial literacy tend to hold higher shares of high cost credit compared to more literate borrowers (e.g. Disney and Gathergood, 2013).⁵ All these concepts are crucial for retirement saving decisions as optimal investment strategies of retirement funds affect the final amount of returns (Clark et al., 2012).

The role of financial literacy in retirement savings decision is also supported by the theory. For example, based on the model of consumption and saving decisions formulated by

⁵ For an interested reader, the importance of financial literacy and education in consumers' financial decisions is comprehensively reviewed by Campbell (2006), Fernandes et al. (2014), Jappelli (2010) and Lusardi and Mitchell (2014).

Lusardi and Mitchell (2011c), a rational consumer derives utility from distribution of consumption and leisure over his/her lifetime. In the base settings, the consumer solves the optimization problem by the expected value of the sum of per-period utility $U(c_j)$ of the consumption c discounted to the present by the factor β and multiplied by the probability of survival p_j from the consumer's current age j to the oldest possible lifetime D :

$$E\left[\sum_{j=s}^D \beta^{j-s} U(c_j)\right].$$

In each period, assets (a_j) and consumption (c_j) are determined endogenously by maximising the expected utility function with respect to an intertemporal budget constraint. In the first period, i.e. before retirement, income (y_j) is a function of earnings (e_j) and returns on assets (a_j). Income in the retirement period is a function of social security benefits (SS), pension (PP) depending on retirement age (R) as well as returns on assets (ra_j):

$$y_j = e_j + ra_j, \quad j \in \{S, \dots, R-1\}$$

$$y_j = SS_j(R) + PP_j(R) + ra_j, \quad j \in [R, \dots, D].$$

Consumption (c_j) depends on income, assets, and benefits. As concluded by Lusardi and Mitchell (2011c), to solve the optimization problem, an individual has to understand and utilise information regarding survival probabilities, discount rates, investment returns, current and future earnings, pension system, Social Security benefits, and inflation. Therefore, a substantial knowledge of these economic concepts is inevitable.

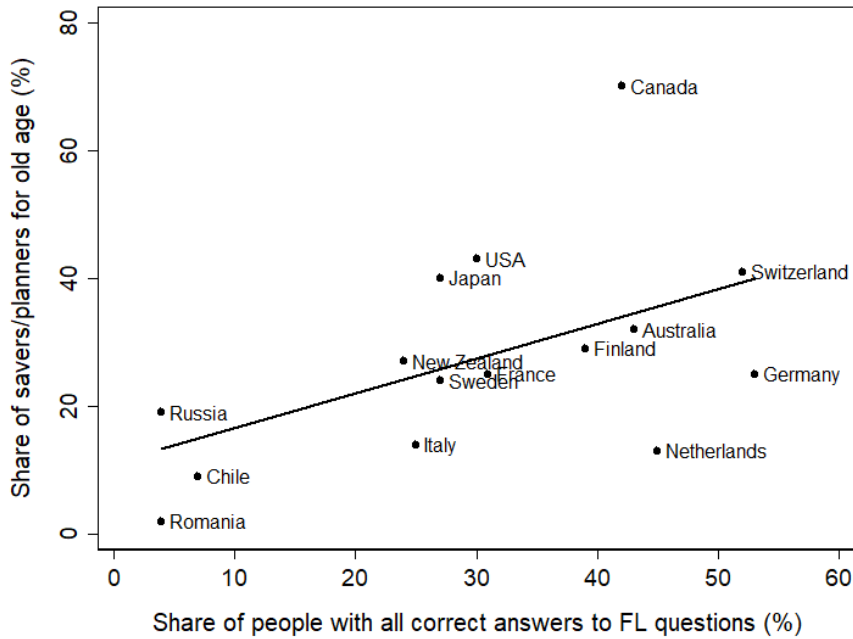
One could argue that financial advisors could substitute for the financial literacy. However, research shows that individuals with low financial literacy are less likely to consult with financial intermediaries. Financial advisors can be biased and can have conflicting goals imperfectly aligned with, or outright orthogonal to the investors' interests (Carmel et al., 2015).

Therefore, a certain level of financial knowledge of individuals is necessary even in the presence of financial advisors (e.g. Van Rooij et al., 2012; Guiso and Viviano, 2015).

There are substantial differences in the level of financial literacy and pension systems across countries (e.g. Atkinson and Messy, 2011; Lusardi and Mitchell, 2011b; Badarinza et al., 2016). The link between financial knowledge and active retirement savings behaviour of individuals has been explicitly studied in a few empirical studies. Existing empirical results from these studies support the hypothesis that a higher level of financial literacy is associated with a higher propensity to save or plan for retirement (see Figure 1). This relationship is stronger in countries with limited public pension systems compared to countries with extensive public pension systems. This pattern can be partially explained by Jappelli and Padula's (2013) human capital model of financial literacy arguing that individuals in countries with an extensive social security system might have little incentive to invest in developing their financial literacy. This can translate to lower levels of voluntary retirement saving.

Whereas the link between financial literacy and retirement savings has been predominantly analysed in regions of North and South America, West and South Europe, or Australia, the relationship has not been widely studied for CEE countries using representative microdata yet. In fact, we are aware of only one particular study conducted by Beckmann (2013) for Romania analysing household saving behaviour (including some aspects of retirement savings) with respect to financial literacy. This presents a significant omission in the literature, as the CEE households and individuals as well as economic environments of these countries differ in many aspects from those of the more developed countries, including general level of income and savings, quality of education, demographic situation, or development of pension systems.

Figure 1: Financial literacy and saving/planning for retirement across countries



Source: Empirical studies on financial literacy and retirement saving/planning (see Table B.1 for the list of studies)

Our contribution to the literature is an analysis of heterogeneity of financial literacy across individuals and estimation of the link between financial literacy and the propensity to save for retirement in the supplementary private pension savings schemes in Slovakia. For this purpose, we utilise recent, representative Household Finance and Consumption Survey data collected in 2014. We also exploit novel to the literature instrumental variables to address potential endogeneity of financial literacy.

3 Data

We analyse voluntary retirement savings decisions and financial literacy of Slovak individuals using the newest wave of the Slovak Household Finance and Consumption Survey (HFCS) data

collected by the National Bank of Slovakia in 2014.⁶ The main aim of the survey is to gather structural information on assets (real and financial), liabilities (mortgage and non-mortgage debt) and consumption of households. The data also contain detailed information on individual household members such as their employment status, income, retirement savings as well as a number of demographic characteristics including age, gender, marital status, education, etc. The Slovak HFCS data is representative both at national and regional levels.⁷

Although two rounds of the Slovak HFCS data (from 2010 and 2014) are available, the surveyed households (individuals) were not monitored over time; hence we cannot treat the two rounds as a panel and analyse the dynamics of the retirement savings. Moreover, the first wave of the HFCS data does not contain information on the financial literacy of respondents. Therefore, we utilise only the latest available dataset. The final net sample of the Slovak HFCS data consists of 2,135 households along with 4,658 individual members aged over 16. Since the questions on financial literacy were asked only to the reference persons of households, we discard information on the other household members. Assessment of the level of financial literacy and participation in the voluntary pension savings is carried out on the sample of non-retired respondents.

⁶ Household Finance and Consumption Survey is carried out in all euro-area countries (except Lithuania) as well as in Hungary and Poland. Unfortunately, only two countries (Luxembourg and Slovakia) included financial literacy questions in their national HFCS wave 2. Therefore, an international comparison of financial literacy and retirement savings patterns is not feasible with this data.

⁷ Survey weights were calibrated to margins such as age structure, sex, household size, and employment status in each region.

3.1 Measuring financial literacy

In the survey, each household represented by the reference person is asked a set of questions on financial literacy⁸. Inspired by the previous literature (e.g. Lusardi and Mitchell, 2014), questions are formed in order to discover the ability of respondents to understand fundamental concepts in personal finance including interest rates, inflation, riskiness and diversification of portfolios.⁹ The questions regarding interest rates and inflation indicate the level of respondents' understanding of fundamental economic concepts for saving decisions and basic financial numeracy (Lusardi and Mitchell, 2011c). Questions focused on the portfolio diversification and risk help to evaluate respondents' knowledge on how financial assets work and if there are familiar with the concept of risk diversification that are important factors of an informed investment decision (Lusardi and Mitchell, 2011c). These concepts represent fundamental financial knowledge for competent retirement saving decisions (Lusardi and Mitchell, 2017). The full list of financial literacy questions asked in the Slovak HFCS is presented in Appendix C.

Following previous studies, we create the first measure of financial literacy as a sum of binary variables taking value of 1 if the particular financial literacy question is answered correctly and 0 otherwise. Our financial literacy index ranges between 0 and 4 for each individual. As an alternative measure of financial literacy, we create a dummy variable taking value 1 if all

⁸ In line with the research of Lusardi and Mitchell (2011a), under the term financial literacy, we understand the ability of individuals to do simple financial calculations and knowledge of fundamental financial concepts important for informed retirement decisions.

⁹ Note that questions were asked in a gradually increasing difficulty level. First, basic questions related to interest rates and inflation were asked, which were followed by more sophisticated questions on portfolio diversification and riskiness of financial products.

financial literacy questions are answered correctly and 0 otherwise. These two measures of financial literacy are the most commonly used in the extant empirical literature.

In Slovakia, only 17% of all the interviewed non-retired respondents were able to correctly answer all four financial literacy questions (Table 1), which is a substantially lower score compared to the results from other countries. For example, around 30% of surveyed respondents were able to correctly answer similar financial literacy questions in the US, 40% in Canada and 50% in Germany (see Lusardi and Mitchell, 2011b; Bucher-Koenen and Lusardi, 2011; Boisclair et al., 2017). The detailed distribution of answers to the particular financial literacy questions across different individual characteristics is further presented in Table 1. The highest financial literacy is observed among the young, high-income and individuals with higher education. On the other hand, respondents in older age cohorts, with low incomes and unemployed tend to know the least. These results are in line with previous research outcomes (e.g. Atkinson and Messy, 2011; Lusardi and Mitchell, 2014). Another interesting result is that no financial literacy gap exists between men and women in Slovakia (the second panel of Table 1). These results are in line with the most recent findings indicating that no, or a very small gender gap exists in financial literacy in post-communist countries (Cupák et. al, 2018).

Overall, the general observation from the financial literacy assessment is that Slovak respondents are quite familiar with the concepts of interest rates, inflation and portfolio diversification. In contrast, the question on riskiness has the lowest share of correct answers across different socio-economic groups of individuals. This could be partially explained by almost no experience with risky financial assets of households in Slovakia. While almost 90% of households own their residence, ownership of sophisticated financial assets (i.e. stocks, bonds, or mutual funds) is very low in Slovakia compared to the other euro-area countries as barely 4% of households hold such assets in their portfolios (Bover et al., 2016).

3.2 Variables description

In our baseline empirical analysis the dependent variable is a dummy variable taking the value of 1 if a non-retired individual saves in the voluntary private pension savings schemes on his/her own (i.e., savings in private pension funds or whole life insurance contracts). We distinguish between two cases, when the participation in such savings schemes is purely voluntary, and when the participation is supported by employers' contributions. These two dependent variables capture savings in the third pillar of the Slovak pension system, which is described in more detail in Appendix A. In addition to the (0/1) participation rates, in our empirical analyses we also consider ordered categorical dependent variables, which were created by assigning ordered categories as follows: the lowest category to the people contributing 0, and then assigning further three increasingly ordered categories to the monthly contributions by discretising the actual monthly contributions to the pension plans at the terciles of the distribution of monthly contributions.

Note that we use current savings rather than a retirement planning indicator that is a measure of whether a respondent has thought about his/her financial needs in retirement. In the literature, both retirement planning (e.g. Alessie et al., 2011; Sekita, 2011; Agnew et al., 2013; Moure, 2016) and current retirement savings (e.g. Fornero and Monticone, 2011; Brown and Graf, 2013; Boisclair et al., 2017) have been used as proxies for the retirement financial security of individuals.

Table 1: Financial literacy across individuals

	Financial literacy question				# of correct answers	All correct
	Interest rates	Inflation	Diversification	Riskiness		
Overall	0.79	0.90	0.78	0.24	2.68	0.17
Income quintile						

1st	0.75	0.86	0.75	0.15	2.51	0.11
2nd	0.85	0.88	0.72	0.17	2.63	0.11
3rd	0.80	0.93	0.73	0.24	2.70	0.18
4th	0.83	0.90	0.76	0.25	2.73	0.16
5th	0.76	0.91	0.77	0.30	2.73	0.22
<hr/>						
Gender						
Male	0.81	0.89	0.74	0.24	2.68	0.17
Female	0.75	0.92	0.80	0.22	2.68	0.17
<hr/>						
Age group						
16-34	0.80	0.94	0.77	0.32	2.84	0.23
35-44	0.81	0.88	0.72	0.25	2.66	0.18
45-54	0.73	0.88	0.76	0.24	2.61	0.18
55-62	0.85	0.91	0.77	0.18	2.71	0.12
63+	0.74	0.98	0.93	0.11	2.76	0.09
<hr/>						
Working status						
Employee	0.80	0.91	0.75	0.26	2.71	0.19
Self-employed	0.76	0.91	0.76	0.27	2.70	0.15
Unemployed	0.76	0.76	0.73	0.14	2.40	0.09
Other	0.86	0.91	0.81	0.07	2.66	0.06
<hr/>						
Education						
Primary or no education	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>
Secondary	0.80	0.91	0.75	0.21	2.66	0.15
Tertiary	0.80	0.87	0.76	0.35	2.78	0.24

Note: Average financial literacy scores computed using survey weights. Retired respondents have been excluded from the sample. Descriptive statistics labelled with *NA* could not be computed due to lack of observations (less than 20 in the sample). The first four columns show the share of population being able to correctly answer the particular financial literacy question. The fifth column shows the total average number of correctly answered questions while the very last column exhibits the share of population being able to correctly answer all 4 financial literacy questions. Source: HFCS 2014, National Bank of Slovakia; own calculations

Our main explanatory variable of interest, the level of financial literacy, is measured in two ways: number of correct answers on financial literacy questions (FL_1), and a dummy variable taking the value of 1 if all questions are correctly answered (FL_2).

Individual income has been identified in the majority of empirical studies as an important driver of retirement savings. In our regressions, we use net monthly individual income to capture current individual's economic resources. We also include a set of control variables such as a dummy variable for respondent's gender, a dummy variable for living in a single-member household, dummy variables for 5 age categories (16-34, 35-44, 55-54, 55-62, and 63+), a

dummy variable for having children, a dummy variable for completed university degree, a dummy variable for a risk-loving attitude, and dummy variables capturing the employment status. We also include a dummy variable capturing whether a respondent lives in a city and a variable capturing the net wealth coming from the real estate, which is particularly important in the case of Slovakia.

Recent microdata shows that almost 90% of Slovak households own their main residence, which is by far the highest rate in the euro-area (Bover et al., 2016). This can have an important impact on voluntary retirement savings as it has been argued in the literature that real estate ownership presents a possible substitute for retirement savings in pension funds (Nakajima and Telyukova, 2011).

We have applied the Inverse hyperbolic sine transformation to the values of both monthly income, and net housing wealth described in the above paragraphs. This transformation is commonly applied to income and wealth measurements in econometric analysis to deal with outliers and extreme skewness that these two measurements commonly exhibit.

Finally, we include a set of regional dummy variables to account for heterogeneity across regions. The above mentioned control variables have been commonly used in other empirical studies to analyse determinants of savings for retirement. Summary statistics of variables used in the empirical analysis are presented in Table 2. Variables' labels and description can be found in Table D.1.

Table 2: Descriptive statistics ($N = 1,235$)

Variable	Mean	SD	Min	Max
Savings without employers' contributions	0.16	0.36	0	1
Savings with employers' contributions	0.19	0.39	0	1
Financial literacy: number of correct answers	2.68	0.86	0	4
Financial literacy: all answers correct	0.17	0.37	0	1
Individual income	743.06	717.05	0	15000

Household net real estate wealth	46860.35	42231.90	-28000	480000
Male	0.79	0.41	0	1
Having children	0.39	0.49	0	1
Single-member household	0.17	0.37	0	1
Age category (16-34)	0.12	0.33	0	1
Age category (35-44)	0.34	0.47	0	1
Age category (45-54)	0.29	0.45	0	1
Age category (55-62)	0.23	0.42	0	1
Age category (63+)	0.03	0.17	0	1
University degree	0.22	0.41	0	1
Positive risk attitude	0.05	0.21	0	1
Employed	0.67	0.47	0	1
Self-employed	0.19	0.39	0	1
Not working	0.14	0.35	0	1
Living in a city	0.30	0.46	0	1
Instrument: ability to convert monetary values from Slovak crowns to euros	3.05	0.73	1	4
Instrument: ability to understand questions in the survey	3.02	0.69	1	4

Note: Descriptive statistics computed using survey weights. Based on the sample of non-retired individuals. There are eight regions in Slovakia (Bratislava, Trnava, Trenčín, Nitra, Žilina, Banská Bystrica, Prešov, and Košice) which are approximately equally represented in the survey.

Source: HFCS 2014, National Bank of Slovakia; own calculations

Detailed participation rates in the supplementary private pension schemes based on different demographic characteristics are shown in Table 3. Results from the univariate analysis demonstrate that only 16% of non-retired individuals voluntarily save on their own for their retirement in the supplementary private pension schemes and 19% of individuals save in such savings schemes, but with employers' contributions. In both cases, we can see a clear trend of rising participation with rising levels of financial literacy and income. The difference in retirement savings patterns is not very pronounced between the male and female population in the case of purely voluntary savings, but is substantial in the case of the savings promoted by employers' contributions. Participation in voluntary savings for retirement falls with rising age. This observation can be explained by the fact that older households in Slovakia have a higher marginal propensity to consume compared to younger ones (Fidrmuc and Senaj, 2014). Participation in the voluntary private pension savings schemes differs across working status and

education level, too. Employed individuals, and individuals with tertiary education have the highest propensity to save for old age in the private pension savings schemes.

4 Estimation and results

4.1 Baseline

We estimate the relationship between financial literacy and the propensity to save for retirement in private pension savings schemes controlling for other individual socio-economic characteristics by running the baseline linear probability model:

$$SAVING_i = \beta_0 + \beta_1 FL_i + \beta_2 X_i + u_i, \quad (1)$$

where $SAVING_i$ is the dependent dummy variable equal to 1 if the i -th individual voluntarily saves for his/her retirement, FL_i is the level of financial literacy measured by a number of correct answers or by a dummy variable if all questions were correctly answered, X_i is the vector of control variables influencing individual financial decision-making, such as income, gender, education, age, employment status, attitude towards risk, having children as well as regional dummy variables, and u_i is the error term. All explanatory variables entering regressions are explained in detail in Table D.1. Based on the existing literature, we hypothesise the effect of financial literacy to be positive ($\beta_1 > 0$) and statistically different from 0.

Table 3: Participation in the voluntary private pension schemes

	Participation rate without employers' contributions	Participation rate with employers' contributions
Overall	0.16	0.19
Financial literacy		
0 or 1 correct	0.12	0.17
2 correct	0.08	0.17
3 correct	0.18	0.20
All correct	0.26	0.22

Income quintile		
1st	0.08	0.05
2nd	0.14	0.19
3rd	0.08	0.09
4th	0.16	0.27
5th	0.24	0.23
Gender		
Male	0.16	0.21
Female	0.15	0.14
Age category		
16-34	0.24	0.19
35-44	0.22	0.22
45-54	0.10	0.21
55-62	0.11	0.15
63+	0.01	0.04
Employment status		
Employed	0.17	0.26
Self-employed	0.17	0.06
Not working	0.08	0.03
Education		
Primary or no education	<i>NA</i>	<i>NA</i>
Secondary education	0.14	0.19
Tertiary education	0.21	0.22

Note: Descriptive statistics computed using survey weights. Descriptive statistics labelled with *NA* could not be computed due to lack of observations (less than 20 in the sample). Retired respondents have been excluded from the analysis.

Source: HFCS 2014, National Bank of Slovakia; own calculations

The results of our baseline linear probability models estimated by OLS, models (1) and (3), are presented in Table 4. Regarding our main variable of interest, there is a significant and positive association between financial literacy and participation in voluntary retirement savings plans. This finding is in line with previous empirical research on financial literacy and retirement savings from other countries (Table B.1). The estimated effects of one additional correctly answered financial literacy question on voluntary pension participation rates range from 2 to 23

percentage points, depending on the estimation method (OLS vs IV) and the presence or absence of employers' contributions.

Besides the level of financial literacy, participation in voluntary retirement savings schemes, both without and with employers' contributions, is also positively correlated with the individual income. The estimated positive association between income and propensity to save is in line with results from other countries. The association between age and retirement savings has an inverted U shape. The relationship is more intense for the younger age categories (16-34, and 35-44) compared to the older age cohorts. The association between voluntary retirement savings decision and education is positive, albeit insignificant for the majority of estimated models.

Females spend a longer time in their retirement compared to the male population in Slovakia. In Slovakia, the average time in retirement was 23.8 years for females and 16.5 years for the male population (OECD, 2015). Yet we do not find a substantial difference between men and women regarding their retirement savings behaviour. Similar results have been found in studies from other countries as well (e.g. Arrondel et al., 2013; Bucher-Koenen and Lusardi, 2011).

An interesting result, mostly driven by the design of the Slovak pension scheme (discussed in Appendix A), is that being employed for a wage matters for the participation in employer-supported savings plan, but not the purely voluntary one. The Slovak government incentivises employers to support its employees to participate in the third pillar by offering tax deductions. It seems that this mechanism could be one of the effective tools how to motivate individuals to save for their old age.

The impact of the net housing wealth on the propensity to save for retirement is positive, albeit insignificant for the majority of specifications. Based on this result, we cannot really conclude whether the two can be viewed more as complements or substitutes to each other.

Propensity to save is higher in urban areas compared to rural ones, which can be attributed to the better infrastructure of financial services in cities. However, this holds only for the purely voluntary retirement savings plans. Finally, there is a positive and significant relationship between employment status (employed for wage) and participation in the voluntary retirement savings schemes with employers' subsidies.

4.2 Endogenous financial literacy

The potential endogeneity of financial literacy has been considered in a number of theoretical and empirical studies (e.g. Fornero and Monticone, 2011; Jappelli and Padula, 2013; Crossley et al., 2017). In our framework, endogeneity of financial literacy could be caused by a possible reverse causality between financial literacy and retirement savings (i.e. acquiring financial literacy by participating in pension plans), omitted (unobserved) factors simultaneously driving both participation in retirement savings and the level of financial literacy, as well as measurement error associated with measuring literacy in surveys (e.g. Fornero and Monticone, 2011; Crossley et al., 2017). It has been argued that the effect of financial literacy will be likely biased in the standard OLS compared to the instrumental variable approach (see Lusardi and Mitchell, 2014; Fernandes et al., 2014). Note that only several empirical studies have accounted for the potential endogeneity of financial literacy (see Table B.1 for an overview).

To address the possible endogeneity problem of financial literacy, we employ instrumental variable (IV) approach and estimate the linear probability model by using the generalised method of moments (GMM) estimator. In a simultaneous-equation framework, this can be written as:

$$SAVING_i = \beta_0 + \beta_1 FL_i + \beta_2 X_i + u_i \quad (2)$$

and

$$FL_i = \pi_0 + \pi_1 X_i + \pi_2 Z_i + v_i, \quad (3)$$

where notation remains the same as in equation (1), except the vector of instrumental variables for financial literacy, Z_i , and the error term v_i . In this model we assume validity of instruments – i.e., we assume the correlation between Z_i and u_i to be equal to zero. Furthermore, we verify through our first-stage regressions, that the instruments are predictive of our financial literacy measures. FL_i is correlated with Z_i , thereby fulfilling the second condition for a valid instrument, that is, that the instrument should be correlated with the endogenous variable being instrumented.

The use of IV approach is often hindered by a lack of suitable instruments in a data set. While several empirical studies have used instruments for financial literacy such as education in the field of finance or economics, literacy, and education of relatives/peers, employment in the field of finance or economics, number of universities per region, or use of the internet at home (e.g. Fornero and Monticone, 2011; Alessie et al., 2011; Lusardi and Mitchell, 2014), the Slovak HFCS data does not contain such information. On the other hand, the survey contains a detailed paradata, that is, a section with questions/comments on each household and detailed assessment of interviewees done by the interviewers.

Out of such questions we have chosen as instruments the general ability of respondents to understand questions in the survey, and the ability of respondents to express monetary values in a legacy currency in terms of euros. These abilities are assessed by interviewers after finishing the interview in each household. Respondents themselves have no influence on the assessment and therefore we assume such variables are not correlated with the error term u_i . At the same time, the above abilities might be closely linked to literacy in general (including financial literacy).

The choice of the mentioned variables for instruments is relevant for the Slovak case. Especially because many people have acquired their real assets (e.g. houses, cars, etc.) before 2009, when the euro was introduced as a new currency, and they still tend to express the

monetary values in terms of the former currency, Slovak crowns. The variable reflecting the ability to express amounts in euros should be a direct proxy for financial literacy and we a-priori expect a positive correlation between the financial literacy and this instrument (see Table D.1 for a definition). Impact of the second instrument, general ability to understand questions, is expected to be positive, too. In fact, we show in the first-stage of our IV regressions that the considered instrumental variables are positively correlated with financial literacy (see Table 4).

The results of the second-stage of the IV regressions estimated by the GMM approach are presented in Table 4 – models (2), (4), (6) and (8). First, p-values of the C chi-squared (difference-in-Sargan) statistic are 0.029 (FL_1) and 0.003 (FL_2) for participation without employers' contributions and 0.004 (FL_1) and 0.006 (FL_2) for participation with employers' contributions, respectively. Therefore, the null hypothesis of exogeneity of the regressors is rejected. This confirms that financial literacy is endogenous in our framework. The results from the Hansen's J test of the validity of our instruments further suggest that our proposed instruments for financial literacy are indeed valid for both FL specifications. The p-values of the Hansen's J test statistic are 0.111 (FL_1) and 0.516 (FL_2) for participation without employers' contributions, and 0.797 (FL_1) and 0.250 (FL_2) for participation with employers' contributions. Therefore, the null hypothesis of the instrument validity cannot be rejected. Instruments are also strong, as is confirmed by the first stage F-statistics on the excluded instruments being larger than 8.5 in all cases.

The individual slope estimates (and their significance with stars) of the proposed instruments for financial literacy measures in the first-stage of the IV regressions are presented in Table 4 (bottom panel). The results show that the ability to express monetary values in a legacy currency in terms of euros and the ability to understand questions in the survey are positively correlated (as a-priori expected) with the level of financial literacy. After addressing endogeneity

of financial literacy by the IV approach, the impact of financial literacy on the propensity to save for retirement increases in all four specifications. For example, answering an additional question correctly in FL_1 increases the propensity to save in the supplementary pension savings schemes by 19.5 percentage points when individuals set up their private pension savings plans on their own, and by almost 23 percentage points in the case of employer-supported private pension schemes.

4.3 Analysis of contributions

As a final step of our empirical analysis, we discretise the monthly contributions into both savings plans and create ordered categorical dependent variables. We set the contributions of 0 to the first category, and then the next three ordered categories reflect the terciles in the distribution of the monthly pension contributions which are bigger than 0. After doing so, we analyse the relationship between financial literacy and contributions to the savings plans by means of ordered probit regressions and instrumental variable ordered probit regressions. We estimate these models by a seemingly unrelated regressions (SUR) framework employing the conditional mixed-process (CMP) technique developed by Roodman (2011). In the presence of endogeneity and available instrumental variables, this framework allows building recursive multi-equation models similar to the two-stage least square framework.

Results of the ordered probit models as well as the instrumental variables variant estimated by the CMP are presented in Table 5. The marginal effects of financial literacy in Table 5 are interpreted as follows. E.g., in the ordered probit without instrumentation, one additional correctly answered financial literacy question leads to 5.2 percentage points *decrease* in the probability of having 0 monthly pension contributions and to 2.6 percentage points *increase* in

the probability of a person being in the top tercile of the monthly pension contributions conditional on the pension contributions being positive, the two marginal effects being reported for the sample without employers' contributions. In the ordered model with instrumentation, one additional correctly answered financial literacy questions leads to 17.4 percentage points *decrease* in the probability of having 0 monthly pension contributions, and to 11.5 percentage points *increase* in the probability of a person being in the top tercile of the monthly pension contributions conditional on the pension contributions being positive, again the marginal effects being reported for the sample without employers' contributions. All the marginal effects reported in Table 5 are calculated at the means of the explanatory variables, and all regressors included in Table 4 are also included in the estimation resulting in the table with marginal effects (Table 5).

The rest of the marginal effects in Table 5 are interpreted similarly to the interpretations given in the previous paragraph. A result similar to the baseline estimates presented in Table 4 is that the effect of financial literacy strengthens after addressing the endogeneity issue, which confirms our discussion on the measurement error (downward) bias.

Table 4: OLS and IV estimates of the participation in voluntary private pension schemes

	Participation without employers' contributions				Participation with employers' contributions			
	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
Financial literacy: score	0.056*** (0.011)	0.195*** (0.068)			0.020* (0.012)	0.228*** (0.079)		
Financial literacy: all correct answers			0.100*** (0.030)	0.737*** (0.261)			0.042 (0.030)	0.692** (0.284)
Net monthly income (IHS†)	0.042*** (0.011)	0.033*** (0.011)	0.044*** (0.010)	0.033** (0.013)	0.029** (0.014)	0.016 (0.017)	0.029** (0.014)	0.018 (0.016)
Net real estate wealth (IHS†)	0.002 (0.002)	0.002 (0.002)	0.001 (0.002)	0.001 (0.003)	0.004* (0.002)	0.004 (0.003)	0.004 (0.002)	0.003 (0.003)
Dummy: age 16-34	0.170*** (0.050)	0.185*** (0.056)	0.169*** (0.050)	0.201*** (0.073)	0.052 (0.056)	0.073 (0.066)	0.052 (0.056)	0.084 (0.079)
Dummy: age 35-44	0.189*** (0.045)	0.222*** (0.053)	0.185*** (0.045)	0.240*** (0.070)	0.130** (0.054)	0.175*** (0.065)	0.129** (0.054)	0.180** (0.079)
Dummy: age 45-54	0.132*** (0.040)	0.173*** (0.050)	0.125*** (0.040)	0.184*** (0.065)	0.141*** (0.048)	0.200*** (0.062)	0.139*** (0.049)	0.196*** (0.075)
Dummy: age 55-62	0.132*** (0.041)	0.160*** (0.048)	0.132*** (0.041)	0.209*** (0.068)	0.116** (0.049)	0.160*** (0.061)	0.117** (0.049)	0.194** (0.078)
Dummy: dependent children	-0.011 (0.026)	0.004 (0.029)	-0.012 (0.026)	0.031 (0.036)	0.042 (0.028)	0.071** (0.033)	0.042 (0.028)	0.089** (0.039)
Dummy: male	0.002 (0.025)	0.003 (0.027)	0.003 (0.025)	0.010 (0.031)	-0.023 (0.026)	-0.023 (0.029)	-0.022 (0.026)	-0.016 (0.031)
Dummy: single member household	-0.041 (0.029)	-0.028 (0.032)	-0.042 (0.029)	-0.012 (0.039)	0.057* (0.031)	0.079** (0.037)	0.057* (0.031)	0.087** (0.041)
Dummy: employed for wage	0.034 (0.025)	0.001 (0.033)	0.039 (0.025)	-0.012 (0.039)	0.199*** (0.026)	0.149*** (0.035)	0.200*** (0.026)	0.147*** (0.039)
Dummy: self-employed	0.025 (0.035)	0.005 (0.040)	0.031 (0.035)	0.007 (0.044)	0.003 (0.027)	-0.031 (0.034)	0.004 (0.027)	-0.022 (0.037)
Dummy: university degree	0.062** (0.026)	0.039 (0.030)	0.063** (0.027)	0.006 (0.041)	0.028 (0.029)	-0.010 (0.034)	0.028 (0.029)	-0.030 (0.042)
Dummy: positive risk attitude	0.038 (0.049)	0.073 (0.054)	0.026 (0.049)	0.050 (0.056)	0.047 (0.053)	0.107* (0.064)	0.043 (0.053)	0.074 (0.061)
Dummy: city	0.061** (0.028)	0.068** (0.029)	0.062** (0.029)	0.082** (0.036)	0.026 (0.031)	0.034 (0.035)	0.027 (0.031)	0.046 (0.039)
First stage instruments coefficients								
IV 1: converting monetary values		0.131***		0.014		0.131***		0.014
IV 2: understanding of questions		0.108**		0.056***		0.108**		0.056***
R ²	0.087		0.080		0.115		0.114	
F of instruments		16.082		8.546		16.082		8.546
Hansen's J χ^2		2.546		0.423		0.066		1.324
P-value of Hansen's J test		0.111		0.516		0.797		0.250
P-value of exogeneity test		0.029		0.003		0.004		0.006

N 1253 1253 1253 1253 1253 1253 1253 1253

Note: Robust standard errors are presented in parentheses. Regressions are estimated on the sample of non-retired individuals. Regressions estimated controlling for regional fixed-effects. Dummy variables for not working, age category over 63 years, and the region of Košice are the reference categories for the respective dummy sets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
† Inverse hyperbolic sine transformation applied to values to deal with extreme skewness and outliers.
Source: HFCS 2014, National Bank of Slovakia; own calculations

Table 5: Ordered probit and IV Ordered probit estimates of the private pension saving contributions

	Savings without employers' contributions				Savings with employers' contributions			
	Oprobit	(IV) Oprobit	Oprobit	(IV) Oprobit	Oprobit	(IV) Oprobit	Oprobit	(IV) Oprobit
FL ₁ (category 1: y=0)	-0.052***	-0.174***			-0.021*	-0.246***		
FL ₁ (category 2: 1st tercile y>0)	0.011***	0.023***			0.006*	-0.054***		
FL ₁ (category 3: 2nd tercile y>0)	0.015***	0.036***			0.004*	0.077***		
FL ₁ (category 4: 3rd tercile y>0)	0.026***	0.115**			0.011*	0.222***		
FL ₂ (category 1: y=0)			-0.082***	-0.462***			-0.046*	-0.453***
FL ₂ (category 2: 1st tercile y>0)			0.018***	0.048***			0.014*	0.071***
FL ₂ (category 3: 2nd tercile y>0)			0.024***	0.066***			0.008*	0.038***
FL ₂ (category 4: 3rd tercile y>0)			0.040***	0.348***			0.024*	0.344***
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1244	1244	1244	1244	1228	1228	1228	1228
Pseudo R ²	0.090		0.083		0.117		0.117	

Notes: Marginal effects displayed at the means of explanatory variables. Regressions are estimated on the sample of non-retired individuals using the same set of covariates as in the baseline model reported in Table 4. Dummy variables for not working, age category over 63 years, and the region of Košice are the reference categories for the respective dummy sets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: HFCS 2014, National Bank of Slovakia; own calculations

4.4 Robustness check

As a robustness check, we re-estimate the relationship between financial literacy and participation in the voluntary retirement savings schemes on a sub-sample of individuals closer to retirement age (age 52-62). The voluntary retirement savings scheme in Slovakia is (unfortunately) designed so that it generates low annual yields, but on the other hand there are generous tax incentives and employers' contributions. Individuals with many decades until retirement may find the low yields more important and find it optimal to save privately in other vehicles – especially individuals with very high financial literacy. On the other hand, individuals with a shorter time until retirement may find the tax incentives and employer contributions more important and find it optimal to participate in the scheme.

We therefore re-estimate the relationship for the sub-sample of individuals closer to the retirement age (from 52 to 62 years). The results of this robustness check are presented in Table D.2 and support our previous findings from the baseline models. The association remains positive and significant especially for the purely voluntary contributions, and even strengthens in the IV models for both specifications of financial literacy compared to the baseline estimations. Similarly to the baseline models, we can reject the null hypothesis of exogeneity of financial literacy.

5 Concluding remarks

Despite of decreasing benefits of state pensions in the majority of developed economies, individuals do not save adequately for their old age in private pension schemes as shown by the recent literature. Among important factors for retirement wealth accumulation, research has identified financial literacy to be an important ingredient of informed choices and sound financial

and economic behaviour of individuals, including retirement savings. However, a gap in the literature remains for CEE countries in this regard.

The aim of this study was to cast light on the voluntary retirement saving behaviour of Slovak individuals with the main focus on financial literacy, as this topic has not been widely studied with representative microdata in CEE countries yet. Utilising recent data from the Slovak Household Finance and Consumption Survey, we find that the share of non-retired individuals voluntarily saving for their retirement is only about 16%. The share of non-retired individuals saving for old age in the employer-supported voluntary private pension schemes is around 19%. All in all, saving for retirement in the voluntary private pension schemes is still quite low in Slovakia, compared to other developed countries.

Only 17% of all the respondents surveyed were able to correctly answer all questions on financial literacy. Compared to the results from similar surveys for other developed countries (e.g. Germany, Netherlands, or Switzerland), this presents a gap in financial literacy of around 30 percentage points. While respondents typically understand concepts of interest rates, inflation and portfolio diversification, they tend to struggle with the riskiness concept. The lowest financial literacy is observed among low-educated, low-income and unemployed respondents. On the other hand, young individuals with university education and high incomes are the most financially literate. This can play an important role when individuals set up portfolios of their pension funds.

Our main result indicates that individuals' propensity to save for retirement in the supplementary private pension schemes is positively associated with financial literacy, controlling for a large set of socio-economic characteristics. Based on our empirical results, we can conclude that the impact of financial literacy is stronger/more significant on individuals' decisions to participate in the voluntary private pension savings schemes compared to

participation in schemes where individuals are rather motivated to participate by (generous) employers' contributions.

We have addressed possible endogeneity of financial literacy with a novel set of instrumental variables in instrumental variable approach. The effect of financial literacy remains positive and statistically significant, and becomes about three times larger in the IV estimates compared to OLS estimates. Furthermore, results are robust to different specifications of financial literacy, different specification of the dependent variables as well as different age sub-samples.

Our findings, being the first study covering a CEE country, contribute to the growing body of empirical research on the relationship between financial literacy and retirement savings. We also contribute to the literature by using novel instrumental variables for financial literacy, which have not been used in the empirical research on household and personal finance yet. Our results can help policymakers in their efforts to promote voluntary saving behaviour of individuals by improving their financial literacy, especially the most vulnerable groups of the population including low-educated, low-income and unemployed individuals. Such policies are important, as shortfalls of financial literacy can have a strong effect on the financial security of individuals during their whole life.

It is important to emphasise that our research focuses solely on decisions of individuals to voluntarily save in the supplementary private pension schemes. There also exist other vehicles to accumulate wealth for old age. It has been argued that net yields (adjusted for relatively high fees) from investing in these pension schemes are limited compared to returns from investing in more sophisticated financial products. On the other hand, investing in such financial assets where individuals are not limited to premature withdrawals can have short-term benefits, but long-term consequences and might not be the best proxy for the retirement financial security. Nevertheless,

we leave the question about the importance of financial literacy in demand for sophisticated financial products open for further research.

Acknowledgement

We would like to thank the participants of the National Bank of Slovakia research seminar in Bratislava (2017), the HFCS-CESEE Workshop of the Austrian Central Bank in Vienna (2017), and the Slovak Economic Association conference in Bratislava (2018) for their useful suggestions and comments. For helpful comments we are in particular grateful to Martin Šuster, Pavel Gertler, Peter Tóth, and Pirmin Fessler. Most of all we would like to thank the two anonymous referees and the editor Chris Adcock for their very useful comments and suggestions, which significantly improved the quality of the paper. The views and results presented in this paper are those of the authors and do not necessarily represent the official opinions of the affiliated institutions. Any remaining errors and omissions are solely ours.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

Andrej Cupák acknowledges the financial support from the Slovak Research and Development Agency under Grant No. APVV-16-0321. Zuzana Brokešová acknowledges the financial support from the Ministry of Education, Science, Research and Sport of the Slovak Republic under Grant No.VEGA 1/0466/19.

References

- Agnew, J. R., H. Bateman, and S. Thorp (2013). Financial literacy and retirement planning in Australia. *Numeracy* 6(2), 7.
- Alessie, R., M. Van Rooij, and A. Lusardi (2011). Financial literacy and retirement preparation in the Netherlands. *Journal of Pension Economics and Finance* 10(04), 527–545.
- Almenberg, J. and J. Säve-Söderbergh (2011). Financial literacy and retirement planning in Sweden. *Journal of Pension Economics and Finance* 10(04), 585–598.
- Ameriks, J., A. Caplin, and J. Leahy (2003). Wealth accumulation and the propensity to plan. *The Quarterly Journal of Economics* 118(3), 1007–1047.
- Arrondel, L., M. Debbich, and F. Savignac (2013). Financial Literacy and Financial Planning in France. *Numeracy* 6(2), 8.
- Aslanyan, G. (2014). The migration challenge for PAYG. *Journal of Population Economics* 27(4), 1023–1038.
- Atkinson, A. and F.-A. Messy (2011). Assessing financial literacy in 12 countries: an OECD/INFE international pilot exercise. *Journal of Pension Economics and Finance* 10(04), 657–665.
- Badarinza, C., J. Y. Campbell, and T. Ramadorai (2016). International comparative household finance. *Annual Review of Economics* 8, 111–144.
- Banks, J. (2010). Cognitive Function, Financial Literacy and Financial Outcomes at Older Ages: Introduction. *The Economic Journal* 120(548), F357–F362.
- Beckmann, E. (2013). Financial literacy and household savings in Romania. *Numeracy* 6(2), 9.
- Behrman, J. R., O. S. Mitchell, C. K. Soo, and D. Brava (2012). How financial literacy affects household wealth accumulation. *American Economic Review* 102(3), 300–304.

- Bernheim, B. D. and D. M. Garrett (2003). The effects of financial education in the workplace: Evidence from a survey of households. *Journal of Public Economics* 87(7), 1487–1519.
- Bernheim, B. D., J. Skinner, and S. Weinberg (2001). What accounts for the variation in retirement wealth among US households? *American Economic Review* 91(4), 832–857.
- Boisclair, D., A. Lusardi, and P.-C. Michaud (2017). Financial literacy and retirement planning in Canada. *Journal of Pension Economics and Finance* 16(3), 277–296.
- Bover, O., M. Schürz, J. Slacalek, and F. Teppa (2016). Eurosystem Household Finance and Consumption Survey: Main Results on Assets, Debt, and Saving. *International Journal of Central Banking* 12(2), 1–13.
- Brown, J. R. and S. J. Weisbenner (2014). Why do individuals choose defined contribution plans? evidence from participants in a large public plan. *Journal of Public Economics* 116, 35–46.
- Brown, M. and R. Graf (2013). Financial literacy and retirement planning in Switzerland. *Numeracy* 6(2), 6.
- Browning, M. and T. F. Crossley (2001). The life-cycle model of consumption and saving. *The Journal of Economic Perspectives* 15(3), 3–22.
- Bucher-Koenen, T. and A. Lusardi (2011). Financial literacy and retirement planning in Germany. *Journal of Pension Economics and Finance* 10(04), 565–584.
- Campbell, J. Y. (2006). Household finance. *The Journal of Finance* 61(4), 1553–1604.
- Cardak, B. A. and R. Wilkins (2009). The determinants of household risky asset holdings: Australian evidence on background risk and other factors. *Journal of Banking and Finance* 33(5), 850–860.

- Carmel, E., D. Carmel, D. Leiser, and A. Spivak (2015). Facing a biased adviser while choosing a retirement plan: the impact of financial literacy and fair disclosure. *Journal of Consumer Affairs* 49(3), 576–595.
- Christelis, D., T. Jappelli, and M. Padula (2010). Cognitive abilities and portfolio choice. *European Economic Review* 54(1), 18–38.
- Clark, R. L., M. S. Morrill, and S. G. Allen (2012). The role of financial literacy in determining retirement plans. *Economic Inquiry*, 50(4), 851–866.
- Crossan, D., D. Feslier, and R. Hurnard (2011). Financial literacy and retirement planning in New Zealand. *Journal of Pension Economics and Finance* 10(04), 619–635.
- Crossley, T. F., T. Schmidt, P. Tzamourani, and J. K. Winter (2017). Interviewer effects and the measurement of financial literacy. Technical report, Institute for Social and Economic Research.
- Cupák, A., Fessler, P., Schneebaum, A., and Silgoner, M. (2018). Decomposing gender gaps in financial literacy: New international evidence. *Economics Letters*, 168, 102-106.
- Disney, R. and J. Gathergood (2013). Financial literacy and consumer credit portfolios. *Journal of Banking and Finance* 37(7), 2246–2254.
- Fernandes, D., J. G. Lynch Jr, and R. G. Netemeyer (2014). Financial literacy, financial education, and downstream financial behaviors. *Management Science* 60(8), 1861–1883.
- Fidrmuc, J. and M. Senaj (2014). Income, Schooling and Housing Wealth during Economic Reforms. *Czech Journal of Economics and Finance* 64(2), 160–176.
- Fornero, E. and C. Monticone (2011). Financial literacy and pension plan participation in Italy. *Journal of Pension Economics and Finance* 10(04), 547–564.
- Gaudecker, H.-M. V. (2015). How does household portfolio diversification vary with financial literacy and financial advice? *The Journal of Finance* 70(2), 489–507.

- Guiso, L. and E. Viviano (2015). How much can financial literacy help? *Review of Finance* 19(4), 1347–1382.
- Hujo, K. (2014). *Reforming Pensions in Developing and Transition Countries*. Springer.
- Jappelli, T. (2010). Economic literacy: An international comparison. *The Economic Journal* 120(548).
- Jappelli, T. and M. Padula (2013). Investment in financial literacy and saving decisions. *Journal of Banking and Finance* 37(8), 2779–2792.
- Kalmi, P. and O.-P. Ruuskanen (2015). Financial Literacy and Retirement Planning in Finland.
- Klapper, L. and G. A. Panos (2011). Financial literacy and retirement planning: the Russian case. *Journal of Pension Economics and Finance* 10(04), 599–618.
- Lusardi, A. (2008). Financial literacy: an essential tool for informed consumer choice? National Bureau of Economic Research, No. w14084.
- Lusardi, A. and O. S. Mitchell (2007). Baby boomer retirement security: The roles of planning, financial literacy, and housing wealth. *Journal of Monetary Economics* 54(1), 205–224.
- Lusardi, A. and O. S. Mitchell (2011a). Financial literacy and retirement planning in the United States. *Journal of Pension Economics and Finance* 10(04), 509–525.
- Lusardi, A. and O. S. Mitchell (2011b). Financial literacy around the world: an overview. *Journal of Pension Economics and Finance* 10(04), 497–508.
- Lusardi, A. and O. S. Mitchell (2011c). Financial Literacy and Planning: Implications for Retirement Well-being. In *Financial Literacy: Implications for Retirement Security and the Financial Marketplace*, Oxford University Press, 17–39.
- Lusardi, A. and O. S. Mitchell (2014). The economic importance of financial literacy: Theory and evidence. *Journal of Economic Literature* 52(1), 5–44.

- Lusardi, A. and O. S. Mitchell (2017). How ordinary consumers make complex economic decisions: financial Literacy and retirement readiness. *Quarterly Journal of Finance* 7(03), 1750008.
- Mitchell, O. S. and A. Lusardi (2015). Financial literacy and economic outcomes: Evidence and policy implications. *The Journal of Retirement* 3(1), 107–114.
- Moure, N. G. (2016). Financial literacy and retirement planning in Chile. *Journal of Pension Economics and Finance* 15(02), 203–223.
- Nakajima, M. and I. A. Telyukova (2011). Home equity in retirement. *Age* 65(75), 85.
- OECD (2015). *Pensions at a Glance 2015: OECD and G20 indicators*. Organisation for Economic Co-operation and Development.
- Roodman, D. (2011). Fitting Fully Observed Recursive Mixed-process Models with `cmp`. *The Stata Journal*, 11(2), 159-206.
- Sekita, S. (2011). Financial literacy and retirement planning in Japan. *Journal of Pension Economics and Finance* 10(04), 637–656.
- Van Rooij, M., A. Lusardi, and R. Alessie (2011). Financial literacy and stock market participation. *Journal of Financial Economics* 101(2), 449–472.
- Van Rooij, M. C., A. Lusardi, and R. J. Alessie (2012). Financial literacy, retirement planning and household wealth. *The Economic Journal* 122(560), 449–478.

Appendix

A Description of the Slovak pension system

The pension system in Slovakia is a multi-tier system based on the Chilean system with three tiers. The system was introduced in 2005 after the structural reform was launched.¹⁰ The first tier is represented by the former PAYG system, the second tier is a contribution-based pension savings system and the third tier represents a supplementary pension scheme.

The first, PAYG, tier is a continuation of the previously implemented pension system and this pension scheme is compulsory for all of the active working population. Pensions for current retirees are continuously financed by contributions paid by the active working population. This tier represents a defined-benefit plan. Benefits for retirees are based on the period of individuals' economic activity and the level of income. Even though the amount of contributions is linked to the amount of the benefits provided, there is a strong element of intergenerational solidarity. This tier is administrated by the Social Insurance Agency, a public institution. There are two types of sub-schemes operated by this tier: pension insurance that provides income for the retired population and insurance in the event of death, and disability insurance for individuals whose earning capacity has declined due to long-term illness or health issues.

As an innovation of the new pension system, a fully-funded defined-contribution tier was established. This tier represents a contribution-based plan that is financed by capitalization of

¹⁰ Before the reform took place, the pension system had been functioning mainly as a mono-tier pay-as-you go system (PAYG) with deeply implemented elements of intergenerational solidarity. Adverse development of demography has revealed the weak spots of such a system, as the ratio of contributors to beneficiaries started to decrease dramatically and the sustainability of the system was pushed to the limit. For example, in 2015, the old-age dependency ratio (i.e. number of people of retirement age per 100 people of working age) was 20.6% and this share is estimated to further increase to 55.4% in 2050 (OECD, 2015). Based on these trends, Slovak government prepared legislative changes to transfer part of the responsibility for future retirement income and wealth onto individuals.

pension funds managed by private pension fund management companies and with mandatory participation for those who have once entered. The amount of pension benefits depends on the capitalized contributions paid, which are collected in the personal accounts of individuals. These funds are invested according to the strategy chosen by a client of the private pension fund company. Since the establishment of this tier up until now, the obligation to participate in this tier has varied substantially.¹¹

Individuals participating in both tiers will receive a combined pension from both sources. The first part will be a proportionally reduced pension from the first tier which is paid by the Social Insurance Agency and the other part of the pension will depend on the contributions paid and investment returns from the chosen investment strategy.¹² Currently in Slovakia, the mandatory contributions to pension schemes are 18% of gross income, from which 13.75% is dedicated to the first pillar and the remaining 4.25% to the second tier.¹³

¹¹ After the adoption of this scheme, participation in the system was compulsory for individuals who became active for the first time in their life after 1st January 2005 and voluntary for the others. However, it was not recommended for those who should retire earlier than 10 years after enrolling in the system. In 2008, participation in this system changed to voluntary for all participants. In 2012, participation for the new working population in the system was again made obligatory and in 2013 and 2015 the system was changed again. Currently, individuals may voluntarily choose if they want to participate in this saving scheme. However, they should be younger than 35 years and once they decide for the participation then the saving becomes mandatory.

¹² According to the Slovak legislation, participants could choose among at least two different types of investment funds (a fund focused on investments in bonds and a fund focused on investments in shares) that differ based on the level of risk and return. In reality, private pension fund management companies offer more than these two funds, typically also a combination of the two as well as an index fund.

¹³ Note that this proportion has varied during the existence of the new system. Since 2005 to 2011, the contributions were half to half (i.e. 9% to the first pillar and 9% to the second pillar). Since 2012 to 2016, 14% of the contributions were dedicated to the first pillar, and the remaining 4% to the second pillar. Since 2017, 4.25% of the contributions are dedicated to the second pillar. The share of contributions to the first and second pillar will stabilise in 2024 at the ratio of 12:6%.

The last part of the pension system, the third tier, is a fully-funded defined-contribution pension scheme managed by supplementary pension management companies.¹⁴ Participation in this form of pension scheme is optional except for employees in hazardous professions (e.g. miners, pilots and others) who must participate by law. The third tier is virtually a hybrid between personal pension schemes and employment-based schemes typical for Western European countries such as the UK, Ireland or the Netherlands. Employees have two options how to participate in this system, either individually or with their employers' contributions. These contributions are usually a part of the compensation benefits and not all employers offer this benefit. The government supports voluntary savings and since 2014 participants (employees as well as employers) can subtract contributions into the third tier from their income tax base.¹⁵

The existing pension system in Slovakia is fairly young and has overcome many hurdles from its establishment. One of the most serious is political and system instability concerning especially the second contribution-based tier. Retirement saving presents a long-term investment decision. However, in the enrolment system, participation as well as the amount of contributions have changed several times during the last decade. After continuous debates about sustainability of the PAYG system and volatility of the second tier, non-mandatory saving for retirement seems to be a superior strategy for individuals to accumulate sufficient wealth for their retirement period.

¹⁴ Note that prior to 2005, when the major reform of the pension system occurred, there was an insurance saving scheme with insurance savings contracts lasting until retirement of the insured person which were operated by supplementary pension insurance companies.

¹⁵ This benefit was cancelled by law for physical entities in 2011 and introduced again from 2014 but with a substantially lower amount.

B Studies on financial literacy and retirement savings

Table B.1: Overview of empirical studies on financial literacy and saving/planning for retirement

Study	Country	Level of financial literacy (all correct)	Share of planners/savers for retirement	Impact of financial literacy on retirement planning/saving	Endogeneity of FL addressed
Agnew et al. (2013)	Australia	43%	Planning (32%)	(+)	YES
Boisclair et al. (2017)	Canada	42%	Actual saving (70%)	(+)	NO
Moure (2016)	Chile	7%	Planning (9%)	(+)	NO
Kalmi and Ruuskanen (2015)	Finland	39%	Planning (29%)	(+)	NO
Arrondel et al. (2013)	France	31%	Planning (25%)	(+)	NO
Bucher-Koenen and Lusardi (2011)	Germany	53%	Planning (25%)	(+)	YES
Fornero and Monticone (2011)	Italy	25%	Actual saving (14%)	(+)	YES
Sekita (2011)	Japan	27%	Planning (40%)	(+)	YES
Alessie et al. (2011)	Netherlands	45%	Planning (13%)	(+)	YES
Crossan et al. (2011)	New Zealand	24%	Planning (27%)	(-/+)	NO
Beckmann (2013)	Romania	4%	Actual saving (2%)	(+)	NO
Klapper and Panos (2011)	Russia	4%	Actual saving (19%)	(+)	YES
Almenberg and Säve-Söderbergh (2011)	Sweden	27%	Planning (24%)	(+)	NO
Brown and Graf (2013)	Switzerland	52%	Actual saving (41%)	(+)	NO
Lusardi and Mitchell (2011a)	USA	30%	Planning (43%)	(+)	YES

Note: The level of financial literacy in particular studies is assessed based on the basic three financial literacy questions (i.e. capacity to do calculus with interest rates, understanding of inflation, and understanding of risk diversification) except Finland with nine financial literacy questions asked.

Source: Own processing based on the available literature.

C Financial literacy questions in the Slovak HFCS

This appendix contains detailed description of questions on financial literacy in the Slovak HFCS. Correct answers are marked in bold.

Q1) Fixed interest rates: Of the following types of mortgages which one do you think will allow you from the start to fix both the amount and the number of instalments needed to pay off the loan?

- a) Floating-rate mortgage
- b) **Fixed-rate mortgage**
- c) Do not know
- d) No answer

Q2) Inflation: Imagine leaving 1,000 euros in a current account that pays 1% interest and has no charges. Imagine also that prices increase by 2%. Do you think that if you withdraw the money in a year's time you will be able to buy the same amount of goods as if you spent the 1,000 euros today?

- a) Yes
- b) **No, I will be able to buy less**
- c) No, I will be able to buy more
- d) Do not know
- e) No answer

Q3) Portfolio diversification: In your opinion, which of the following investment strategies entails a greater risk of losing money?

- a) **Invest all savings in the securities issued by a single company**
- b) Invest all savings in the securities issued by a wide range of unrelated companies

c) Do not know

d) No answer

Q4) Risk: A company can obtain financing either issuing shares or bonds. In your opinion, which financial instrument entails a greater risk of losing money from the investor's point of view?

a) **Shares**

b) Bonds

c) Equally risky

d) I do not know the difference between bonds and shares

e) Do not know

f) No answer

D Additional Tables

Table D.1: Description of variables used in regressions

Variable	Definition
Savings without employers' contributions	Dummy: 1 if respondent saves for retirement in a form of private pension funds or whole life insurance contracts without employers' contributions
Savings with employers' contributions	Dummy: 1 if respondent saves for retirement in a form of private pension funds or whole life insurance contracts with employers' contributions
Financial literacy: number of correct answers	Number of correctly answered financial literacy questions
Financial literacy: all answers correct	Dummy: 1 if all financial literacy questions answered correctly
Individual income	Total monthly net income from labour activities also including unofficial income such as tips and gratitude
Household net real estate wealth	Total value of real estate minus corresponding liabilities
Male	Dummy: 1 if male
Having children	Dummy: 1 if respondent has at least one child
Single-member household	Dummy: 1 if respondent lives in a single member household
Age categories	Dummy variables set for 5 age categories (16-34, 35-44, 45-54, 55-62, and 63+)
University degree	Dummy: 1 if respondent gained university education
Positive risk attitude	Dummy: 1 if respondent declares positive attitude towards risk
Employed	Dummy: 1 if respondent is employed for wage
Self-employed	Dummy: 1 if respondent is self-employed

Not working	Dummy: 1 if respondent is unemployed (including unemployed people, students, and homemakers)
Living in a city	Dummy: 1 if respondent lives in a city (population above 50,000)
Regions	Dummy variables set for regions of Bratislava, Trnava, Trenčín, Nitra, Žilina, Banská Bystrica, Prešov, and Košice
Instrumental variable	Ability to convert monetary values from Slovak crowns to euros; from poor (1) to excellent (4)
Instrumental variable	Ability to understand questions in the survey; from poor (1) to excellent (4)

Source: HFCS 2014, National Bank of Slovakia

Table D.2: OLS and IV estimates of the participation in voluntary private pension schemes (robustness check)

	Participation without employers' contributions				Participation with employers' contributions			
	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
Financial literacy: score	0.051*** (0.019)	0.365** (0.165)			0.022 (0.020)	0.275* (0.165)		
Financial literacy: all correct answers			0.131*** (0.050)	0.905** (0.438)			0.072 (0.050)	0.486 (0.385)
Net monthly income (IHS†)	0.044*** (0.017)	0.033 (0.022)	0.045*** (0.016)	0.032 (0.025)	0.042** (0.019)	0.032 (0.021)	0.042** (0.018)	0.036* (0.019)
Net real estate wealth (IHS†)	0.002 (0.004)	0.003 (0.005)	0.002 (0.004)	0.002 (0.006)	-0.001 (0.004)	-0.000 (0.005)	-0.001 (0.004)	-0.000 (0.005)
Dummy: dependent children	-0.035 (0.052)	-0.044 (0.071)	-0.034 (0.050)	-0.029 (0.066)	0.039 (0.055)	0.033 (0.060)	0.039 (0.055)	0.043 (0.057)
Dummy: male	-0.000 (0.041)	-0.004 (0.055)	0.002 (0.041)	0.011 (0.055)	-0.123*** (0.045)	-0.128** (0.052)	-0.122*** (0.045)	-0.117** (0.048)
Dummy: single member household	-0.044 (0.046)	-0.021 (0.060)	-0.040 (0.047)	0.008 (0.066)	-0.020 (0.045)	-0.001 (0.058)	-0.017 (0.045)	0.012 (0.057)
Dummy: employed for wage	-0.018 (0.043)	-0.113 (0.082)	-0.016 (0.043)	-0.099 (0.076)	0.183*** (0.040)	0.108 (0.067)	0.182*** (0.041)	0.137** (0.057)
Dummy: self-employed	0.047 (0.066)	-0.023 (0.093)	0.053 (0.066)	0.024 (0.084)	-0.016 (0.046)	-0.070 (0.063)	-0.014 (0.045)	-0.037 (0.050)
Dummy: university degree	0.013 (0.046)	-0.056 (0.066)	0.010 (0.046)	-0.079 (0.079)	0.031 (0.047)	-0.026 (0.064)	0.028 (0.046)	-0.018 (0.065)
Dummy: positive risk attitude	-0.106* (0.055)	0.015 (0.105)	-0.131** (0.053)	-0.167* (0.087)	-0.004 (0.088)	0.099 (0.126)	-0.016 (0.088)	-0.029 (0.093)
Dummy: city	0.105** (0.047)	0.120** (0.056)	0.112** (0.047)	0.163** (0.068)	-0.068 (0.043)	-0.057 (0.051)	-0.064 (0.044)	-0.035 (0.054)
First stage instruments coefficients								
IV 1: converting monetary values		0.071		-0.018		0.071		-0.018
IV 2: understanding of questions		0.124*		0.076***		0.124*		0.076***
R ²	0.082		0.086		0.161		0.163	
F of instruments		4.178		3.800		4.178		3.800
Hansen's J χ^2		0.005		1.437		0.255		2.129
P-value of Hansen's J test		0.946		0.231		0.614		0.145
P-value of exogeneity test		0.011		0.021		0.078		0.228
N	477	477	477	477	477	477	477	477

Note: Robust standard errors are presented in parentheses. Regressions are estimated on the sample of non-retired individuals aged 52-62. Regressions estimated controlling for regional fixed-effects. Dummy variables for not working, first income quintile, and the region of Košice are the reference categories for the respective dummy sets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

† Inverse hyperbolic sine transformation applied to values to deal with extreme skewness and outliers.

Source: HFCS 2014, National Bank of Slovakia; own calculations