EKONOMICKÁ UNIVERZITA V BRATISLAVE

NÁRODOHOSPODÁRSKA FAKULTA

Evidenčné číslo: 101007/H/2024/36124420746204932

Empirické skúmanie rozdielov vo finančnej gramotnosti a jej vplyvu na individuálne ekonomické a finančné rozhodnutia

SÚBOR PUBLIKOVANÝCH VEDECKÝCH PRÁC DOPLNENÝ KOMENTÁROM

Habilitačná práca

2024 **Ing. Andrej Cupak, PhD.**

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Odbor habilitačného a inauguračného konania: financie, bankovníctvo a investovanie
Pracovisko: Katedra bankovníctva a medzinárodných financií

Bratislava 2024 **Ing. Andrej Cupak, PhD.**

Poďakovanie

Na úvod sa chcem poďakovať svojim kolegom a kolegyniam z Národnej banky Slovenska a Ekonomickej univerzity v Bratislave, ktorí/é ma podporovali v rôznych etapách mojej kariéry. Najmä som vďačný spoluautorkám a spoluautorom, bez ktorých by nebolo možné realizovať výskum, ktorý prezentujem v tejto práci.

Navyše, táto habilitačná práca benefitovala z užitočných rád a pripomienok od Zuzany Brokešovej, Judity Jurašekovej Kucserovej, Denysa Orlova a Petra Tótha. Taktiež by som sa chcel poďakovať Lukášovi Láffersovi za pomoc s typografickým systémom LaTeX pre kompilovanie textu v tejto habilitačnej práci.

V neposlednom rade ďakujem svojej manželke Emílii, rodine a priateľom za to, že počas celého obdobia plne podporujú moju akademickú a pedagogickú kariéru. Na záver, túto prácu by som chcel venovať svojej dcérke, Emilke.

ABSTRAKT

CUPAK, Andrej: *Empirické skúmanie rozdielov vo finančnej gramotnosti a jej vplyvu na individuálne ekonomické a finančné rozhodnutia.* – Ekonomická univerzita v Bratislave. Národohospodárska fakulta; Katedra bankovníctva a medzinárodných financií. – Bratislava: NHF EU, 2024, 152 s.

Táto habilitačná práca pojednáva o skúmaní finančnej gramotnosti a jej pozitívnych vplyvoch na ekonomické a finančné rozhodnutia jednotlivcov a domácností. Použitím unikátnych mikroekonomických údajov z rôznych zisťovaní a prieskumov (OECD/INFE, HFCS, SCF) a využitím mikroekonometrických dekompozičných metód a metód regresnej analýzy a kauzálnej inferencie, táto práca prináša viaceré zistenia. Výsledky naznačujú, že existujú výrazné rozdiely vo finančnej gramotnosti jednotlivcov naprieč krajinami. Zaujímavosťou je, že rozdiely v charakteristikách jednotlivcov nedokážu vysvetliť celú časť medzery vo finančnej gramotnosti, ale do výraznej miery tieto rozdiely ovplyvňujú aj rozdielne inštitucionálne charakteristiky krajín. Výsledky taktiež ukazujú, že existujú významné rodové rozdiely vo finančnej gramotnosti a finančnom sebavedomí v neprospech žien, čo sa prejavuje aj na ich nižšej participácii na investovaní do sofistikovaných finančných produktov, akými sú akcie alebo dlhopisy. Lepšie finančné znalosti sa prejavujú vo vyššej angažovanosti jednotlivcov a domácností v plánovaní a sporení na dôchodok (napríklad v treťom dôchodkovom pilieri na Slovensku) a aj vo vyššej miere diverzifikácie portfólií aktív v prospech rizikových finančných aktív. Výsledky výskumu môžu byť užitočné pre tvorcov politík, či už z pohľadu identifikácie zraniteľných skupín obyvateľstva s nízkou úrovňou finančného povedomia, ale aj z pohľadu investovania do finančného vzdelávania na zvýšenie finančnej gramotnosti obyvateľstva pre dosahovanie optimálnych ekonomických a finančných rozhodnutí pre zlepšenie svojho finančného blahobytu.

Kľúčové slová: finančná gramotnosť, rodové rozdiely, dôchodkové sporenie, investovanie, diverzifikácia portfólií, dekompozícia, regresná analýza, endogenita, mikrodáta z prieskumov.

ABSTRACT

CUPAK, Andrej: *Empirical investigation of differences in financial literacy and its impact on individual economic and financial outcomes.* – University of Economics in Bratislava. Faculty of Economics and Finance; Department of Banking and International Finance. – Bratislava: NHF EU, 2024, 152 p.

This habilitation thesis examines the study of financial literacy and its positive effects on the economic and financial decisions of individuals and households. Using unique microeconomic data from various surveys and surveys (OECD/INFE, HFCS, SCF) and employing microeconometric decomposition and regression analysis and causal inference methods, this thesis presents several findings. The results suggest that there are significant differences in the financial literacy of individuals across countries. Interestingly, differences in individuals' characteristics cannot explain all of the financial literacy gap, but different institutional characteristics of countries also influence these differences to a significant extent. The results also show that there are significant gender differences in financial literacy and financial self-confidence to the detriment of women, which is also reflected in their lower participation in investing in sophisticated financial products such as stocks or bonds. Better financial literacy is reflected in higher involvement of individuals and households in planning and saving for retirement (e.g. in the third pension pillar in Slovakia) and also in higher diversification of asset portfolios in favour of risky financial assets. The results of the research can be useful for policy makers, both in terms of identifying vulnerable populations with low levels of financial awareness, but also in terms of investing in financial education to increase the financial literacy of the population to make optimal economic and financial decisions improving their financial well-being.

Keywords: financial literacy, gender differences, retirement savings, investing, portfolio diversification, decomposition, regression analysis, endogeneity, survey microdata.

Obsah

1 Komentár

Tento komentár zhrňuje publikované články, ktoré tvoria samotnú habilitačnú prácu. V komentári sú priblížené teoretické východiská a takisto prehľad literatúry pre lepšie pochopenie definovania a merania finančnej gramotnosti a jej dôležitosti pre ekonomické a finančné správania jednotlivcov a domácností. Komentár taktiež približuje použité empirické dáta a metódy, ktorými overujeme hlavné výskumné tézy. V komentári sú v súhrne prezentované hlavné empirické zistenia, či už ohľadom hlavných determinantov finančnej gramotnosti jednotlivcov alebo vplyvov finančného povedomia na finančné rozhodovania o sporení na dôchodok alebo o účasti na trhu s akciami a dlhopismi.

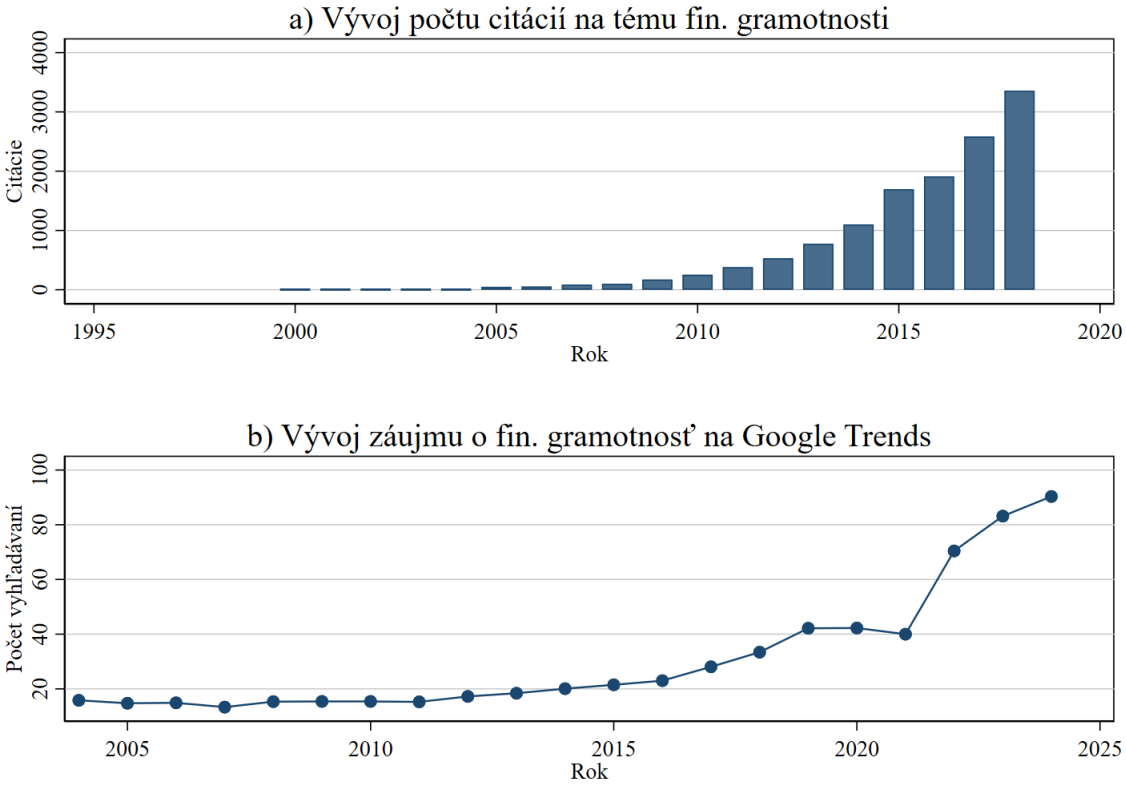
1.1 Úvod

Väčšina finančných a ekonomických rozhodnutí jednotlivcov a domácností je vo svojej podstate zložitá a vyžaduje si značnú úroveň finančných znalostí. Z nedávnych štatistík napríklad vyplýva, že nedostatok zručností a vedomostí na prijímanie správnych finančných rozhodnutí môže v priemere stáť globálnu domácnosť až 4 740 eur ročne (Allianz, 2023). Okrem toho, nedávne americké údaje ukazujú, že nízka angažovanosť jednotlivcov a domácností na finančných trhoch — skrz finančnú neinformovanosť a ignoranciu — môže domácnostiam zapríčiniť značné straty blahobytu a to až do výšky 2 % ich ročnej spotreby (Cocco a iní, 2005). I napriek tomu, iba malá časť populácie (dokonca aj vo vyspelých krajinách) využíva výhody finančných trhov. Napríklad, v eurozóne v priemere iba približne 11 % domácností drží akcie a iba 3 % populácie deklaruje držbu dlhopisov (ECB, 2023). Navyše, na strane pasív výskum ukazuje, že pre menší úver o hodnote 100 tisíc dolárov môžu potenciálne straty z nízkej finančnej gramotnosti domácností činiť až 10 tisíc dolárov počas celkovej maturity úveru (Cota a Šterc, 2024).

I napriek tomu, že finančná gramotnosť bola identifikovaná ako dôležitý determinant pre optimálne ekonomické a finančné rozhodnutia na mikro aj makro úrovni (napr. Jappelli, 2010; Fernandes a iní, 2014; Lusardi a Mitchell, 2014; Kaiser a iní, 2022) a záujem o túto tému exponenciálne narastá u odbornej aj laickej verejnosti (viď obrázok 1), empirická literatúra stále neposkytuje odpovede na viaceré dôležité otázky. Je tomu tak najmä z dôvodu absencie kvalitných a spoľahlivých mikrodát — častokrát jediného nástroja na meranie finančnej gramotnosti u jednotlivcov a domácností.

Hlavným cieľom tejto habilitačnej práce je odhaliť nové zistenia o formovaní finančnej gramotnosti u populácie v krajinách, ktoré boli doteraz málo preskúmané v tomto ohľade a taktiež skúmať dôsledky nízkeho finančného povedomia na niektoré zásadné ekonomické a finančné rozhodnutia jednotlivcov a domácností.

Obr. 1: Narastajúci záujem o tému finančnej gramotnosti u odbornej aj laickej verejnosti



Poznámka: Údaje z vyhľadávaní na platforme Google sú priemerované na ročnú frekvenciu kvôli sezónnym výkyvom.
Zdroj: Spracované na základe údajov z Kaiser a iní (2022) a platformy Google (https://trends.google.com/trends/).

Táto práca prispieva do empirickej literatúry o finančnej gramotnosti vo viacerých oblastiach: i) využitie nových mikroekonomických údajov zo zisťovaní a prieskumov o finančnej gramotnosti a bohatstve jednotlivcov a domácností; ii) identifikovanie rozdielov v úrovni finančného povedomia u jednotlivcov a identifikovanie zraniteľných skupín populácie z pohľadu nízkej finančnej gramotnosti; iii) odhad vplyvov finančnej gramotnosti na ekonomické a finančné správania jednotlivcov a domácností, ako sporenie na dôchodok alebo investovanie do sofistikovaných finančných nástrojov, akými sú akcie alebo dlhopisy. Výskumné oblasti tejto habilitačnej práce sú zhrnuté na obrázku 2.

Výsledky výskumu v tejto habilitačnej práci naznačujú, že existujú výrazné rozdiely vo finančnej gramotnosti (a taktiež vo finančnom sebavedomí) naprieč krajinami a naprieč rôznymi socio-demografickými skupinami obyvateľstva. Napríklad, ženy dosahujú v priemere nižšiu finančnú gramotnosť ako muži, kde existuje výrazná heterogenita naprieč krajinami sveta. Zaujímavosťou je, že rodové medzery vo finančnej gramotnosti sú výraznejšie vo vyspelých krajinách v porovnaní s post socialistickými krajinami. Výsledky taktiež naznačujú, že rozdiely v charakteristikách jednotlivcov ne-

Obr. 2: Sumarizovanie oblastí výskumu habilitačnej práce pomocou "Word Cloud" schémy

Poznámka: Veľkosť slova / slovného spojenia znázorňuje jeho intenzitu výskytu v texte.
Zdroj: Vlastné spracovanie na základe publikovaných článkov (podkapitoly 2.1 až 2.5) v softvéri Python pomocou 'wordcloud' knižnice.

dokážu plne vysvetliť rozdiely vo finančnej gramotnosti a inštitúcie a politiky krajín taktiež zohrávajú dôležitú úlohu vo vysvetlení týchto medzier. Medzery vo finančnej gramotnosti a finančnom sebavedomí sa odrážajú na nižšej miere investovania do akcií alebo dlhopisov. Výsledky výskumu taktiež naznačujú, že úroveň finančnej gramotnosti jednotlivých domácností je jedným z hlavných determinantov sporenia na dôchodok v dobrovoľných schémach, čo je hlavným predpokladom na zabezpečenie finančného blahobytu v starobe. Finančná gramotnosť taktiež úzko súvisí s lepšie diverzifikovanými (rozloženými) finančnými portfóliami, kedy domácnosti s vyšším finančným povedomím alokujú väčšiu časť svojho majetku do rizikových finančných aktív, čo je žiaduci výsledok z pohľadu teórií finančnej ekonómie.

Celkovo je prezentovaný výskum v tejto habilitačnej práci výsledkom dlhoročnej spolupráce s viacerými spoluautormi a spoluautorkami z niekoľkých renomovaných

domácich a medzinárodných univerzít a výskumných inštitúcií (napr. Ekonomická univerzita v Bratislave, Národná banka Slovenska, LIS Cross-National Data Center in Luxembourg, Oesterreichische Nationalbank, University of Michigan, Vienna University of Economics and Business). Navyše, výskum benefitoval z podpory z niekoľkých domácich (APVV-20-0359, VEGA 1/0221/21) výskumných grantových projektov.

Habilitačná práca sa skladá z dvoch hlavných častí. Prvá časť práce poskytuje komentár k publikovaným článkom, kde teoretické východiská a prehľad empirickej literatúry sú popísané v podkapitole 1.2. Hlavné výskumné otázky a prínosy práce sú popísané v časti 1.3. Dáta a ekonometrické metódy aplikované v článkoch sú podrobne popísané v podkapitole 1.4 a samotné empirické výsledky článkov sú prezentované v podkapitole 1.5. Výsledky sú diskutované v záverečnej časti 1.6, pričom táto časť obsahuje aj námety pre ďalší výskum. Druhá časť práce obsahuje päť publikovaných článkov (podkapitoly 2.1, 2.2, 2.3, 2.4 a 2.5). Je pritom dôležité poznamenať, že tieto publikácie podliehajú autorským právam nasledujúcim vydavateľstvám: Springer Nature B.V., Elsevier B.V. a Taylor & Francis Group.

1.2 Teoretické východiská a prehľad literatúry

Meranie finančnej gramotnosti. Z teórie a definície finančnej gramotnosti vyplýva, že finančná gramotnosť a finančné znalosti sú formou ľudského kapitálu (napr. Kapička a Neira, 2019; Cota a Šterc, 2024), avšak odlišnými dimenziami. Finančné znalosti sú integrálnou dimenziou finančnej gramotnosti, ale nie sú jej úplným ekvivalentom. Finančná gramotnosť má dodatočný aplikačný rozmer, ktorý znamená, že jednotlivec by mal mať schopnosť a sebadôveru využívať svoje finančné znalosti na prijímanie komplexných finančných rozhodnutí. V jednej z prvotných štúdií Huston (2010) sumarizuje niekoľko zaužívaných definícií a meraní finančnej gramotnosti:

- *"Finančná gramotnosť je schopnosť robiť informované úsudky a prijímať účinné rozhodnutia týkajúce sa používania peňazí a hospodárenia s nimi."*
- *"Finančná gramotnosť je schopnosť čítať, analyzovať, riadiť a komunikovať o osobných finančných podmienkach, ktoré ovplyvňujú materiálny blahobyt. Zahŕňa schopnosť rozlišovať finančné rozhodnutia, diskutovať o peniazoch a finančných otázkach bez nepríjemných pocitov (alebo napriek nim), plánovať budúcnosť a kompetentne reagovať na životné udalosti, ktoré ovplyvňujú každodenné finančné rozhodnutia, vrátane udalostí vo všeobecnom hospodárstve."*
- *"Finančná gramotnosť je schopnosť využívať vedomosti a zručnosti na efektívne riadenie finančných zdrojov pre celoživotné finančné zabezpečenie."*

Definície finančnej gramotnosti naznačujú, že informovaný spotrebiteľ by sa mal vyznať vo viacerých aspektoch komplexného finančného sveta. Práve preto sa Lusardi a iní (2010) a Lusardi a Mitchell (2014) vo svojich prvých prácach zamerali na vytvorenie súboru otázok (tzv. "The Big Three")[1] v rámci dotazníkových šetrení, ktoré sa ukázali ako účinné pre komplexné vyhodnotenie individuálnych finančných vedomostí a zručností. V najzákladnejšom znení tieto otázky testujú porozumenie jednotlivcov konceptom úročenia, inflácie a diverzifikácie rizika:

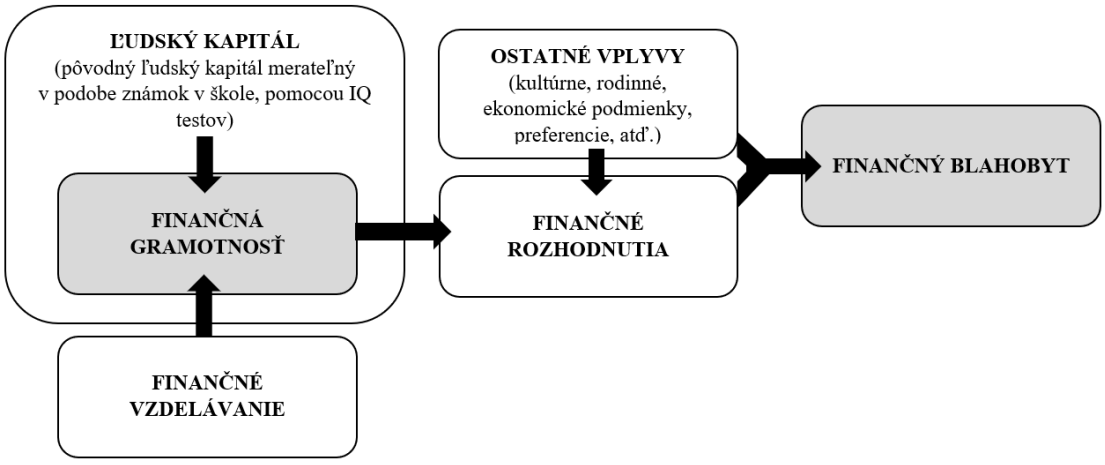
1. *"Predpokladajme, že máte na sporiacom účte 100 USD a úroková sadzba je 2 % ročne. Koľko si myslíte, že by ste mali na účte po piatich rokoch, keby ste nechali peniaze rásť?"*
2. *"Predstavte si, že úroková sadzba na vašom sporiacom účte je 1 % ročne a inflácia 2 % ročne. Koľko by ste si po jednom roku mohli kúpiť za peniaze na tomto účte?"*
3. *"Povedzte mi, prosím, či je toto tvrdenie pravdivé alebo nepravdivé. Nákup ak-*

[1] Tieto otázky sa stali základným pilierom pre meranie finančnej gramotnosti naprieč krajinami a ich základné alebo rozšírené znenie boli aplikované v mnohých empirických prácach (napr. Lusardi a Mitchell, 2011b; Van Rooij a iní, 2011; Cupak a iní, 2022; Cota a Šterc, 2024).

cií jednej spoločnosti zvyčajne poskytuje bezpečnejší výnos ako akciový podielový fond."

Celkovo finančná gramotnosť pozostáva z vedomostí aj z uplatňovania ľudského kapitálu špecifického pre osobné / rodinné financie. Na obrázku 3 je znázornená schéma vzťahov medzi finančnými znalosťami, vzdelaním, gramotnosťou, finančným správaním a blahobytom. V prvom rade, úroveň celkového vybavenia a dosiahnutého ľudského kapitálu ovplyvňuje finančnú gramotnosť jednotlivca. Ak má napríklad jednotlivec problémy s numerickými zručnosťami, určite to ovplyvní jeho / jej finančnú gramotnosť. Dostupné nástroje (napr. kalkulačky, počítačový softvér) však môžu tieto nedostatky kompenzovať; preto je vhodnejšie zamerať sa pri meraní finančnej gramotnosti na informácie priamo súvisiace s úspešnou orientáciou v osobných financiách ako na počtárske zručnosti. Navyše, úroveň finančnej gramotnosti a samotného finančného správania ovplyvňujú aj ďalšie externé faktory, akými sú ekonomické prostredie, kultúra, preferencie a podobne (napr. Huston, 2010; Jappelli, 2010; Brown a iní, 2018; De Beckker a iní, 2019).

Obr. 3: Konceptualizácia vzťahov medzi finančnou gramotnosťou a finančným blahobytom



Poznámka: Táto schéma zobrazuje zjednodušený vzťah medzi jednotlivými elementmi, pričom predpokladá jednosmerné závislosti. Treba však zdôrazniť, že vzťahy môžu byť aj obojsmerné, teda endogénne (viď Jappelli a Padula, 2013).
Zdroj: Spracované na základe Huston (2010).

Je taktiež dôležité zdôrazniť, že na úroveň finančných vedomostí / finančnej gramotnosti významne vplýva samotné finančné vzdelávanie, teda intervencia na budovanie finančného povedomia. Vyhodnocovanie efektívnosti politík finančného vzdelávania sa v posledných rokoch stalo ústrednou témou v literatúre o finančnej gramotnosti (napr. Fernandes a iní, 2014; Kaiser a iní, 2022; De Beckker a iní, 2021; Bover a iní, 2024; Cannistrà a iní, 2024).

Finančná gramotnosť, ekonomické a finančné rozhodovania. Finančná gramotnosť bola identifikovaná ako dôležitý faktor ovplyvňujúci ekonomické a finančné rozhodnutia a ako mediátor akumulovania dostatočného majetku na zabezpečenie finančného blahobytu (Huston, 2010; Behrman a iní, 2012). Jednotlivci a domácnosti pritom investujú z rozličných dôvodov, ako sumarizujú Browning a Lusardi (1996):

- Vytvoriť si rezervu pre prípad nepredvídaných udalostí (motív opatrnosti);
- Zabezpečiť predpokladaný budúci vzťah medzi príjmom a potrebami jednotlivca (motív životného cyklu);
- Benefitovať z úročenia a zhodnocovania (intertemporálny substitučný motív);
- Užívanie si postupne sa zvyšujúcich výdavkov (motív zlepšovania);
- Užívanie si pocitu nezávislosti a moci robiť veci, hoci bez jasnej predstavy alebo konkrétneho zámeru konať (motív nezávislosti);
- Zabezpečiť manévrovací priestor pre realizáciu špekulatívnych alebo obchodných projektov (podnikateľský motív);
- Hromadiť prostriedky na kúpu aktív (napr. domov, áut) a iných predmetov dlhodobej spotreby (motív splácania);
- Odkázať majetok (motív dedenia).

Existuje niekoľko zaužívaných teoretických prístupov, ktoré popisujú, ako jednotlivci a domácnosti akumulujú finančnú gramotnosť (ako formu ľudského kapitálu) a ako úroveň finančnej gramotnosti determinuje úroveň ich úspor, držbu aktív a v konečnom dôsledku akumulovanie bohatstva.

Napríklad, Jappelli a Padula (2013) vytvárajú teoretický rámec integrovaním investície do finančnej gramotnosti do štandardného modelu intertemporálnej voľby. Model zdôrazňuje, že zhromažďovanie finančných informácií má náklady aj prínosy. Pokiaľ ide o prínosy, finančná gramotnosť umožňuje spotrebiteľom prístup k lepším investičným príležitostiam, čím sa zvyšuje návratnosť každého ušetreného eura. Na strane nákladov si investovanie do finančnej gramotnosti vyžaduje čas a peňažné zdroje.

Vo svojom modeli Jappelli a Padula (2013) predpokladajú, že životný cyklus spotrebiteľov trvá dve obdobia, a že v období 0 dosahujú príjem y a v období 1 žijú na dôchodku. Na začiatku obdobia 0 nemajú žiadne aktíva, ale sú vybavení zásobou finančnej gramotnosti Φ_0, ktorá depreciuje tempom δ. Počiatočná zásoba gramotnosti je to, čo ľudia vedia o financiách pred vstupom na trh práce; súvisí teda s rozhodnutiami o školskom vzdelávaní a rodinnom zázemí. Návratnosť úspor je úroková miera faktora

R, ktorá sa platí na začiatku druhého obdobia z bohatstva prevedeného z prvého do druhého obdobia. Zvyšovanie finančnej gramotnosti umožňuje spotrebiteľom prístup k lepším investičným príležitostiam a šetrí transakčné náklady a poplatky. Predpokladá sa preto, že úrokový faktor je funkciou stavu finančnej gramotnosti na začiatku prvého obdobia:

$$R(\Phi_1) = \Phi_1^{\alpha}, \tag{1}$$

kde $\alpha \in (0,1)$ a Φ_1 je stav finančnej gramotnosti na začiatku obdobia. Parameter α je elasticita úrokového faktora vzhľadom na stav finančnej gramotnosti a označuje sa ako výnos z finančnej gramotnosti. V súlade s literatúrou o ľudskom kapitáli predpokladáme, že investície do finančnej gramotnosti zvyšujú výnosy, aj keď s klesajúcou mierou.

Spotrebitelia vedia zvýšiť úroveň finančnej gramotnosti investíciou do finančnej gramotnosti v období 0. Relatívne náklady na gramotnosť z hľadiska spotrebného tovaru sú p, ktoré zahŕňajú peňažné a časové náklady vynaložené spotrebiteľmi. Úroveň gramotnosti sa teda vyvíja podľa vzťahu:

$$\Phi_1 = (1-\delta)\Phi_0 + \phi, \tag{2}$$

kde ϕ označuje investície do finančnej gramotnosti. V prvom období si ľudia volia úspory a investície do finančnej gramotnosti, pričom maximalizujú nasledujúcu logaritmickú funkciu užitočnosti:

$$\ln c_0 + \ln c_1 \tag{3}$$

s ohľadom na rozpočtové obmedzenia:

$$c_0 + s + p\phi = y \quad \text{a} \quad c_1 = \Phi_1^{\alpha} s, \tag{4}$$

kde $0 < \beta < 1$ je diskontný faktor a s sú úspory v prvom období.

Jappelli a Padula (2013) odvodzujú podmienky prvého rádu vzhľadom na s a ϕ nasledovne:

$$s : \frac{c_1}{\beta c_0} = \Phi_1^{\alpha} \tag{5}$$

$$\phi : p = \frac{\alpha\beta c_0 s \Phi_1^{\alpha-1}}{c_1} \tag{6}$$

Po dodatočných kalkuláciách model určuje optimálnu úroveň finančnej gramotnosti podľa nasledovného vzťahu:

$$\Phi_1^{*} = \frac{\alpha\beta}{1+\beta+\alpha\beta}\left[\Phi_0(1-\delta) + \frac{y}{p}\right] \tag{7}$$

a optimálnu úroveň investícií / úspor:

$$s^* = \frac{\beta}{1+\beta+\alpha\beta}\left[y + p\Phi_0(1-\delta)\right]. \tag{8}$$

Jappelli a Padula (2013) rozširujú tento jednoduchý model s dvomi obdobiami aj na model s viacerými obdobiami (detaily modelu sú prístupné v samotnom článku). Tento model implikuje, že finančná gramotnosť a bohatstvo sú počas životného cyklu silne prepojené: oba profily sa počas pracovného života zvyšujú, bohatstvo dosahuje vrchol v čase odchodu do dôchodku, gramotnosť dosahuje vrchol jedno obdobie po odchode do dôchodku a na konci životného cyklu oba profily klesajú. V priereze jednotlivcov rôzneho veku by mala existovať pozitívna korelácia medzi finančnou gramotnosťou a úsporami. Táto korelácia závisí aj od štedrosti systému sociálneho zabezpečenia. Systém, v ktorom rozhodovanie o sporení sprostredkúva vláda, poskytuje málo stimulov pre jednotlivcov na sporenie a akumuláciu finančnej gramotnosti.

Navyše, v nadstavbovej práci Jappelli a Padula (2015) používajú podobný prístup a odvodzujú teoretický model, ktorý určuje vzťah medzi úrovňou finančnej gramotnosti a investovaním jednotlivcov do rizikových aktív v rámci ich portfólií. Tento model taktiež implikuje pozitívny vplyv finančnej gramotnosti na úroveň investovania do sofistikovaných (rizikových) aktív akými sú akcie alebo dlhopisy.

Dôležitosť finančnej gramotnosti pre rozhodovanie o dôchodkovom sporení podporuje aj teória od Lusardi a Mitchell (2011a). Napríklad na základe modelu rozhodovania o spotrebe a sporení, racionálny spotrebiteľ získava úžitok z rozdelenia spotreby a voľného času počas svojho života. V základných nastaveniach spotrebiteľ rieši optimalizačný problém pomocou očakávanej hodnoty súčtu úžitkov za obdobie $U(c_j)$ spotreby c diskontovanej do súčasnosti koeficientom β a vynásobenej pravdepodobnosťou prežitia p_j od súčasného veku spotrebiteľa j do najstaršieho možného veku života D:

$$\mathrm{E}\left[\sum_{j=s}^{D} \beta^{j-s} U(c_j)\right]. \tag{9}$$

V každom období sa aktíva (a_j) a spotreba (c_j) určujú endogénne maximalizáciou funkcie očakávaného úžitku vzhľadom na intertemporálne rozpočtové obmedzenie. V prvom období, t. j. pred odchodom do dôchodku, je príjem (y_j) funkciou zárobkov (e_j) a výnosov z aktív (a_j). Príjem v období odchodu do dôchodku je funkciou dávok sociálneho zabezpečenia (SS), dôchodku (PP) v závislosti od dôchodkového veku (R), ako aj výnosov z aktív (ra_j):

$$y_j = e_j + ra_j, \quad j \in \{S, ..., R-1\} \tag{10}$$

a

$$y_j = SS_j(R) + PP_j(R) + ra_j, \quad j \in \{R, ..., D\} \tag{11}$$

Okrem toho spotreba závisí od príjmu, aktív a dávok, takže:

$$c_j + a_{j+1} = y_j + a_j, \quad j \in \{S, ..., R-1\} \quad \text{pred} \quad \text{dôchodkom} \quad (R) \tag{12}$$

a

$$c_j + a_{j+1} = y_j + a_j, \quad j \in \{R, ..., D\} \quad \text{od dôchodku po smrť} \quad (D). \tag{13}$$

Celkovo model implikuje, že spotreba c_j závisí od príjmu, majetku a sociálnych dávok. Lusardi a Mitchell (2011a) konštatujú, že na vyriešenie optimalizačného problému musí jednotlivec pochopiť a využiť informácie týkajúce sa pravdepodobnosti prežitia, diskontných sadzieb, výnosov z investícií, súčasných a budúcich príjmov, dôchodkového systému, dávok sociálneho zabezpečenia a inflácie. Preto je nevyhnutná značná znalosť týchto ekonomických pojmov a teda určitá úroveň finančnej gramotnosti.

Prezentované teoretické modely implikujú, že vyššie finančné povedomie jednotlivcov a domácností vie dopomôcť k lepším a obozretnejším ekonomickým a finančným rozhodnutiam. Tieto teórie boli aplikované v mnohých empirických článkoch z rôznych krajín sveta. Zistilo sa napríklad, že finančná gramotnosť podporuje účasť na trhu so sofistikovanými finančnými aktívami (napr. Van Rooij a iní, 2011; Lusardi a Mitchell, 2014; Jappelli a Padula, 2015), diverzifikáciu finančných portfólií (napr. Abreu a Mendes, 2010; Von Gaudecker, 2015), ale aj plánovanie / sporenie na dôchodok (napr. Alessie a iní, 2011; Bucher-Koenen a Lusardi, 2011), čo následne pomáha akumulovať väčšie finančné bohatstvo (napr. Behrman a iní, 2012; Lusardi a iní, 2017) potrebné pre finančnú prosperitu jednotlivých domácností.

1.3 Výskumné otázky a prínosy práce

Na základe predchádzajúcej teoretickej a empirickej literatúry (popísanej v časti 1.2) koncipujeme nasledovné hlavné výskumné hypotézy, ktoré sú analyzované v publikovaných článkoch Cupak a iní (2021b), Cupak a iní (2018), Cupak a iní (2019), Cupak a iní (2021a) a Cupak a iní (2022) (viď podkapitoly 2.1 až 2.5):

- Aké veľké sú rozdiely vo finančnej gramotnosti naprieč krajinami?
- Sú pozorované rozdiely vo finančnej gramotnosti spôsobené najmä rozdielmi v individuálnych charakteristikách, prípadne zohrávajú inštitucionálne charakteristiky krajín úlohu pri vysvetľovaní rozdielov vo finančnej gramotnosti v jednotlivých krajinách?
- Aké veľké sú rodové medzery vo finančnej gramotnosti a dokážu medzeru vysvetliť aj iné ako individuálne charakteristiky jednotlivcov?
- Ako vplýva úroveň finančnej gramotnosti na plánovanie a zabezpečenie sa na dôchodok?
- Ako vplýva úroveň finančnej gramotnosti na investovanie do rizikových finančných aktív, akými sú akcie alebo dlhopisy a existuje heterogenita v správaní domácností naprieč ich socio-demografickými charakteristikami?

Táto habilitačná práca prispieva vo viacerých rovinách do empirickej literatúry pojednávajúcej o finančnej gramotnosti a ekonomickom / finančnom správaní jednotlivcov a domácností.[2]

Hlavný príspevok článku "Exploring Differences in Financial Literacy Across Countries: The Role of Individual Characteristics and Institutions" (Cupak a iní, 2021b, viď podkapitola 2.1) je využitie (v tom čase novo publikovaných) mikrodát zo zisťovania OECD/INFE. Článok bol medzi prvými, ktorý detailne analyzoval úroveň finančnej gramotnosti populácie vo viacerých krajinách sveta na základe rozšíreného počtu otázok finančnej gramotnosti. Článok bol taktiež medzi prvým, ktorý použil kontrafaktuálne dekompozičné (Blinder-Oaxaca) techniky na skúmanie rozdielov vo finančnej gramotnosti, po vzore štúdie od Christelis a iní (2013).

Ďalšie publikované články "Decomposing gender gaps in financial literacy: New international evidence" (Cupak a iní, 2018, viď podkapitola 2.2) a "Gender differences in risky asset behavior: The importance of self-confidence and financial literacy" (Cupak

[2]Treba však podotknúť, že prínosy práce (v čase ich publikovania) sa najmä spájajú s dostupnosťou nových mikroekonomických údajov o jednotlivcoch a domácnostiach. V súčasnosti už existuje viacero podobných výskumov, ktoré prinášajú viac detailné zistenia s lepšou dostupnosťou kvalitných mikroúdajov o finančnej gramotnosti a finančnom správaní mikroekonomických subjektov.

a iní, 2021a, viď podkapitola 2.3) nadväzujú na unikátny prístup k novým OECD/INFE mikrodátam. Štúdie boli medzi prvými, ktoré poukázali na systematické rodové rozdiely vo finančnej gramotnosti (a finančnom sebavedomí) na veľkom počte krajín a na základe veľkého počtu otázok finančnej gramotnosti. Dekompozičnými (Blinder-Oaxaca) metódami navyše analýzy ako prvé ukázali, že rozdiely v charakteristikách medzi mužmi a ženami nedokážu úplne vysvetliť rodové medzery vo finančnej gramotnosti a inštitucionálne charakteristiky krajín zohrávajú dôležitú úlohu vo formovaní finančnej gramotnosti u žien. Navyše analýzy poukázali aj na dôležitosť finančnej gramotnosti a sebavedomia vo vlastné finančné schopnosti ako dôležité determinanty pre vysvetlenie rozdielov v rizikovom investičnom správaní jednotlivcov, čo nadväzuje na predchádzajúcu empirickú literatúru v tejto výskumnej oblasti (napr. Bannier a Neubert, 2016).

Štvrtý publikovaný článok "Financial literacy and voluntary savings for retirement: novel causal evidence" (Cupak a iní, 2019, viď podkapitola 2.4) prispieva do literatúry viacerými spôsobmi. V prvom rade, článok ako jeden z prvých analyzoval úroveň finančnej gramotnosti na Slovensku, málo preskúmanou krajinou v tomto ohľade kvôli absencii kvalitných mikrodát pre región Strednej a východnej Európy. Pritom už existovalo viacero dôkazov o pozitívnom vplyve finančných znalostí a plánovania na dôchodok z iných vyspelých krajín (napr. Alessie a iní, 2011; Bucher-Koenen a Lusardi, 2011). Článok taktiež patril medzi prvé, ktoré odhadovali vplyv finančnej gramotnosti na dôchodkové sporenie v dobrovoľných schémach, pričom dáta umožňovali analyzovať čisto dobrovoľné sporenie a taktiež sporenie s príspevkami zamestnávateľov. Posledným príspevkom je použitie nových inštrumentálnych premenných na izolovanie kauzálneho vplyvu finančnej gramotnosti na pravdepodobnosť sporenia si na dôchodok. Inštrumentálne premenné boli skonštruované na základe paradát dotazníka po vzore Crossley a iní (2021), kde opytovatelia hodnotili schopnosť respondentov porozumieť otázkam a ich schopnosť previesť koruny na eurá, čo sa ukázalo ako validné inštrumenty.

Posledný článok "Investor confidence and high financial literacy jointly shape investments in risky assets" (Cupak a iní, 2022, viď podkapitola 2.5) benefitoval z prístupu k detailným mikrodátam o finančnom správaní amerických domácností. Článok ako jeden z prvých poukázal na spoločnú dôležitosť meranej finančnej gramotnosti a finančného sebavedomia domácností pre investovanie do rizikových aktív (akcie, dlhopisy), pričom bral do úvahy aj makroekonomické očakávania domácností – dovtedy málo preskúmaným faktorom na úrovni domácností. Ukázalo sa, že hoci domácnosti nie sú profesionálnymi prognostikmi, dôvera v ekonomiku (na 5 ročnom horizonte) pozitívne súvisí s podielom finančného majetku investovaného do akcií, pričom na menej rizikové dlhopisy má len malý vplyv. Tento nový empirický výsledok súvisí s nedávanými zisteniami od Ng a iní (2016), ktorí poukázali na prepojenie medzi dôverou v ekonomiku a výkon-

nosťou akciových trhov v 60 analyzovaných krajinách. Článok taktiež využil prístup inštrumentálnych premenných na odhad (kauzálnych) vplyvov a kvantilové regresie, ktoré poukázali na výraznú heterogenitu v odhadoch naprieč distribúciou závislých premenných.

1.4 Dáta a metódy

1.4.1 Dáta

Tak ako každá empirická analýza, aj táto práca sa opiera o detailné údaje, pričom najväčší dôraz je v dátach kladený na meranie finančnej gramotnosti a investičných rozhodnutí jednotlivcov a domácností. Hlavným cieľom tejto podkapitoly je oboznámiť čitateľa s detailmi použitých údajov.

Štatistické zisťovanie / prieskum. Nakoľko sa výskum v tejto habilitačnej práci opiera exkluzívne o mikroekonomické údaje o jednotlivcoch a domácnostiach zbieraných v rámci reprezentatívnych štatistických zisťovaní alebo prieskumov, je na úvod užitočné si priblížiť takýto druh zberu dát.

Bethlehem (2009) definuje štatistické zisťovanie / prieskum[3] ako nástroj na zhromažďovanie informácií o presne vymedzenej populácii. Táto populácia nemusí nevyhnutne pozostávať z osôb. Prvky populácie môžu byť napríklad domácnosti, firmy, podniky alebo školy. Zvyčajne sa informácie zbierajú kladením otázok zástupcom prvkov populácie, pričom sa na tento účel používa jednotný a konzistentný dotazník.

Jedným zo spôsobov, ako získať informácie o populácii, je zhromaždiť údaje o všetkých jej prvkoch. Takéto zisťovanie sa nazýva sčítanie (cenzus). I napriek tomu, že takýto typ zberu dát poskytuje maximálnu reprezentatívnosť, tento prístup má niekoľko zásadných nevýhod ako vysoké finančné náklady, časová náročnosť alebo zátaž na účastníkov zisťovania v prípade veľkého počtu monitorovaných informácií.

Bethlehem (2009) uvádza, že zisťovanie / prieskum je riešením mnohých problémov štatistického sčítania. Prieskumy zhromažďujú informácie len o malej, vymedzenej časti populácie, pričom táto malá časť sa nazýva vzorka. Vzorka v zásade poskytuje informácie len o vybraných prvkoch populácie, pričom o prvkoch, ktoré nie sú súčasťou vzorky, sa nezískajú žiadne informácie. Napriek tomu, ak je vzorka vybraná správnym spôsobom, je možné vyvodiť závery o populácii ako celku. V tomto kontexte "správny" znamená, že vzorka je vybraná pomocou pravdepodobnostného výberu. Postup pravdepodobnostného výberu využíva prvok náhody a určuje, ktoré prvky sa vyberú a ktoré nie. Ak je mechanizmus výberu vzorky jasný a dá sa určiť pravdepodobnosť výberu, tak aj výsledky prieskumu umožňujú spoľahlivé a presné vyhlásenia o populácii ako celku.

V praxi má zber dát pomocou zisťovaní / prieskumov niekoľko dôležitých fáz, ktoré sumarizuje Bethlehem (2009):

[3] I napriek tomu, že v štatistickom slovníku zisťovanie a prieskum neznamenajú úplne to isté, my v tejto habilitačnej práci pre jednoduchosť používame tieto dva výrazy ako synonymum.

- Dizajn prieskumu – rozhodovanie o výberovej vzorke a populácii, ktorú má táto vzorka reprezentovať. Táto fáza taktiež zahŕňa vytvorenie dotazníka.

- Zber dát v teréne – zhromažďovanie informácií o subjektoch (jednotlivci, domácnosti, firmy, atď.) na základe dotazníka. Informácie sa častokrát zbierajú tzv. CAPI/CAWI (Computer Assisted Personal / Web Interview) metódou a zaznamenávajú sa v zariadeniach použitím špecializovaného softvéru (napr. Blaise). Je pritom dôležité zdôrazniť, že metóda zberu dát (napr. CAPI alebo CAWI) môže mať výrazný dopad na samotnú kvalitu prieskumu a zozbieraných odpovedí (viď Fessler a iní, 2018).

- Editovanie dát – ďalšou dôležitou časťou procesu je odhalenie chýb v dátach (napr., ak hodnoty ležia mimo možných intervalov) a taktiež tzv. imputovanie dát (teda nahradenie chýbajúcich hodnôt zmysluplnými hodnotami na základe rôznych štatistických modelovaní). Špecifickou črtou viacerých prieskumov (napr. o bohatstve domácností) je, že chýbajúce hodnoty u premenných sú viacnásobne imputované sofistikovanou štatistickou metódou, ktorú navrhol Rubin (2004).

- Ošetrenie neochoty odpovedať – zozbierané údaje nemusia byť reprezentatívne pre cieľovú populáciu, pretože vzorka je ovplyvnená neodpovedaním – to znamená, že pre niektoré prvky vo vzorke nie sú získané informácie. Ak sa respondenti, ktorí neodpovedali, správajú odlišne vzhľadom na skúmané charakteristiky populácie, výsledky môžu byť skreslené. Na korekciu nerovnakej pravdepodobnosti výberu do vzorky a neochoty odpovedať sa aplikuje tzv. váženie. Každému prvku vzorky sa priradí určitá váha. Tieto váhy sa vypočítajú takým spôsobom, aby vážené rozdelenie výberového súboru charakteristík (ako je napríklad pohlavie, vek, rodinný stav alebo región) odrážalo známe rozdelenie týchto charakteristík v celkovej populácii. Jednou z najvšeobecnejších metód na vytvorenie váh je ich kalibrácia (viď Deville a Särndal, 1992).

- Analýza a diseminácia dát – poslednou fázou je samotná analýza údajov, publikácia štatistickej správy a diseminácia údajov.

Navyše, Stantcheva (2023) argumentuje, že štatistické zisťovania a prieskumy nie sú len výskumným nástrojom a spôsobom zberu údajov. Okrem toho zahŕňajú vytváranie procesu, ktorý vie generovať vzácne údaje. To umožňuje výskumníkom vytvoriť vlastnú identifikačnú a kontrolovanú variáciu, či už v rámci randomizovaných experimentov alebo v tvorbe tzv. inštrumentálnych premenných, ktoré sú aplikované aj v tejto habilitačnej práci.

Medzinárodné zisťovanie finančnej gramotnosti dospelých OECD/INFE. Výskum prezentovaný v článkoch Cupak a iní (2021b), Cupak a iní (2018) a Cupak a iní

(2021a) (viď podkapitoly 2.1, 2.2, 2.3) sa opiera o mikroekonomické údaje zo zisťovania OECD/INFE (OECD/INFE International Survey of Adult Financial Literacy).[4]

OECD/INFE (Medzinárodná sieť pre finančné vzdelávanie) zbiera údaje o kompetenciách v oblasti finančnej gramotnosti dospelých osôb. Hoci sa zisťovanie uskutočňuje vo viac ako 30 krajinách sveta, len niekoľko krajín poskytuje údaje na výskumné účely. Táto práca využíva údaje na individuálnej úrovni z Rakúska, Brazílie, Kanady, Chorvátska, Fínska, Nemecka, Hongkongu, Maďarska, Jordánska, Holandska, Ruska, Spojeného kráľovstva a Španielska, čo spolu predstavuje viac ako 20 000 pozorovaní (viď prehľad v tabuľke 1). Jedinečnou črtou tohto zisťovania je, že otázky sú kladené harmonizovaným spôsobom v rôznych krajinách, vďaka čomu sú výsledky porovnateľné – čo je veľká výhoda v porovnaní s predchádzajúcimi zisťovaniami / prieskumami o finančnej gramotnosti a finančných kompetenciách jednotlivcov. Aj súbor otázok o finančnej gramotnosti je širší ako v predchádzajúcich výskumoch, ktoré sa zvyčajne zameriavajú na malý súbor troch/štyroch ("The Big Three") základných otázok o finančnej gramotnosti týkajúcich sa úrokových sadzieb, inflácie a diverzifikácie / rizikovosti (viď Lusardi a Mitchell, 2014). V zisťovaní OECD/INFE otázky zahŕňajú pojmy ako časová hodnota peňazí, úroky platené z úverov, úrok a istina, zložené úročenie, riziko a výnos, inflácia a diverzifikácia rizika, čo poskytuje oveľa širší rámec pre meranie finančnej gramotnosti na individuálnej úrovni. Veľkou výhodou OECD/INFE údajov je aj to, že obsahujú štandardné socio-demografické premenné a základné informácie o tom, aké druhy aktív držia jednotlivci a aké preferencie majú k sporeniu / investovaniu.

Tabuľka 1: Prehľad o OECD/INFE zisťovaní

Krajina	Inštitúcia	Dátum zberu údajov	Typ zisťovania	Výberová metóda	Veľkosť vzorky
Rakúsko (AT)	Oesterreichische Nationalbank	2014	CAPI	Stratifikovaný výber	1 994
Brazília (BR)	Banco Central do Brasil	2015	CAPI	Stratifikovaný výber so zhlukovaním	2 002
Kanada (CA)	Financial Consumer Agency of Canada	2015	CATI	Kvótny výber	1 002
Chorvátsko (HR)	Croatian National Bank and Croatian Financial Services Agency	2015	CAPI	Stratifikovaný výber	1 049
Fínsko (FI)	University of Tampere and University of Vaasa	2014	CAPI	Stratifikovaný výber so zhlukovaním	1 533
Nemecko (DE)	Deutsche Bundesbank	2016	CATI	Stratifikovaný výber	1 001
Hongkong (HK)	Investor Education Center	2015	CAPI	Stratifikovaný výber	1 000
Maďarsko (HU)	Magyar Nemzeti Bank	2015	CAPI	Kvótny výber	1 000
Jordánsko (JO)	INJAZ	2016	CAPI	Stratifikovaný výber	1 140
Holandsko (NL)	Money Wise	2015	CAWI	N.A.	1 018
Rusko (RU)	Ministry of Finance of the Russian Federation	2015	CAPI	Stratifikovaný výber	1 649
Spojené kráľovstvo (UK)	Money Advice Service	2015	CATI/CAWI	Stratifikovaný náhodný výber	1 000
Španielsko (SE)	Banco de Espana	2015	CATI/CAWI	Stratifikovaný náhodný výber	8 554
					23 942

Zdroj: CAPI (Computer Assisted Personal Interview), CAWI (Computer Assisted Web Interview), CATI (Computer Assisted Telephone Interview).
Zdroj: Spracované na základe OECD/INFE.

[4]Viac informácií o zisťovaní a o prístupe k týmto mikrodátam je dostupných tu: https://www.oecd.org/en/networks/infe.html.

Detaily o samotných premenných použitých v empirických analýzach sú popísané v sumárnej tabuľke 2. Je pritom dôležité spomenúť, že publikácie Cupak a iní (2021b) a Cupak a iní (2018) používajú štandardné merané skóre finančnej gramotnosti – teda počet bodov za správne zodpovedané otázky o financiách – (v súlade s Lusardi a Mitchell, 2014) – ako závislú premennú, zatiaľ čo článok Cupak a iní (2021a) aplikuje informáciu o držbe finančných aktív (akcie a dlhopisy) ako vysvetľovanú premennú. Tabuľka 2 obsahuje aj súhrnné informácie o ďalších vysvetľujúcich premenných, ktoré sú použité v regresných analýzach a dekompozíciách.

Tabuľka 2: Popis premenných z OECD/INFE použitých v článkoch Cupak a iní (2021b), Cupak a iní (2018) a Cupak a iní (2021a)

Premenná	Definícia
Finančná gramotnosť: počet správnych odpovedí	Počet správne zodpovedaných otázok jednotlivcom týkajúcich sa finančnej gramotnosti (časová hodnota peňazí, úroky platené z úverov, úrok a istina, zložené úročenie, riziko a výnos, inflácia a diverzifikácia rizika); skóre od 0 do 7
Finančné sebavedomie	Sebahodnotenie dôvery jednotlivca vo vlastné znalosti o finančných záležitostiach: od 1 "veľmi nízke" po 5 "veľmi vysoké"
Príjem	Umelá premenná = 1, ak má jednotlivec finančnú rezervu (na úrovni aspoň troch mesačných príjmov) pre prípad, že by stratil zamestnanie
Pohlavie	Umelá premenná = 1, ak ide o ženu
Single	Umelá premenná = 1, ak jednotlivec žije sám
Univerzitné vzdelanie	Umelá premenná = 1, ak je najvyššie dosiahnuté vzdelanie vysokoškolské
Veková kategória (18-29)	Umelá premenná = 1, ak ide o jednotlivca vo veku od 18 do 29 rokov
Veková kategória (30-49)	Umelá premenná = 1, ak ide o jednotlivca vo veku od 30 do 49 rokov
Veková kategória (50-69)	Umelá premenná = 1, ak ide o jednotlivca vo veku od 50 do 69 rokov
Veková kategória (70+)	Umelá premenná = 1, ak ide o jednotlivca vo veku od 70+ rokov
Zamestnaný	Umelá premenná = 1, ak je platené zamestnanie (práca pre niekoho iného)
SZČO	Umelá premenná = 1, ak je samostatne zárobkovo činný (pracuje sám na seba)
Dôchodca	Umelá premenná = 1, ak je na dôchodku
Iné, nepracujúci	Umelá premenná = 1, ak je nezamestnaný alebo nepracuje (napr. učeň, hľadá si prácu, stará sa o domácnosť, nemôže pracovať pre chorobu, študent)
Drží rozpočet	Umelá premenná = 1, ak je jednotlivec v domácnosti zodpovedný za rozpočet a drží rozpočet
Aktívne sporí	Umelá premenná = 1, ak jednotlivec aktívne sporí v jednom z nasledujúcich systémov (hotovosť doma, sporiaci účet, neformálny sporiaci klub, investičné produkty)
Drží rizikové aktíva	Umelá premenná = 1, ak jednotlivec vo svojom finančnom portfóliu vlastní akcie alebo dlhopisy
Finančné plánovanie	Umelá premenná: 1, ak si jednotlivec stanovuje dlhodobé finančné ciele

Poznámka: Údaje sú zbierané na úrovni jednotlivca.
Zdroj: Spracované na základe OECD/INFE dotazníka.

Zisťovanie o financiách a spotrebe domácností. Výsledky výskumu prezentovaného v publikácii Cupak a iní (2019) (viď podkapitola 2.4) sú založené na základe mikroekonomických údajov zo Zisťovania o financiách a spotrebe domácností (Household Finance and Cosumption Survey, HFCS). HFCS je medzinárodné reprezentatívne zisťovanie, ktoré zbiera v harmonizovanej forme údaje o domácnostiach a jednotlivcoch.

Údaje sa zbierajú každé tri roky (2010, 2014, 2017, 2020/21) v krajinách eurozóny a ďalších krajinách ako Česko, Maďarsko alebo Poľsko. Hlavný cieľ zisťovania je monitorovanie aktív a pasív domácností, avšak mikroúdaje obsahujú aj detailné informácie o príjmoch, spotrebe a rôznych socio-demografických charakteristikách domácností a jednotlivcov.[5]

Tabuľka 3: Popis premenných z HFCS použitých v Cupak a iní (2019)

Premenná	Definícia
Závislé premenné	
Sporenie bez príspevkov zamestnávateľa	Umelá premenná = 1, ak si referenčná osoba v domácnosti sporí na dôchodok vo forme súkromných dôchodkových fondov alebo zmlúv o celoživotnom poistení bez príspevkov zamestnávateľa
Sporenie s príspevkami zamestnávateľa	Umelá premenná = 1, ak si referenčná osoba v domácnosti sporí na dôchodok vo forme súkromných dôchodkových fondov alebo zmlúv o celoživotnom poistení s príspevkami zamestnávateľov
Nezávislé premenné	
Finančná gramotnosť: počet správnych odpovedí	Počet správne zodpovedaných otázok referenčnou osobou v domácnosti týkajúcich sa finančnej gramotnosti (úrokové sadzby, inflácia, diverzifikácia, riziko); skóre od 0 po 4
Finančná gramotnosť: všetky správne odpovede	Umelá premenná = 1, ak všetky otázky týkajúce sa finančnej gramotnosti boli zodpovedané správne
Príjmové kvintily	Súbor umelých premenných pre 5 príjmových kvintilov, v ktorých sa daná domácnosť nachádza
Muž	Umelá premenná = 1, ak je referenčnou osobou v domácnosti muž
Deti	Umelá premenná = 1, ak má domácnosť aspoň jedno dieťa
Jednočlenná domácnosť	Umelá premenná = 1, ak ide o jednočlennú domácnosť
Vekové kategórie	Súbor umelých premenných pre 5 vekových kategórií (16-34, 35-44, 45-54, 55-62 a 63+) referenčnej osoby v domácnosti
Vysokoškolský titul	Umelá premenná = 1, ak má referenčná osoba v domácnosti vysokoškolské vzdelanie
Postoj k riziku	Umelá premenná = 1, ak referenčná osoba v domácnosti deklaruje pozitívny postoj k riziku
Zamestnaný	Umelá premenná = 1, ak je referenčná osoba v domácnosti zamestnaná za mzdu
Samostatne zárobkovo činná osoba	Umelá premenná = 1, ak je referenčná osoba v domácnosti samostatne zárobkovo činná osoba
Nepracujúca osoba	Umelá premenná = 1, ak je referenčná osoba v domácnosti nezamestnaná (vrátane nezamestnaných, študentov a osôb v domácnosti)
Život v meste	Umelá premenná = 1, ak domácnosť žije v meste (nad 50 000 obyvateľov)
Vlastníctvo hlavného bydliska domácnosti	Umelá premenná = 1, ak domácnosť vlastní svoje hlavné obydlie
Vlastníctvo inej nehnuteľnosti	Umelá premenná = 1, ak domácnosť vlastní iné nehnuteľnosti (napr. dom, byt, garáž, pozemok, atď.)
Inštrumentálne premenné	
Inštrumentálna premenná 1	Schopnosť referenčnej osoby v domácnosti porozumieť otázkam v prieskume; od slabej (1) po výbornú (4)
Inštrumentálna premenná 2	Schopnosť referenčnej osoby v domácnosti prepočítať peňažné hodnoty zo slovenských korún na eurá; od slabej (1) po výbornú (4)

Poznámka: Údaje sú zbierané na úrovni domácnosti, za ktorú odpovedá referenčná osoba. Touto osobou je spravidla osoba, ktorá má najvyššie dosiahnuté vzdelanie, resp. osoba, ktorá má na starosti hospodárenie domácnosti.
Zdroj: Spracované na základe HFCS dotazníka.

I napriek tomu, že zisťovanie prebieha na medzinárodnej úrovni, táto práca používa iba údaje pre Slovensko (konkrétne za rok 2014), nakoľko ostatné krajiny nezhromažďujú všetky potrebné informácie pre účely tohto výskumu. Veľkou výhodou sloven-

[5]Viac informácií o zisťovaní a o prístupe k dátam je dostupných tu: https://nbs.sk/en/research-at-nbs/household-finance-and-consumption-survey-hfcs/.

ského HFCS teda je, že okrem štandardných otázok existujú informácie o finančnej gramotnosti a sporení na dôchodok v rôznych dôchodkových plánoch (konkrétne 3. dôchodkový pilier bez / s príspevkami zamestnávateľov). Celkovo údaje HFCS 2014 zhromažďujú informácie pre viac ako 2 000 domácností, avšak táto práca pracuje iba so sub-vzorkou pre približne 1 200 domácností, nakoľko dôchodcovské domácnosti sú vylúčené z analýz o doplnkovom dôchodkovom sporení.

Veľkou výhodou HFCS dát sú aj detailné informácie o dôchodkovom sporení jednotlivých domácností. Z tohto titulu v regresnej analýze modelujeme niekoľko závislých premenných: umelé premenné ohľadom participácie na doplnkovom dôchodkovom sporení (tretí dôchodkový pilier v kontexte Slovenska) a taktiež veľkosť príspevkov do týchto schém. Našou hlavnou vysvetľujúcou premennou je skóre finančnej gramotnosti (ktoré je štandardne počítané ako počet správne zodpovedaných otázok o financiách). V empirickej analýze taktiež zohľadňujeme vplyv veľkého množstva kontrolných premenných, ktoré sa bežne používajú v literatúre o rodinných financiách. Dáta taktiež umožňujú skonštruovanie tzv. inštrumentálnych premenných na zohľadnenie možnej endogenity finančnej gramotnosti. Detaily a popis všetkých premenných, ktoré vstupujú do empirickej analýzy sú popísané v tabuľke 3.

Zisťovanie o spotrebiteľských financiách. Posledný článok Cupak a iní (2022) (výsledky prezentované v podkapitole 2.5) používa mikrodáta zo Zisťovania spotrebiteľských financií (Survey of Consumer Finances, SCF). SCF je národné reprezentatívne zisťovanie o domácnostiach v Spojených štátoch amerických (USA), ktoré zastrešuje Rada guvernérov Federálneho rezervného systému každé tri roky s cieľom získať komplexné údaje o finančnej situácii domácností. SCF má dlhoročnú tradíciu a údaje zhromažďuje už od roku 1989. Údaje zahŕňajú mnohé podrobnosti o bilancii domácností vrátane vlastníctva konkrétnych aktív a dlhov, ako aj veľkosti týchto aktív. Zisťovanie obsahuje aj informácie o príjmoch, spotrebe, dôchodkoch a demografických charakteristikách jednotlivcov v rámci domácností. V práci používame prierezové údaje z roku 2019, ktoré zahŕňajú kompletné informácie pre 5 777 amerických domácností.[6]

Analýza na základe SCF mikrodát je založená na bohatom súbore informácií o investíciách do rizikových finančných aktív, merané na úrovni domácností. Tieto investície zahŕňajú finančné nástroje a účty s priamo alebo nepriamo držanými akciami, dlhopismi a inými dlhovými cennými papiermi. Hoci rôzne finančné nástroje zahŕňajú rôznu mieru rizika, zoskupujeme nástroje do dvoch širokých kategórií: akcie a dlhopisy. Našou prvou závislou premennou je umelá premenná, ktorá nadobúda hodnotu 1, ak domácnosť vlastní akcie a 0 v opačnom prípade, a binárnu premennú, ktorá nadobúda

[6]Viac informácií o zisťovaní, základných výsledkoch a o prístupe k mikrodátam je dostupných tu: https://www.federalreserve.gov/econres/scfindex.htm.

hodnotu 1, ak domácnosť vlastní dlhopisy a 0 v opačnom prípade. Naša druhá závislá premenná pozostáva z podielov celkových finančných aktív (vrátane dôchodkových účtov) držaných v akciách alebo dlhopisoch, podmienených držbou týchto finančných aktív.

Tabuľka 4: Popis premenných z SCF použitých v Cupak a iní (2022)

Premenná	Definícia
Závislé premenné	
Investovanie do akcií	Umelá premenná = 1, ak domácnosť drží akúkoľvek akciu nasledujúceho typu: verejne obchodované akcie, akciové podielové fondy, kombinované fondy, IRA/Keogh investované do akcií, iné spravované aktíva s akciovým podielom (napr. anuity, trusty, MIA), dôchodkové účty sporivého typu investované do akcií, sporiace účty klasifikované ako 529 (vzdelávacie sporiace účty)
Podiel akcií na finančných aktívach	Podiel hodnoty akcií na celkových finančných aktívach (vrátane dôchodkov)
Investovanie do dlhopisov	Umelá premenná = 1, ak domácnosť drží akékoľvek nástroje tohto typu: štátne sporiace dlhopisy, podnikové dlhopisy, komerčné cenné papiere, štátne alebo obecné nesporiace dlhopisy, zahraničné dlhopisy a iné nesporiace dlhopisy, dlhopisy, cenné papiere kryté hypotékami, obchodovateľné vkladové certifikáty, štátne pokladničné poukážky (T-bills), štátne pokladničné certifikáty (T-certificates), štátne dlhopisy (T-bonds), dlhopisy s nulovým kupónom a podobné nástroje, s ktorými sa bežne obchoduje na finančných trhoch
Podiel dlhopisov na finančných aktívach	Podiel dlhopisov a iných dlhových cenných papierov na celkových finančných aktívach (vrátane dôchodkov)
Nezávislé premenné	
Finančná gramotnosť: počet správnych odpovedí	Počet správne zodpovedaných otázok referenčnou osobou v domácnosti týkajúcich sa finančnej gramotnosti (úrokové sadzby, inflácia, riziko); skóre od 0 po 3
Finančné sebavedomie	Sebahodnotenie dôvery referenčnej osoby v domácnosti vo vlastné znalosti o finančných záležitostiach: od 1 “veľmi nízke” po 5 “veľmi vysoké”
Dôvera v ekonomiku	Dôvera referenčnej osoby v domácnosti v celkovú výkonnosť ekonomiky USA v horizonte 5 rokov v porovnaní so súčasnosťou (2019): od 1 "situácia bude horšia"do 3 "situácia bude lepšia"
Postoj k riziku	Umelá premenná = 1, ak referenčná osoba v domácnosti deklaruje pozitívny postoj k riziku
Čisté bohatstvo z nehnuteľností	Čisté bohatstvo domácnosti držané v nehnuteľnostiach (celková hodnota nehnuteľností mínus príslušné záväzky)
Súkromne vlastnené podniky	Umelá premenná = 1, ak domácnosť vlastní alebo sa podieľa na vlastníctve akýchkoľvek súkromne vlastnených podnikov
Disponibilný príjem domácnosti	Celkový peňažný a nepeňažný bežný príjem domácnosti po odpočítaní daní z príjmu a príspevkov na sociálne zabezpečenie. Disponibilný príjem domácností sa vypočíta tak, že sa od hrubého príjmu domácností (zisťovaného v SCF) odpočítajú dane z príjmu simulované pomocou programu TAXIM, ktorý poskytuje NBER (https://taxsim.nber.org/to-taxsim/scf27-32/)
Prijaté dedičstvo/dar	Umelá premenná = 1, ak domácnosť v minulosti prijala dedičstvo alebo dar

Poznámka: Údaje sú zbierané na úrovni domácnosti, za ktorú odpovedá referenčná osoba. Touto osobou je spravidla osoba, ktorá má najvyššie dosiahnuté vzdelanie, resp. osoba, ktorá má na starosti hospodárenie domácnosti. Dáta obsahujú aj ďalšie premenné (veľkosť domácnosti, počet detí, rodinný stav, vek, pohlavie, vzdelanie, zamestnanecký status), ktoré pre krátkosť priestoru vynechávame. Dáta taktiež obsahujú inštrumentálne premenné (vzdelanie matky / otca a používanie dokumentov pre zodpovedanie finančných otázok), ktoré sú použité v regresnej analýze.
Zdroj: Spravované na základe SCF dotazníka.

Hlavnými vysvetľujúcimi premennými v regresnej analýze (po vzore, napr. Lusardi a Mitchell, 2014; Bannier a Schwarz, 2018) sú úroveň finančnej gramotnosti a sebadôvery, ktoré boli nedávno pridané do SCF. V zisťovaní sa kladú štandardné tri otázky, ktoré

sa týkajú inflácie, úrokových mier a rizikovosti. Deatily SCF mikrodát umožňujú aj vytvorenie premennej, ktorá meria úroveň sebadôvery investora vo vlastné finančné zručnosti na základe otázky: *"Na stupnici od nuly do desiatich, kde nula znamená, že sa vôbec nevyznáte do osobných financií a desať je výborná informovanosť o osobných financiách, aké číslo by ste vy (a váš manžel/manželka/partner) dali na tejto stupnici?"*.

SCF zahŕňa aj ďalšiu premennú týkajúcu sa očakávaní o budúcom makroekonomickom vývoji ekonomiky USA v horizonte piatich rokov, ktorú používame ako ďalšiu mieru dôvery. Respondentom bola v rámci zisťovania položené nasledujúca otázka: *"Rád(a) by som sa Vás opýtal(a) na Vaše očakávania do budúcnosti. Očakávate, že v najbližších piatich rokoch bude americká ekonomika rásť lepšie, horšie alebo približne rovnako ako v súčasnosti?"*. Dominitz a Manski (2004) popisujú tento druh premennej ako dôveru v ekonomiku.

Všetky ostatné kontrolné ako aj inštrumentálne premenné, ktoré vstupujú do regresnej analýzy, sú detailne popísané v tabuľke 4.

1.4.2 Ekonometrické metódy

Teoretické východiská práce naznačujú, že úroveň finančnej gramotnosti (ľudského kapitálu) ako aj finančné rozhodovania ovplyvňuje viacero faktorov, či už individuálnych alebo externých. Navyše, teória implikuje, že finančné znalosti významne ovplyvňujú ekonomické a finančné správanie sa jednotlivcov a domácností. V tejto časti popisujeme základné ekonometrické metódy, na základe ktorých overujeme výskumné hypotézy. Tieto ekonometrické odhady zahŕňajú klasickú regresnú analýzu, dekompozičné metódy, ale aj kauzálnu dvoj-krokovú metódu najmenších štvorcov (Two-Stage Least-squares, 2SLS) a nepodmienené kvantilové regresie.

Odhad rozdielov vo finančnej gramotnosti naprieč jednotlivcami a krajinami pomocou dekompozičných metód. V rámci empirického skúmania sa najskôr zameriavame na odhalenie a vysvetlenie rozdielnych úrovní vo finančnej gramotnosti naprieč krajinami. Keďže nás primárne zaujíma vysvetlenie rozdielov (medzier) v pozorovanej finančnej gramotnosti v jednotlivých krajinách, dekomponujeme ich pomocou Blinder-Oaxaca (B-O) metodológie (Blinder, 1973; Oaxaca, 1973). B-O dekompozícia sa v literatúre o trhu práce používala prevažne na štúdium rozdielov v mzdách a zamestnanosti. V poslednom čase sa však táto metóda začala uplatňovať aj v oblasti rodinných financií na vysvetlenie rozdielov v držbe akcií medzi domácnosťami v USA a eurozóne (napr. Christelis a iní, 2013) alebo rozdielov v bohatstve v krajinách eurozóny (napr. Mathä a iní, 2017).

V našom prípade B-O dekompozícia definuje priemerný rozdiel v skóre finančnej

gramotnosti ($\overline{\triangle FL_c}$) jednotlivcov z konkrétnej skúmanej krajiny ($c \in \{AT, BR, ..., ES\}$) a jednotlivcov z referenčnej skupiny, Fínska[7]. Priemerný rozdiel je dekomponovaný na dve hlavné časti – rozdiely v pozorovateľných individuálnych charakteristikách, ktoré sú predmetom skúmania a druhú, ktorú nie je možné vysvetliť rozdielmi v pozorovaných individuálnych charakteristikách - t. j. rozdielmi v koeficientoch (parametroch):

$$\overline{\triangle FL_c} = \underbrace{(\bar{X}_{c=j} - \bar{X}_c)'\hat{\beta}_{c=j}}_{\text{rozdiely v charakteristikách}} + \underbrace{\bar{X}_c'(\hat{\beta}_{c=j} - \hat{\beta}_c)}_{\text{rozdiely v parametroch}} . \tag{14}$$

Empirický výskum navyše ukazuje, že na úroveň finančného povedomia nevplývajú iba samotné charakteristiky jednotlivcov, ale aj ekonomické prostredie krajín (Jappelli, 2010). Preto v podobnom duchu ako Christelis a iní (2013) v druhom kroku korelujeme odhadnuté komponenty z B-O dekompozičej analýzy, $\bar{X}_c'(\hat{\beta}_{c=j} - \hat{\beta}_c)$, s vybranými charakteristikami krajín ako HDP na obyvateľa, podiel používateľov internetu, priemerná dĺžka života, podiel žiakov stredných škôl, kapitalizácia akciového trhu, výsledky testov PISA a miera sociálnych príspevkov (ukazovateľ sociálneho štátu).[8]

Podobným metodologickým prístupom (rovnica 14) skúmame rozdiely vo finančnej gramotnosti medzi rôznymi typmi jednotlivcov naprieč krajinami. Na základe predchádzajúcej literatúry (napr. Fonseca a iní, 2012; Bucher-Koenen a iní, 2017) sa najmä zameriavame na kvantifikovanie rodových rozdielov vo finančnej gramotnosti medzi mužmi a ženami, pričom zohľadňujeme aj dôležitosť ostatných relevantných charakteristík (napr. príjem, vzdelanie, vek, zamestnanie) pre akumuláciu ľudského kapitálu. Aj v tejto analýze pomocou Blinder-Oaxaca dekompozičnej metódy dekomponujeme pozorovaný priemerný rozdiel v meranom skóre finančnej gramotnosti medzi mužmi (M) a ženami (W) na časť, ktorá existuje kvôli rozdielom v charakteristikách medzi mužmi a ženami a na časť, ktorá nie je vysvetliteľná pozorovanými charakteristikami (resp. rozdiely v parametroch).[9]

Odhad rodových rozdielov v investovaní jednotlivcov pomocou dekompozičných metód. Skúmanie dôležitosti finančnej gramotnosti pre ekonomické a finančné rozhodnutia opäť začíname aplikovaním kontrafaktuálnych (hypotetických) dekompozičných metód. Nakoľko je našou závislou premennou umelá (0/1) premenná,

[7] Výber Fínska ako referenčnej kategórie je opodstatnený nielen z dôvodu dostupnosti údajov, ale aj z iných dôvodov. Napríklad fínska populácia (dospelí aj stredoškoláci) sa v rôznych prieskumoch finančnej gramotnosti (OECD, 2013, 2016) umiestňuje medzi najlepšími v porovnaní s populáciou z iných európskych krajín. Okrem toho, fínske domácnosti vykazujú intenzívnu interakciu s finančnými trhmi, keďže takmer 39 % domácností má vo svojich portfóliách rizikové finančné aktíva (Bover a iní, 2016).

[8] Bližšie detaily o použitej metodológii sú dostupné v Cupak a iní (2021b) (podkapitola 2.1).

[9] Viac detailov ohľadom použitej metodológie je prístupných v Cupak a iní (2018) (podkapitola 2.2).

či jednotlivci investujú do sofistikovaných aktív (akcie, dlhopisy), tak je nutné použiť alternatívnu B-O dekompozičnú metódu, ktorú navrhol Fairlie (2005). Rozdiely medzi mužmi (M) a ženami (W) v držaní aktív pomocou dekompozičnej metódy môžeme zapísať nasledovne:

$$Pr\left(Y^M = 1|X^M\right) - Pr\left(Y^W = 1|X^W\right) = \underbrace{\left[\overline{\Lambda X^M \beta^M} - \overline{\Lambda X^W \beta^M}\right]}_{\text{rozdiely v charakteristikách}} + \underbrace{\left[\overline{\Lambda X^M \beta^M} - \overline{\Lambda X^M \beta^W}\right]}_{\text{rozdiely v parametroch}}, \tag{15}$$

kde X^M a X^W predstavujú skupinu kontrolných premenných pre mužov a ženy spolu s vektormi koeficientov (β^M a β^W) odhadnutých osobitne pre obe skupiny. Λ je distribučná funkcia logistického rozdelenia. V našom cvičení nás zaujíma najmä príspevok jednotlivých charakteristík vysvetľujúcich "rozdiel v charakteristikách".[10]

Odhad vplyvu finančnej gramotnosti na dôchodkové sporenie pomocou regresnej analýzy. Vzťah medzi finančnou gramotnosťou a sklonom k sporeniu na dôchodok v súkromných dôchodkových schémach (3. dôchodkový pilier) na Slovensku odhadujeme pomocou základného lineárneho pravdepodobnostného modelu, pričom kontrolujeme pre dôležitosť veľkého počtu socio-demografických a ekonomických faktorov:

$$Pr(Y_i = 1|x) = \beta_0 + \beta_1 \cdot FL_i + \beta_2 \cdot X_i + u_i, \tag{16}$$

kde Y_i je závislá umelá premenná rovnajúca sa 1, ak si i-ta jednotlivá domácnosť dobrovoľne sporí na dôchodok, FL_i je úroveň finančnej gramotnosti meraná počtom správnych odpovedí alebo umelou premennou, ak boli všetky otázky zodpovedané správne, X_i je súbor kontrolných premenných ovplyvňujúcich finančné rozhodovanie jednotlivca, ako je príjem, pohlavie, vzdelanie, vek, zamestnanecký status, postoj k riziku, vlastnenie detí, ako aj regionálne umelé premenné a u_i je náhodný poruchový člen.

Navyše, nakoľko predchádzajúca teoretická aj empirická literatúra (napr. Jappelli a Padula, 2013; Lusardi a Mitchell, 2014; Deuflhard a iní, 2019) identifikovala finančnú gramotnosť ako možnú endogénnu premennú[11], aplikujeme dvoj-krokovú metódu najmenších štvorcov (Two-Stage Least-Squares, 2SLS) použitím tzv. inštrumentálnych premenných na ošetrenie tohto problému.

V našom prípade používame inštrumentálne premenné na identifikovanie možného kauzálneho vplyvu finančnej gramotnosti na dôchodkové sporenie. Vo všeobecnosti, inštrumentálna premenná by mala súvisieť iba s endogénnou premennou (finančná gramotnosť v našom prípade) a nemala by ovplyvňovať závislú premennú nijakým

[10] Bližšie detaily o použitej metodológii sú dostupné v Cupak a iní (2021a) (podkapitola 2.3).

[11] Viac detailov o možnej endogenite finančnej gramotnosti, jej dôvodov a dôsledkov pre odhadnuté regresné koeficienty je dostupných v prílohe A.

iným kanálom. V praxi je veľmi náročné nájsť takéto informácie, avšak HFCS dáta obsahujú aj tzv. paradátovú časť (ktorú vypĺňajú skúsení opytovatelia). Z tejto časti využívame dve premenné (schopnosť respondentov prerátať slovenské koruny na eurá a schopnosť porozumieť otázkam v dotazníku). Predpokladáme, že respondenti, ktorí majú lepšie tieto schopnosti, budú mať aj lepšiu schopnosť správne zodpovedať otázky o finančnej gramotnosti, avšak tieto inštrumentálne premenné nemajú mať prečo súvis s našou závislou premennou. Toto dáva predpoklad pre zvolené inštrumenty byť validné. Táto hypotéza navyše súvisí so zisteniami od Crossley a iní (2021), ktorí poukázali na nižšiu chybovosť respondentov v ich odpovedaní na otázky finančnej gramotnosti v prítomnosti opytovateľov.

Formálne vieme 2SLS ekonometrický model zapísať nasledovne:

$$FL_i = \pi_0 + \pi_1 Z_i + \pi_2 X_i + v_i \tag{17}$$

a

$$Y_i = \beta_0 + \beta_1 \widehat{FL_i} + \beta_2 X_i + u_i, \tag{18}$$

kde Fl_i je úroveň meranej finančnej gramotnosti domácností (reprezentovaných referenčnou osobou), ktorá je modelovaná v prvom kroku na základe exogénnych inštrumentálnych premenných (Z_i) a kontrolných premenných (X_i). Y_i je závislá premenná (participácia domácností na dobrovoľnom dôchodkovom sporení), ktorá je modelovaná v druhom kroku na základe predikovanej úrovne finančnej gramotnosti $\widehat{FL_i}$ a kontrolných premenných X_i. Náhodné poruchové členy jednotlivých regresií sú dané v_i a u_i.[12]

Odhad vplyvu finančnej gramotnosti na investovanie do rizikových aktív pomocou regresnej analýzy a kvantilových regresií. Empirická stratégia v tejto časti je motivovaná štandardnými teóriami výberu portfólia domácností (pozri Guiso a iní, 2002). Domácnosť čelí dvojstupňovému rozhodovaniu: binárnemu rozhodnutiu o účasti na finančných trhoch a rozhodnutiu o alokácii podielu majetku do určitej skupiny finančných aktív. Tieto dve rozhodnutia modelujeme so zameraním na finančnú gramotnosť a dôveru investorov pomocou niekoľkých ekonometrických techník. Na posúdenie relatívneho významu finančnej gramotnosti a dôvery investorov na investovanie do akcií / dlhopisov používame štandardné regresné modely, ako aj nepodmienené kvantilové regresie. Okrem toho sa zaoberáme potenciálnou endogenitou pomocou inštrumentálnych premenných.

V našom základnom modeli odhadujeme vzťah medzi pravdepodobnosťou účasti na

[12] Viac detailov ohľadom použitej metodológie je prístupných v Cupak a iní (2019) (podkapitola 2.4).

akciových/dlhopisových trhoch a finančnou gramotnosťou a mierami dôvery investorov (pričom kontrolujeme pre dôležitosť ostatných charakteristík domácností) pomocou lineárneho pravdepodobnostného modelu, ktorý má tento všeobecný tvar:

$$Pr(Y_i^k = 1|x) = \delta_0 + \delta_1 \cdot FL_i + \delta_2 \cdot Conf1_i + \delta_3 \cdot Conf2_i + \vartheta \cdot X_i + \eta_i, \tag{19}$$

kde Y_i^k označuje účasť i-tej domácnosti v k-tej triede aktív (akcie, dlhopisy), FL_i je úroveň meranej finančnej gramotnosti a $Conf1_i$ a $Conf2_i$ predstavujú sebadôveru domácností vo vlastné finančné schopnosti a dôveru v ekonomiku. X_i zahŕňa veľký súbor kontrolných premenných, ktoré sa zvyčajne používajú na modelovanie finančného správania domácností, ako sú vzdelanie, pohlavie, vek, etnicita, zamestnanecký status, príjem, majetok, vlastníctvo blízkych podnikov, dedičstvo, tolerancia voči riziku, veľkosť domácnosti, počet detí, atď. a η_i je náhodný poruchový člen. Finančnú gramotnosť, sebadôveru investorov a dôveru v ekonomiku analyzujeme najprv po jednom a potom vo vzájomnej interakcii. Nakoniec odhadneme úplnú špecifikáciu vrátane všetkých členov.

Pre tie domácnosti, ktoré vlastnia akcie a/alebo dlhopisy, modelujeme vzťah medzi podielom finančného majetku investovaného do daného typu aktív a vysvetľujúcimi premennými pomocou nasledujúceho lineárneho regresného modelu:

$$S_i^k = \beta_0 + \beta_1 \cdot FL_i + \beta_2 \cdot Conf1_i + \beta_3 \cdot Conf2_i + \theta \cdot X_i + \varepsilon_i, \tag{20}$$

kde S_i^k predstavuje podiel finančného bohatstva, ktoré i-ta domácnosť alokuje do k-tej triedy aktív. Zápis premenných na pravej strane zostáva rovnaký ako v predchádzajúcom modeli, okrem nového súboru koeficientov, ktoré sa majú odhadnúť a náhodného poruchového člena ε_i. Opäť analyzujeme finančnú gramotnosť, sebadôveru investorov a dôveru v ekonomiku najprv po jednom a potom vo vzájomnej kombinácii.

Ďalej odhadujeme vplyv determinantov v rôznych častiach distribúcie našej závislej premennej, S_i^k. Pre tieto účely využívame nepodmienené kvantilové regresie (Unconditional Quantile Regressions, UQR), ktoré navrhli Firpo a iní (2009) a ktoré sú založené na koncepte RIF (Recentered Influence Functions). Tento rámec má oproti štandardným podmieneným kvantilovým regresiám niekoľko výhod a je atraktívnym nástrojom pre výskumníkov skúmajúcich distribučné vplyvy. Všeobecný odhad UQR možno zapísať nasledovne:

$$RIF(S^k, \tau) = X\beta^{UQR} + \epsilon. \tag{21}$$

Kvantilové regresie odhadujeme pre τ (časť distribúcie závislej premennej) nadobúdajúce hodnoty od 0,1 do 0,9.

Podobne, ako v prípade analýzy o finančnej gramotnosti a dôchodkovom sporení

(rovnice 17 a 18), aj v tomto prípade uvažujeme o finančnej gramotnosti ako o možnej endogénnej premennej (z dôvodu chybovosti jej merania, viď príloha A) a aplikujeme 2SLS s inštrumentálnymi premennými na odstránenie skreslení z dôvodu endogenity. V prípade SCF dát taktiež uvažujeme o viacerých inštrumentálnych premenných, ktoré by dokázali izolovať kauzálny efekt finančnej gramotnosti a finančného sebavedomia na investičné rozhodnutia domácností. SCF mikrodáta obsahujú informácie o vzdelaní rodičov respondentov, ktoré v súlade s prechádzajúcou literatúrou (Behrman a iní, 2012; Ćumurović a Hyll, 2019) využívame ako inštrumenty. Okrem toho taktiež využívame informácie z paradát zisťovania (frekvencia využívania dokumentov na zodpovedanie finančných otázok) na zostrojenie tretieho inštrumentu. V tomto prípade taktiež predpokladáme, že tieto inštrumenty plnia podmienku exogenity a sú v našom kontexte validné.[13]

[13] Viac detailov ohľadom použitej metodológie je prístupných v Cupak a iní (2022) (podkapitola 2.5).

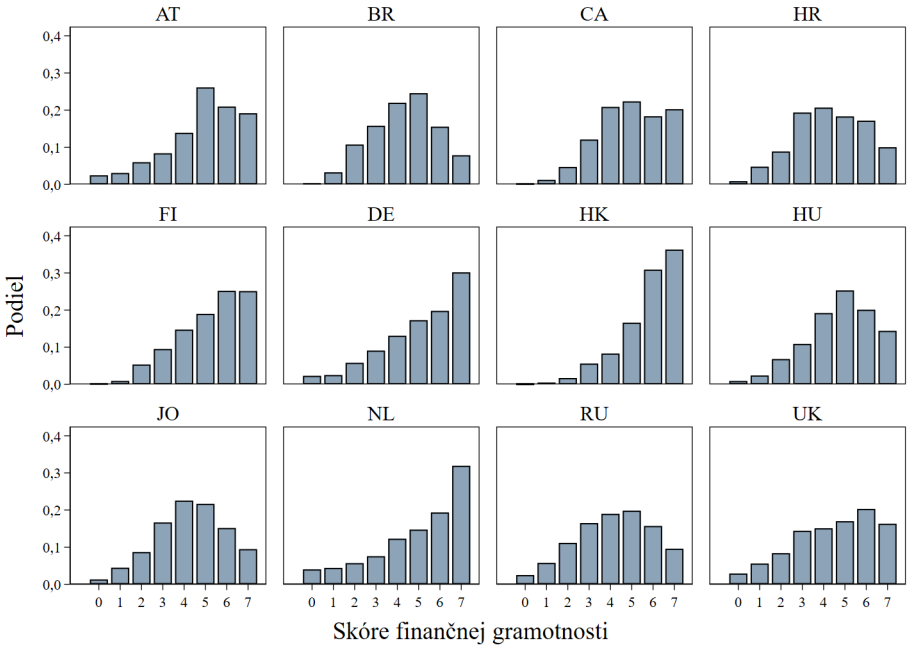
1.5 Výsledky

V tejto časti habilitačnej práce prezentujeme hlavné empirické zistenia z publikovaných článkov (viď podkapitoly 2.1 až 2.5). Hlavný dôraz je kladený na vysvetlenie medzier vo finančnej gramotnosti naprieč krajinami, identifikovanie zraniteľných skupín obyvateľstva s nízkym finančným povedomím a taktiež na skúmanie vplyvov finančných znalostí na ekonomické a finančné rozhodnutia ako plánovanie a sporenie na dôchodok alebo investovanie do finančných nástrojov, akými sú akcie alebo dlhopisy.

1.5.1 Rozdiely vo finančnej gramotnosti

Finančná gramotnosť naprieč krajinami. Obrázok 4 znázorňuje distribúciu skóre finančnej gramotnosti v analyzovaných krajinách. Takmer vo všetkých krajinách dokáže väčšina jednotlivcov správne odpovedať na 5 alebo viac otázok, pričom v niektorých krajinách je toto rozdelenie viac zošikmené ako v iných. Navyše, skóre finančnej gramotnosti sa líši podľa socio-demografických charakteristík jednotlivcov. Vo všetkých krajinách dosahujú muži v priemere vyššie skóre finančnej gramotnosti ako ženy. Vyššie vzdelanie ide ruka v ruke s lepšími výsledkami finančnej gramotnosti. Zdá sa, že finančná gramotnosť sa s vekom spočiatku zvyšuje a u starších ľudí opäť klesá. Pokiaľ ide o zamestnanosť, vo väčšine krajín dosahujú zamestnaní a samostatne zárobkovo činné osoby v priemere vyššiu finančnú gramotnosť.[14]

Obr. 4: Distribúcia skóre finančnej gramotnosti naprieč krajinami



Poznámka: Štatistiky sú odhadnuté použitím váh. Horizontálna os zobrazuje skóre finančnej gramotnosti (od 0 po 7) a vertikálna os znázorňuje podiel populácie.
Zdroj: OECD/INFE 2014-2016.

[14] Viac detailných výsledkov je dostupných v Cupak a iní (2021b).

Deskriptívne výsledky, ktoré prinášajú OECD/INFE mikroúdaje sú celkovo v súlade s predchádzajúcou literatúrou. Tieto vzťahy sú informatívne, ale jednoduché korelácie nezohľadňujú význam charakteristík jednotlivcov a krajín. S cieľom zohľadniť tieto faktory sa preto obraciame na komplexnú regresnú analýzu.

V tabuľke 5 sú prezentované odhadnuté výsledky determinantov finančnej gramotnosti. Odhadujeme dve špecifikácie so základnými socio-demografickými charakteristikami ako vysvetľujúcimi premennými: (1) bez fixných efektov krajín, (2) s fixnými efektmi krajín. Taktiež odhadujeme dva ďalšie rozšírené modely (3) a (4), v ktorých zohľadňujeme dôležitosť skúseností s financiami ako dodatočným faktorom ovplyvňujúcim finančnú gramotnosť.

Tabuľka 5: Odhad determinantov finančnej gramotnosti

	(1)	(2)	(3)	(4)
Príjem (aspoň na 3 mesiace)	0,594***	0,433***	0,465***	0,321***
	(0,033)	(0,035)	(0,036)	(0,037)
Pohlavie (žena)	-0,456***	-0,468***	-0,410***	-0,432***
	(0,032)	(0,031)	(0,033)	(0,032)
Single	-0,077*	-0,120***	-0,036	-0,098**
	(0,043)	(0,043)	(0,045)	(0,045)
Univerzitné vzdelanie	0,569***	0,686***	0,483***	0,607***
	(0,034)	(0,035)	(0,035)	(0,036)
Vek (18-29)	-0,107	-0,065	-0,191**	-0,091
	(0,081)	(0,080)	(0,084)	(0,083)
Vek (30-49)	0,124	0,113	-0,015	0,027
	(0,076)	(0,076)	(0,080)	(0,079)
Vek (50-69)	0,268***	0,265***	0,103	0.136**
	(0,065)	(0,064)	(0,068)	(0.067)
Zamestnaný	0,167***	0,204***	0,090*	0.113***
	(0,046)	(0,045)	(0,046)	(0.046)
SZČO	-0,002	0,154***	-0,109*	0.055
	(0,059)	(0,061)	(0,060)	(0.062)
Dôchodca	-0,126**	-0,062	-0,183***	-0,120*
	(0,064)	(0,064)	(0,066)	(0,066)
Drží rozpočet			-0,059*	-0,009
			(0,033)	(0,034)
Aktívne sporí			0,070*	0,064**
			(0,036)	(0,037)
Finančné plánovanie			0,190***	0,147***
			(0,034)	(0,034)
Drží rizikové aktíva			0,375***	0,270***
			(0,040)	(0,042)
Fixné efekty pre krajiny	Nie	Áno	Nie	Áno
Korigované R^2	0,097	0,144	0,103	0,146
N	12 298	12 298	10 810	10 810

Poznámka: V zátvorkách sú uvedené robustné štandardné chyby. Regresie sú odhadnuté použitím váh. Umelé premenné pre vekovú kategóriu (70+), nepracujúcich a Fínsko sú referenčné kategórie. $^{*}p < 0,10$; $^{**}p < 0,05$; $^{***}p < 0,01$.
Zdroj: OECD/INFE 2014-2016.

Výsledky odhadnutých vplyvov individuálnych charakteristík na finančnú gramotnosť sú robustné po pridaní fixných efektov krajín. Umelá premenná pre dostatočný príjem (aspoň na 3 mesiace) pozitívne súvisí s finančnou gramotnosťou s efektom (v závislosti od špecifikácie) približne o 0,3-0,6 bodov viac pre jednotlivcov s dostatočným príjmom. Rozdiel medzi pohlaviami, ktorý sa bežne vyskytuje v literatúre, je jasne viditeľný aj na základe odhadnutých regresií. Ženy dosahujú v priemere približne o 0,4-0,5

bodov horšie skóre ako muži. Aj slobodní jednotlivci majú tendenciu dosahovať o niečo nižšie skóre. Jednotlivci s vysokoškolským vzdelaním dosahujú približne o 0,5-0,7 bodov lepšie skóre, v závislosti od špecifikácie. Vzťah medzi vekom a finančnou gramotnosťou nadobúda tvar obráteného U: najnižšia veková kategória (18-29) dosahuje nižšie skóre ako tá najstaršia, pričom veková kategória od 50 do 69 rokov dosahuje ešte vyššie skóre ako referenčná kategória (70+). Zatiaľ čo zamestnaní dosahujú výrazne vyššie výsledky ako nepracujúci, v prípade samostatne zárobkovo činných osôb a dôchodcov je to menej zreteľné.

Pridaním premenných, ktoré zachytávajú skúsenosti s financiami, sa mierne zlepšuje vypovedacia schopnosť odhadnutých regresných modelov (modely 3 a 4). Po prvé, pokiaľ ide o rozpočet: táto umelá premenná určuje, či je jednotlivec v domácnosti zodpovedný za rozpočet. Zaujímavé však je, že súvisí s mierne nižšou finančnou gramotnosťou (hoci nie je významná v špecifikácii s fixnými efektmi krajín). Mohlo by to mať dva dôvody. Buď majú jednotlivci s nízkymi príjmami a nízkym vzdelaním vyššiu pravdepodobnosť, že budú mať rozpočet, pretože vykonávajú viac hotovostných transakcií. Alebo je za rozpočet domácnosti zvyčajne zodpovedná najmenej finančne gramotná osoba v domácnosti. To by bolo znepokojujúce, pretože by to viedlo k menej efektívnemu alokovaniu rodinných financií. Po druhé, všetky ostatné premenné týkajúce sa skúseností sú spojené s vyššou finančnou gramotnosťou. Aktívne sporenie pozitívne prispieva k finančnej gramotnosti, s efektom o hodnote necelého 0,1 bodu. Držba rizikových finančných aktív a finančné plánovanie majú ekonomicky významné vplyvy o hodnote 0,2 (finančné plánovanie) a 0,3-0,4 (držba rizikových aktív) bodov. Samozrejme, tieto koeficienty by sa nemali interpretovať ako kauzálne efekty, ale skôr ako prediktívne efekty alebo podmienené korelácie. Považujeme za pravdepodobné, že jednotlivci sa učia pred a počas obchodovania s určitými finančnými produktmi a tým zvyšujú svoje finančné znalosti, čo vyplýva aj z teoretického modelu od Jappelli a Padula (2013).

V našom empirickom skúmaní medzier vo finančnej gramotnosti taktiež používame Blinder-Oaxaca (B-O) dekompozíciu, kde skúmame, či základné socio-demografické charakteristiky jednotlivcov vedia vysvetliť rozdiely vo finančnej gramotnosti naprieč krajinami. Výsledky tejto analýzy sú uvedené v tabuľke 6 (panel A). Ako referenčnú krajinu, ku ktorej porovnávame ostatné krajiny, používame Fínsko. Najväčšie rozdiely vo finančnej gramotnosti (približne 15 % alebo viac) sa pozorujú v Brazílii, Chorvátsku, Jordánsku, Rusku a Spojenom kráľovstve. Pomerne veľké medzery v porovnaní s Fínskom vykazuje aj Maďarsko (takmer 10 %). Rakúsko, Nemecko a Kanada stále vykazujú rozdiely na úrovni 5-6 %, zatiaľ čo Holandsko takmer nevykazuje relevantné odchýlky. Hongkong (ako jediná krajina v našej vzorke) prevyšuje priemernú finančnú gramotnosť Fínska.

Tabuľka 6: Výsledky B-O dekompozičnej analýzy

	AT	BR	CA	HR	DE	HK	HU	JO	NL	RU	UK
Panel A: Dekompozícia so základnými X premennými											
I. Odhadnuté rozdiely											
Referenčná skupina (FI)	5,222***	5,222***	5,222***	5,222***	5,222***	5,222***	5,222***	5,222***	5,222***	5,222***	5,222***
	(0,056)	(0,056)	(0,056)	(0,056)	(0,056)	(0,056)	(0,056)	(0,056)	(0,056)	(0,056)	(0,056)
Porovnávaná krajina	4,908***	4,510***	4,968***	4,348***	4,951***	5,773***	4,743***	4,483***	5,221***	4,430***	4,340***
	(0,044)	(0,045)	(0,044)	(0,054)	(0,066)	(0,040)	(0,052)	(0,048)	(0,061)	(0,054)	(0,061)
Rozdiel	0,314***	0,712***	0,254***	0,874***	0,271***	-0,551***	0,479***	0,740***	0,002	0,792***	0,883***
	(0,071)	(0,071)	(0,071)	(0,077)	(0,086)	(0,069)	(0,076)	(0,073)	(0,082)	(0,077)	(0,082)
Rozdiel (%)	6,20	14,63	4,99	18,26	5,33	-10,01	9,62	15,25	0,03	16,41	18,46
II. Dekompozícia											
Vysvetlená časť	0,160***	0,154**	-0,265***	0,188***	-0,004	-0,084	0,189***	-0,248***	-0,202***	0,166***	-0,061
	(0,039)	(0,069)	(0,057)	(0,052)	(0,042)	(0,063)	(0,056)	(0,080)	(0,060)	(0,057)	(0,051)
Nevysvetlená časť	0,154*	0,558***	0,519***	0,686***	0,275***	-0,467***	0,290***	0,987***	0,204**	0,626***	0,944***
	(0,080)	(0,092)	(0,084)	(0,091)	(0,092)	(0,090)	(0,093)	(0,108)	(0.097)	(0,098)	(0,092)
Počet pozorovaní (FI)	1 131	1 131	1 131	1 131	1 131	1 131	1 131	1 131	1 131	1 131	1 131
Počet pozorovaní (krajina c)	1 737	1 158	952	950	915	970	914	858	853	962	898
Panel B: Dekompozícia s rozšíreným súborom X premenných											
I. Odhadnuté rozdiely											
Referenčná skupina (FI)	5,235***	5,235***	5,235***	5,235***	5,235***	5,235***	5,235***	5,235***	5,235***	5,235***	5,235***
	(0,054)	(0,054)	(0,054)	(0,054)	(0,054)	(0,054)	(0,054)	(0,054)	(0,054)	(0,054)	(0,054)
Porovnávaná krajina	5,219***	4,510***	5,259***	4,536***	5,238***	5,773***	4,973***	4,603***	5,221***	4,437***	4,616***
	(0,043)	(0,044)	(0,047)	(0,057)	(0,068)	(0,039)	(0,057)	(0,049)	(0,060)	(0,053)	(0,067)
Rozdiel	0,016	0,725***	-0,024	0,699***	-0,003	-0,538***	0,262***	0,632***	0,014	0,798***	0,619***
	(0,069)	(0,070)	(0,072)	(0,079)	(0,087)	(0,067)	(0,079)	(0,073)	(0,081)	(0,076)	(0,086)
Rozdiel (%)	0,31	14,87	-0,46	14,30	-0,05	-9,77	5,14	12,84	0,27	16,51	12,56
II. Dekompozícia											
Vysvetlená časť	0,130**	0,274***	-0,428***	0,152**	-0,089	-0,197***	0,257***	-0,222***	-0,188**	0,231***	-0,179***
	(0,062)	(0,082)	(0,062)	(0,063)	(0,056)	(0,062)	(0,074)	(0,079)	(0,074)	(0,064)	(0,065)
Nevysvetlená časť	-0,114	0,450***	0,404***	0,547***	0,086	-0,341***	0,005	0,853***	0,202*	0,568***	0,798***
	(0,094)	(0,100)	(0,085)	(0,096)	(0,100)	(0,086)	(0,104)	(0,107)	(0,105)	(0,101)	(0,102)
N (FI)	1 113	1 113	1 113	1 113	1 113	1 113	1 113	1 113	1 113	1 113	1 113
N (krajina c)	1 344	1 158	719	802	759	970	699	774	853	946	673

Poznámka: Robustné štandardné chyby sú uvedené v zátvorkách. Dekompozícia pomocou váh zisťovania. Dekompozície v paneli A zohľadňujú základné vysvetľujúce premenné ako príjem, pohlavie, rodinný status, vzdelanie a zamestnanecký status. Okrem základných socio-demografických charakteristík sa v paneli B zohľadňujú aj premenné, ktoré zachytávajú skúsenosti s financiami (t.j. jednotlivec má rozpočet, má sporiace produkty, drží rizikové finančné aktíva a zapája sa do finančného plánovania). $^{*}p < 0,10$; $^{**}p < 0,05$; $^{***}p < 0,01$.

Zdroj: OECD/INFE 2014-2016.

Výsledky z dekompozícií ďalej naznačujú, že v niektorých krajinách rozdiely v pozorovaných charakteristikách jednotlivcov v porovnaní s Fínskom tento rozdiel výrazne zmierňujú (Kanada, Jordánsko a Holandsko), zatiaľ čo v iných krajinách je rozdiel výrazne väčší v dôsledku rozdielov v individuálnych charakteristikách (Rakúsko, Brazília, Chorvátsko, Maďarsko a Rusko). To znamená, že ak sa odfiltrujú rozdiely spôsobené rozdielmi v podiele charakteristík v populácii a berú sa do úvahy len rozdiely v rámci charakteristík, rozdiel sa o túto sumu zníži. Rovnakým spôsobom sa rozdiel zväčšuje v prípade krajín, kde charakteristiky tlmia nepodmienené pozorované rozdiely. V Nemecku sa časť nižšieho skóre vysvetlená týmito individuálnymi charakteristikami významne nelíši od Fínska, zatiaľ čo individuálne charakteristiky významne nevysvetľujú časť vyššieho skóre v Hongkongu.

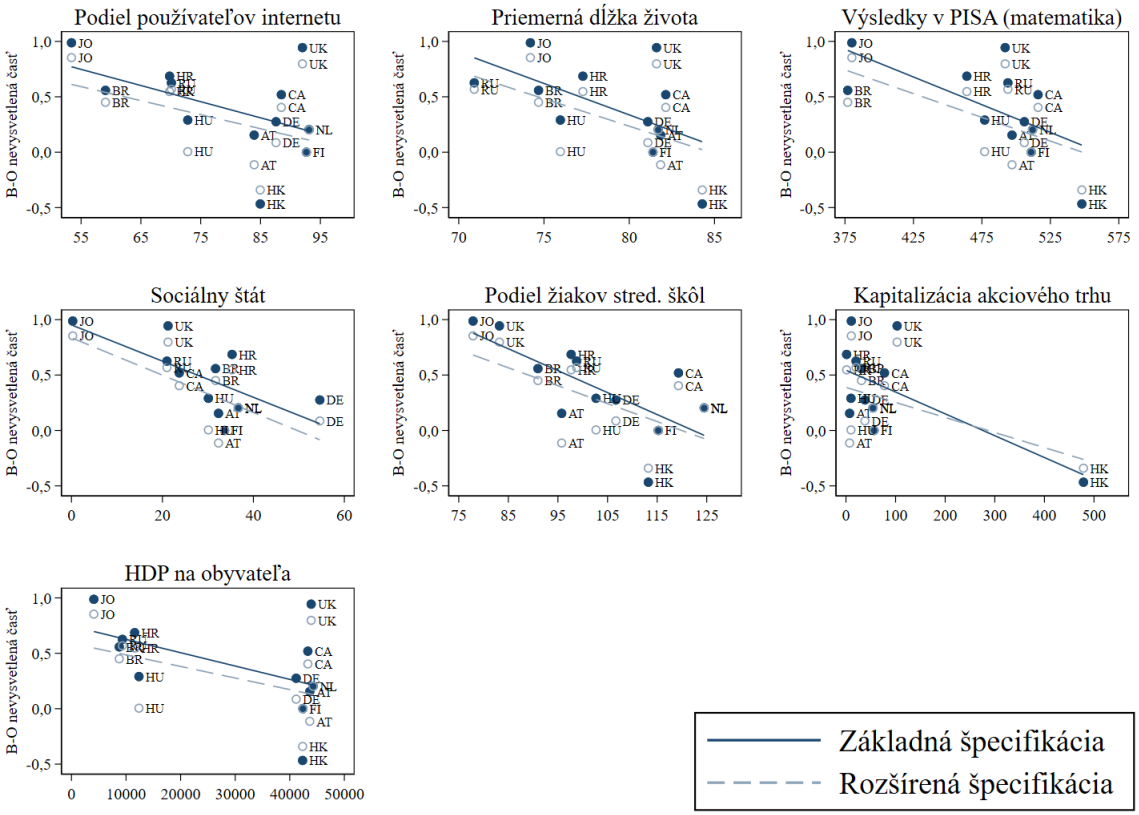
V rámci dekompozičnej analýzy taktiež skúmame, do akej miery môže učenie sa praxou, ktoré zachytávame na základe skúseností s financiami, ďalej vysvetliť pozorované rozdiely vo finančnej gramotnosti medzi krajinami. Výsledky tejto časti sú taktiež zhrnuté v tabuľke 6 (panel B). V Kanade, Hongkongu, Jordánsku, Holandsku a Spojenom kráľovstve individuálne charakteristiky a skúsenosti stále výrazne tlmia pozorované rozdiely, zatiaľ čo v prípade Rakúska, Brazílie, Chorvátska, Maďarska a Ruska sa rozdiely zdajú byť ešte väčšie. Po zohľadnení skúseností sa rozdiel odstráni v prípade Rakúska, Nemecka a takmer sa odstráni v prípade Maďarska. Výrazne sa znižuje aj v prípade Brazílie a Ruska, zatiaľ čo v prípade Chorvátska zostáva takmer rovnaký. Kanada sa ešte viac vzďaľuje, čo znamená, že pri porovnaní jednotlivcov s podobnými skúsenosťami a charakteristikami v Kanade a Fínsku je rozdiel v rámci skupiny voči Fínsku ešte väčší. To isté, ale v menšej miere platí aj pre Spojené kráľovstvo. Holandsko a Jordánsko sa takmer nezmenili. Napokon v Hongkongu sa približne tretina rozdielu dá vysvetliť skúsenosťami.

Po vzore od Christelis a iní (2013) si taktiež kladieme otázku, do akej miery môžu byť medzery vo finančnej gramotnosti ďalej vysvetlené inými ako individuálnymi charakteristikami, ktoré sme už priamo zohľadnili v dekompozičnej analýze. Výsledky tejto analýzy sú prezentované na obrázku 5. Ako už bolo spomenuté v časti o metodológii, zaujímajú nás inštitucionálne charakteristiky krajín, ktoré môžu ovplyvniť finančnú gramotnosť. Ako je možné vidieť na obrázku 5, medzery vo finančnej gramotnosti (časť, ktorá nie je vysvetlená rozdielmi v charakteristikách jednotlivcov, resp. rozdiely v parametroch) majú tendenciu sa znižovať v závislosti od podielu žiakov stredných škôl, výsledkov PISA testovaní, či rozvinutosťou finančných trhov.

Je však treba zdôrazniť, že tento typ analýzy je nanajvýš deskriptívny a výsledky sa nedajú interpretovať ako kauzálne. I napriek tomu je zrejmé, že treba brať do úvahy či už individuálne charakteristiky jednotlivcov, ale aj prostredia v ktorom žijú pre

komplexné vyhodnotenie rozdielov vo finančnej gramotnosti naprieč krajinami.

Obr. 5: Nevysvetlená časť medzier finančnej gramotnosti z B-O dekompozície v porovnaní s vybranými makroekonomickými ukazovateľmi



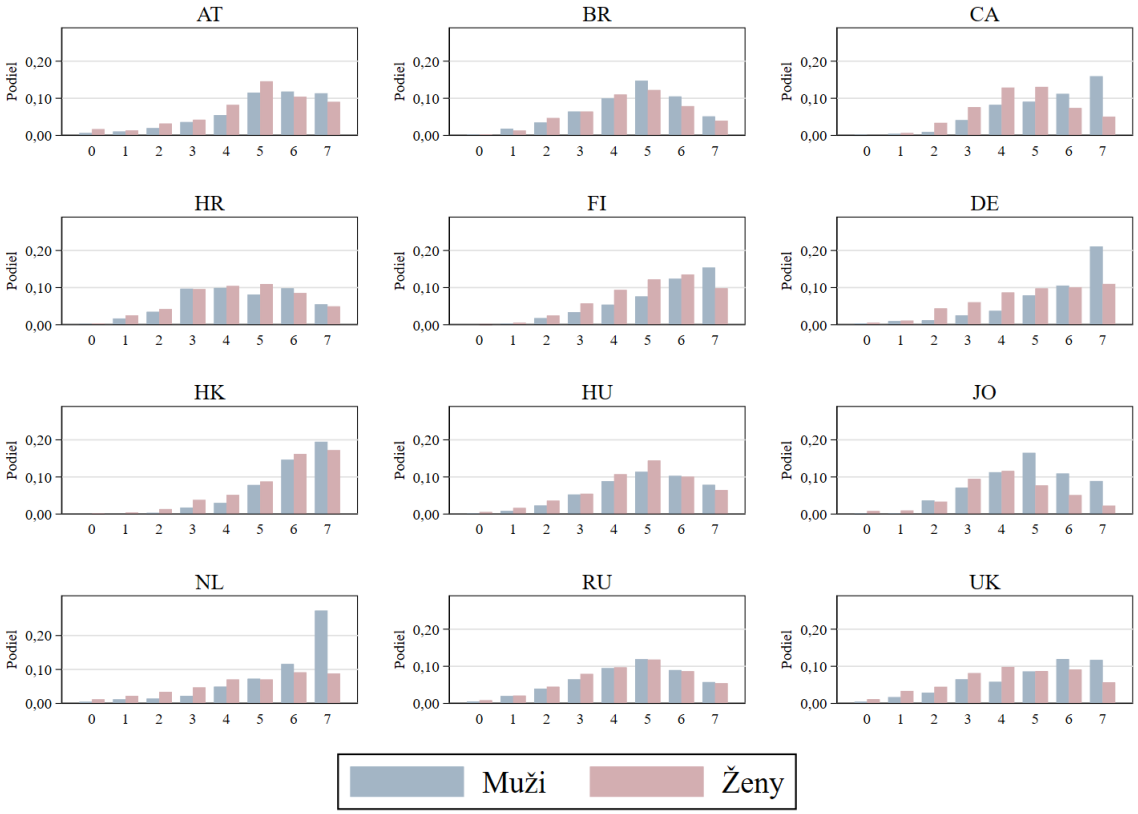
Poznámka: Dekompozície v základnej špecifikácii zohľadňujú základné vysvetľujúce premenné ako príjem, pohlavie, rodinný status, vzdelanie a zamestnanecký status. Dekompozície v rozšírenej špecifikácii okrem základných socio-demografických charakteristík zohľadňujú aj premenné, ktoré zachytávajú skúsenosti s financiami (t.j. jednotlivec má rozpočet, má sporiace produkty, drží rizikové finančné aktíva a zapája sa do finančného plánovania).
Zdroj: OECD/INFE 2014-2016; Svetová banka.

Rodové rozdiely vo finančnej gramotnosti, sebavedomí a ich vplyv na držbu aktív. Nakoľko predchádzajúca deskriptívna analýza odhalila robustný výsledok nižšej finančnej gramotnosti žien v porovnaní s mužskou populáciou, v tejto časti sa zameriame na odhalenie možných príčin a aj dôsledkov rodových medzier vo finančnej gramotnosti. Okrem samotnej objektívnej finančnej gramotnosti (meranej pomocou testových otázok na škále od 0 do 7) skúmame aj finančné sebavedomie, ktoré je merané pomocou sebahodnotenia finančných znalostí (na škále od 1 do 5).

Rozdelenie skóre finančnej gramotnosti podľa pohlavia v jednotlivých krajinách je znázornené na obrázku 6. Vo väčšine krajín je jasne viditeľná medzera vo finančnej gramotnosti medzi mužmi a ženami, najmä v pravej časti distribúcie skóre. Tieto medzery sa taktiež dajú dekomponovať na časť vysvetlenú rozdielmi v charakteristikách medzi mužmi a ženami a nevysvetlenú časť. Výsledky tejto B-O dekompozičnej analýzy

(výsledky tu nie sú prezentované, avšak sú dostupné v Cupak a iní, 2018) naznačujú, že medzera sa dá vysvetliť iba do malej miery rozdielnymi charakteristikami medzi mužmi a ženami, čo otvára otázku o dôležitosti iných, nepozorovaných determinantoch ako napríklad sociálnych a spoločenských normách, ktoré môžu ovplyvňovať úroveň finančnej gramotnosti u žien. Zaujímavosťou je, že viac vyspelé krajiny (merané pomocou HDP na obyvateľa) vykazujú väčšie relatívne rodové medzery vo finančnej gramotnosti ako tie post-socialistické krajiny.

Obr. 6: Rodové rozdiely vo finančnej gramotnosti naprieč krajinami



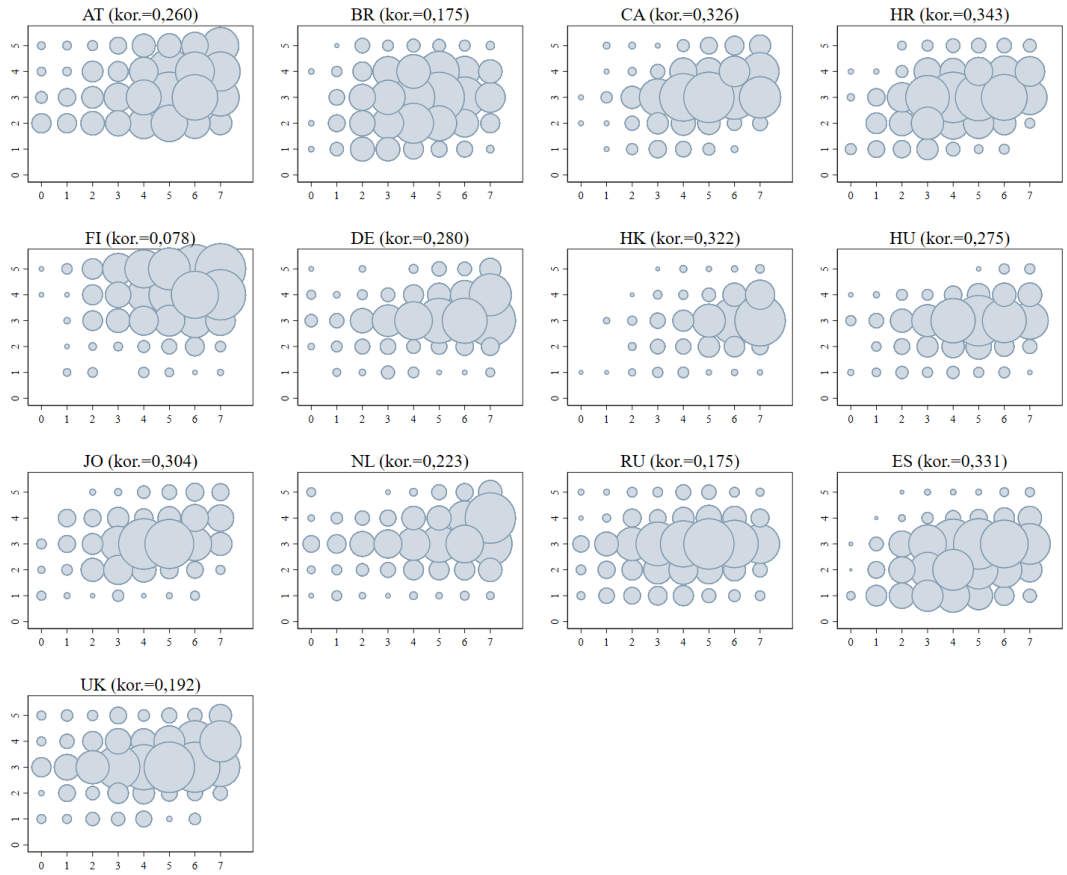
Poznámka: Horizontálna os zobrazuje skóre finančej gramotnosti (od 0 po 7) a vertikálna os znázorňuje podiel populácie.
Zdroj: OECD/INFE 2014-2016.

Literatúra navyše naznačuje, že ženy vykazujú nielen systematicky nižšiu finančnú gramotnosť v porovnaní s mužmi, ale aj nižšie sebavedomie vo vlastné finančné schopnosti (napr. Bannier a Schwarz, 2018). Zároveň táto literatúra konštatuje, že finančné sebavedomie je taktiež dôležitým faktorom, ktorý ovplyvňuje finančné správanie jednotlivcov a domácností.

OECD/INFE mikroúdaje poskytujú unikátnu príležitosť skúmať spoločné rozdelenie objektívnej finančnej gramotnosti a taktiež subjektívneho hodnotenia vlastných finančných schopností (finančné sebavedomie). Môže sa zdať, že obe tieto miery merajú rovnakú stránku mince, avšak pohľad na obrázok 7 naznačuje, že tieto dva ukazova-

tele vykazujú iba miernu koreláciu, čo dáva opodstatnenie analyzovať oba tieto faktory spoločne pre vysvetlenie rodových rozdielov vo finančnom správaní.

Obr. 7: Spoločné rozdelenie skóre finančnej gramotnosti a finančného sebavedomia



Poznámka: Tento graf znázorňuje spoločné rozdelenie dôvery vo vlastné finančné schopnosti (skóre 0 až 5 na osi y) a finančnej gramotnosti (skóre 0 až 7 na osi x) v jednotlivých krajinách, pričom body sú vážené podľa frekvencie pozorovaní.
Zdroj: OECD/INFE 2014-2016.

V rámci tejto empirickej analýzy taktiež skúmame, ako rozdielne charakteristiky medzi mužmi a ženami vedia vysvetliť rozdiely v držbe sofistikovaných finančných aktív (akcie / dlhopisy). Táto analýza podobne používa B-O dekompozíciu, ktorá je v tomto prípade založená na logistickej regresii, nakoľko závislá premenná je binárneho charakteru.

V tabuľke 7 sú uvedené výsledky dekompozície. Vo väčšine krajín možno aspoň polovicu rozdielu v držbe rizikových finančných aktív (akcií alebo dlhopisov) vysvetliť rozdielmi v pozorovaných charakteristikách. Zatiaľ čo niektoré charakteristiky môžu vysvetliť určitú časť rozdielu (napríklad mať dostatočný príjem a zamestnanie), v mnohých krajinách je úroveň finančného sebavedomia najsilnejším alebo druhým najsilnejším determinantom rodového rozdielu v držbe rizikových aktív. Fínsko a Španielsko sú jediné krajiny, v ktorých rozdiely v meranej finančnej gramotnosti vysvetľujú viac rozdielov v rizikových aktívach ako finančné sebavedomie.

Tabuľka 7: Výsledky Fairlieho dekompozície pre vlastníctvo akcií / dlhopisov podľa pohlavia

	AT	BR	CA	HR	FI	DE	HK	HU	JO	NL	RU	ES	UK
Pravdepodobnosť vlastníctva (muži)	0,149***	0,013***	0,495***	0,145***	0,343***	0,350***	0,565***	0,075***	0,173***	0,163***	0,071***	0,187***	0,423***
Pravdepodobnosť vlastníctva (ženy)	0,095***	0,007***	0,412***	0,110***	0,268***	0,260***	0,460***	0,032***	0,096***	0,047***	0,123***	0,157***	0,348***
Rozdiel v pravdepodobnosti vlastníctva	0,054***	0,006	0,083**	0,034	0,076**	0,090**	0,105***	0,043**	0,076***	0,117***	-0,053***	0,031**	0,075
Vysvetlená časť	0,040***	0,005	0,113***	0,002	0,036*	0,081***	0,069**	0,036***	0,099***	0,090***	-0,009	0,054***	0,068**
Finančné sebavedomie	0,002	-0,000	0,030***	0,005	0,002	0,020**	0,015***	0,014**	0,017*	0,011*	-0,000	0,010***	0,006
	(0,002)	(0,002)	(0,008)	(0,004)	(0,004)	(0,008)	(0,005)	(0,006)	(0,010)	(0,006)	(0,002)	(0,002)	(0,013)
Finančná gramotnosť	0,002	-0,001	0,022	-0,001	0,018*	0,011	0,002	-0,001	-0,001	0,015	-0,000	0,027***	0,026
	(0,002)	(0,002)	(0,019)	(0,002)	(0,009)	(0,018)	(0,008)	(0,003)	(0,006)	(0,010)	(0,001)	(0,004)	(0,020)
Postoj k riziku	0,024***	0,000	0,051***	0,001	0,021***	0,042***	0,001	0,022**	-0,001	0,055***	-0,001	0,006***	0,029**
	(0,005)	(0,001)	(0,012)	(0,002)	(0,008)	(0,010)	(0,002)	(0,009)	(0,004)	(0,010)	(0,004)	(0,002)	(0,012)
Príjem	0,001	0,001	0,008*	0,006	0,008*	0,009*	-0,002	0,014**	0,008**	0,007**	-0,000	0,004***	0,013**
	(0,003)	(0,002)	(0,004)	(0,004)	(0,005)	(0,005)	(0,003)	(0,006)	(0,004)	(0,003)	(0,001)	(0,001)	(0,006)
Single	0,000	0,000	0,001	-0,001	-0,002	-0,000	-0,003	-0,000	-0,001	0,000	-0,001	0,000	-0,001
	(0,001)	(.)	(0,003)	(0,003)	(0,004)	(0,002)	(0,004)	(0,002)	(0,003)	(0,004)	(0,003)	(0,000)	(0,003)
Vek	0,001	0,000	-0,004	0,002	-0,006	-0,002	-0,001	-0,001	0,020**	-0,005	0,010	0,003	-0,001
	(0,003)	(.)	(0,005)	(0,007)	(0,005)	(0,005)	(0,005)	(0,005)	(0,008)	(0,005)	(0,013)	(0,003)	(0,009)
Zamestnanie	0,005	0,002	0,007	-0,006	-0,003	-0,001	0,052*	-0,005	0,056***	0,011*	-0,013	0,008*	-0,005
	(0,003)	(.)	(0,006)	(0,010)	(0,005)	(0,006)	(0,027)	(0,007)	(0,015)	(0,006)	(0,014)	(0,005)	(0,009)
Vzdelanie	0,004*	0,003	-0,001	-0,004	-0,003	0,005	0,005	-0,005	0,000	-0,005	-0,003	-0,004*	0,002
	(0,002)	(0,004)	(0,003)	(0,005)	(0,002)	(0,006)	(0,006)	(0,009)	(0,002)	(0,005)	(0,005)	(0,002)	(0,005)
N (muži)	662	595	370	393	511	366	450	337	463	445	424	2 535	331
N (ženy)	664	547	343	389	586	381	510	355	301	330	438	2 363	319
N	1 326	1 142	713	782	1 097	747	960	692	764	775	862	4,898	650

Poznámka: Štandardné chyby (uvádzané v zátvorkách) sú založené na 500 bootstrapových replikáciách. Dekompozícia pomocou váh zisťovania. $^{*}p < 0,10$; $^{**}p < 0,05$; $^{***}p < 0,01$.
Zdroj: OECD/INFE 2014-2016.

1.5.2 Vplyv finančnej gramotnosti na ekonomické a finančné rozhodovania

V druhej časti nášho empirického skúmania sa snažíme odhaliť vplyv finančnej gramotnosti na niektoré dôležité ekonomické a finančné rozhodnutia jednotlivcov a domácností.

Finančná gramotnosť a sporenie na dôchodok. Teoretická aj empirická literatúra (napr. Lusardi a Mitchell, 2011a; Bucher-Koenen a Lusardi, 2011) naznačuje, že plánovanie a zabezpečenie sa na dôchodok patria medzi jedny z najkomplexnejších rozhodnutí vo finančnom živote jednotlivcov. Preto sa predpokladá, že lepšia orientácia spotrebiteľov vo svete financií im dopomôže v dlhodobom horizonte (nastavením správnych parametrov investičných portfólií) nahromadiť dostatok majetku na zabezpečenie finančného blahobytu na dôchodku.

HFCS mikroúdaje zo Slovenska poskytujú príležitosť overiť túto výskumnú hypotézu, pričom podobný typ analýzy doposiaľ empirická literatúra pre krajiny Strednej a východnej Európy neponúkala. Naše skúmanie sa zameriava na odhad (kauzálneho) vplyvu finančnej gramotnosti – meranej štyrmi základnými otázkami o financiách – na pravdepodobnosť sporenia na dôchodok v treťom dôchodkovom pilieri (bez a s príspevkami zamestnávateľov).

Výsledky regresnej analýzy (obyčajnej OLS aj 2SLS) ohľadom pravdepodobnosti účasti na dôchodkovom sporení sú zobrazené v tabuľke 8. Pokiaľ ide o našu hlavnú premennú záujmu, existuje významný a pozitívny vzťah medzi finančnou gramotnosťou a účasťou na dobrovoľnom dôchodkovom sporení, čo je v súlade so zisteniami predchádzajúcej empirickej literatúry. Odhadnutý efekt jednej dodatočnej správne zodpovedanej otázky finančnej gramotnosti sa pohybuje od 2 do 23 percentuálnych bodov v závislosti od metódy odhadu (OLS / 2SLS) a prítomnosti alebo neprítomnosti príspevkov zamestnávateľov.

Je dôležité vyzdvihnúť výsledok ohľadom zosilnenia odhadnutého efektu finančnej gramotnosti použitím dvoj-krokovej metódy s inštrumentálnymi premennými. Tento výsledok poukazuje na endogenitu finančnej gramotnosti (viď p-hodnota testu exogenity menšia ako hladina významnosti 0,01) z dôvodu chybovosti jej merania (viď príloha A pre diskusiu). Tabuľka 8 prezentuje aj výsledky pre prvý krok, kde sa ukazuje, že naše zvolené inštrumentálne premenné (t.j. schopnosť porozumieť otázkam v zisťovaní a schopnosť previesť slovenské koruny na euro) silne korelujú s endogénnou premennou a teda sú validné.

Výsledky pre ostatné charakteristiky jednotlivcov a domácností sú intuitívne a v súlade s literatúrou: jednotlivci s vyššími príjmami a s univerzitným vzdelaním majú väčšiu pravdepodobnosť dobrovoľne si sporiť na dôchodok.

Zaujímavým výsledkom (viď Cupak a iní, 2019), ktorý vyplýva najmä z konštrukcie slovenského dôchodkového systému je, že zamestnanie za mzdu má význam pre účasť v doplnkovom dôchodkovom sporení podporovanom zamestnávateľom, ale nie pre čisto dobrovoľné sporenie. Politiky motivujú zamestnávateľov, aby podporovali svojich zamestnancov v účasti v treťom pilieri pomocou daňových úľav. Zdá sa, že tento mechanizmus je jedným z účinných nástrojov, ako motivovať jednotlivcov k sporeniu na starobu okrem analyzovanej úrovne finančnej gramotnosti.

Tabuľka 8: OLS a 2SLS odhady účasti v dobrovoľných súkromných dôchodkových schémach

	Bez príspevkov zamestnávateľa				S príspevkami zamestnávateľa			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Finančná gramotnosť	0,056***	0,195**			0,020*	0,228**		
	(0,011)	(0,068)			(0,012)	(0,079)		
Finančná gramotnosť: všetky správne odpovede			0,100***	0,737**			0,042	0,692**
			(0,030)	(0,261)			(0,030)	(0,284)
Inštrumentálne premenné								
Schopnosť prepočítať hodnoty z SK na EUR		0,131***		0,014		0,131***		0,014
Schopnosť porozumieť otázkam v prieskume		0,108**		0,056***		0,108**		0,056***
Kontrolné premenné	Áno	Áno	Áno	Áno	Áno	Áno	Áno	Áno
Regionálne fixné efekty	Áno	Áno	Áno	Áno	Áno	Áno	Áno	Áno
Korigované R^2	0,087		0,080		0,115		0,114	
F štatistika inštrumentov		16,082		8,546		16,082		8,546
Hansenova J štatistika		2,546		0,423		0,066		1,324
P-hodnota Hansenovej J štatistiky		0,111		0,516		0,797		0.250
P-hodnota testu exogenity		0,029		0,003		0,004		0,006
N	1 253	1 253	1 253	1 253	1 253	1 253	1 253	1 253

Poznámka: Robustné štandardné chyby sú uvedené v zátvorkách. Regresie sú odhadnuté použitím váh zisťovania na vzorke domácností, ktoré ešte nie sú v dôchodku. V regresiách sú zohľadnené vplyvy veľkého počtu charakteristík domácností (viď tabuľka 3). $^{*}p < 0,10$; $^{**}p < 0,05$; $^{***}p < 0,01$.
Zdroj: HFCS 2014.

V rámci našej empirickej analýzy skúmame nielen determinanty pravdepodobnosti účasti na doplnkovom dôchodkovom sporení, ale aj veľkosť mesačných príspevkov do dôchodkových fondov. Pre účely tejto analýzy sme pracovali so zoradenou kategorickou premennou, ktorá rozdeľovala distribúciu príspevkov na 4 kategórie: príspevky rovné 0, príspevky v prvom tercile distribúcie, príspevky v druhom tercile distribúcie a príspevky v treťom tercile distribúcie.

Výsledky odhadnutých modelov usporiadanej odozvy (Ordered probit) sú prezentované v tabuľke 9. Kvôli endogenite finančnej gramotnosti odhadujeme nielen obyčajný Ordered probit model, ale aj jeho verziu s inštrumentálnymi premennými, ktoré zostávajú rovnaké ako pri predchádzajúcich odhadoch (t.j. schopnosť porozumieť otázkam v zisťovaní a schopnosť previesť slovenské koruny na euro). Marginálne efekty (vyhodnotené na priemerných hodnotách ostatných premenných) pre jednotlivé kategórie závislej premennej potvrdzujú pozitívnu rolu finančnej gramotnosti aj pre samotné mesačné príspevky do dôchodkových fondov.

Napríklad, v modeloch bez príspevkov zamestnávateľa, dodatočne správne zodpo-

vedaná otázka o finančnej gramotnosti znižuje pravdepodobnosť toho, že domácnosť bude mať nulové mesačné úspory o 5 percentuálnych bodov pri obyčajnej špecifikácii a o 17 percentuálnych bodov pri špecifikácii s inštrumentálnymi premennými. Finančná gramotnosť vplýva pozitívne (takmer vo všetkých špecifikáciách) na pravdepodobnosť pozitívnych príspevkov (prvý, druhý a tretí tercil distribúcie) do súkromných dôchodkových fondov.

Tabuľka 9: Odhady modelov usporiadaných odoziev spolu s inštrumentálnymi premennými – príspevky do súkromných dôchodkových schém

	Bez príspevkov zamestnávateľa				S príspevkami zamestnávateľa			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Oprobit	IV Oprobit	Oprobit	IV Oprobit	Oprobit	IV Oprobit	Oprobit	IV Oprobit
Fin. gramotnosť 1: (kategória 1: $y = 0$)	-0,052***	-0,174***			-0,021*	-0,246***		
Fin. gramotnosť 1: (kategória 2: prvý tercil $\|y > 0$)	0,011***	0,023***			0,006*	-0,054***		
Fin. gramotnosť 1: (kategória 3: druhý tercil $\|y > 0$)	0,015***	0,036***			0,004*	0,077***		
Fin. gramotnosť 1: (kategória 4: tretí tercil $\|y > 0$)	0,026***	0,115**			0,011*	0,222***		
Fin. gramotnosť 2: (kategória 1: $y = 0$)			-0,082***	-0,462***			-0,046*	-0,453***
Fin. gramotnosť 2: (kategória 2: prvý tercil $\|y > 0$)			0,018***	0,048***			0,014*	0,071***
Fin. gramotnosť 2: (kategória 3: druhý tercil $\|y > 0$)			0,024***	0,066***			0,008*	0,038***
Fin. gramotnosť 2: (kategória 4: tretí tercil $\|y > 0$)			0,040***	0,348***			0,024*	0,344***
Kontrolné premenné	Áno	Áno	Áno	Áno	Áno	Áno	Áno	Áno
Regionálne fixné efekty	Áno	Áno	Áno	Áno	Áno	Áno	Áno	Áno
Pseudo R^2	0,090		0,083		0,117		0,117	
N	1 253	1 253	1 253	1 253	1 253	1 253	1 253	1 253

Poznámka: Uvádzané sú marginálne efekty vyhodnotené na priemerných hodnotách ostatných nezávislých premenných. Regresie sú odhadnuté použitím váh zisťovania na vzorke domácností, ktoré ešte nie sú v dôchodku. V regresiách sú zohľadnené vplyvy veľkého počtu charakteristík domácností (viď tabuľka 3). * $p < 0,10$; ** $p < 0,05$; *** $p < 0,01$.
Zdroj: HFCS 2014.

Finančná gramotnosť, sebavedomie a investovanie do finančných aktív. Ako už bolo viackrát spomenuté (napr. Cocco a iní, 2005), ekonomická a finančná teória naznačujú, že neúčasť domácností na trhu s investovaním do vysoko výnosových aktív, akými sú akcie alebo dlhopisy, dokáže v priemere znížiť blahobyt domácností až do výšky 2 % ich celkovej ročnej spotreby. Účasť na trhu s investovaním je celkovo veľmi nízka v európskych krajinách a je o niečo lepšia v USA, kde sa s určitou formou investovania stretáva približne polovica dospelej populácie (viď Cupak a iní, 2022).

Na záver nášho empirického skúmania sa snažíme zistiť, do akej miery vedia finančná gramotnosť a dôvera vo vlastné finančné schopnosti, ale aj dôvera v makroekonomické prostredie krajiny, zvýšiť účasť na akciových trhoch v USA, už spomínanej krajine s dobre fungujúcimi kapitálovými trhmi. SCF mikroúdaje o bohatstve domácností poskytujú možnosť na overenie tejto výskumnej otázky.

V súlade s modelmi o investovaní domácností (Guiso a iní, 2002), v našej empirickej analýze najskôr odhadujeme determinanty pravdepodobnosti vstupu domácnosti na trh s investovaním do sofistikovaných finančných aktív (akcie / dlhopisy) a v druhom kroku analyzujeme, akú veľkú časť svojho portfólia drží v tomto type aktív.

Výsledky hlavných odhadnutých regresií – obyčajnej OLS aj 2SLS s inštrumentál-

nymi premennými na zohľadnenie problému endogenity finančnej gramotnosti a finančného sebavedomia – sú prezentované v tabuľke 10. Hlavný výsledok naznačuje, že aj v prípade amerických domácností, vyššia finančná gramotnosť pozitívne vplýva na vstup domácností na trh s investovaním. Vyššie odhadnuté koeficienty v prípade 2SLS odhadov opäť naznačujú problém endogenity finančnej gramotnosti z dôvodu chybovosti jej merania, čo je bežný problém identifikovaný v literatúre (Lusardi a Mitchell, 2014).

Zaujímavým zistením je, že domácnosti, ktoré majú vyššiu dôveru v rast americkej ekonomiky v horizonte piatich rokov, sú ochotné investovať väčší podiel svojho finančného majetku do akcií, ale tento faktor nezohráva žiadnu úlohu v prípade investovania do dlhopisov, čo môže naznačovať určité dlhodobé finančné plánovanie, nakoľko do akcií je odporúčané investovať na dlhšom investičnom horizonte. Ukazuje sa, že i napriek tomu, že domácnosti nie sú profesionálnymi prognostikmi, ich makroekonomické očakávania významne ovplyvňujú ich ekonomické a finančné rozhodnutia, čo celkovo zapadá do súčasnej literatúry o očakávaniach a dôvere v inštitúcie. Napríklad, Ng a iní (2016) analyzovali 60 krajín a zistili, že dôvera v ekonomické prostredie je pozitívnym faktorom hĺbky a likvidity akciového trhu. Extrapoláciou z makroúrovne na mikroúroveň toto zistenie podporuje myšlienku, že dôvera investorov alebo dôvera v ekonomiku by viedla k väčšej účasti domácností na akciových trhoch.

Tabuľka 10: OLS a 2SLS odhady determinantov vlastníctva akcií a dlhopisov

	Účasť na aktívach				Investovaný podiel			
	Akcie		Dlhopisy		Akcie		Dlhopisy	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Finančná gramotnosť	0,069***		0,016***		0,021**		-0,038***	
	(0,007)		(0,003)		(0,008)		(0,013)	
Finančná gramotnosť (predikovaná)		0,643***		0,167***		0,029		-0,155***
		(0,070)		(0,040)		(0,065)		(0,052)
Finančné sebavedomie	0,006**		0,001		0,005*		-0,000	
	(0,003)		(0,001)		(0,003)		(0,003)	
Finančné sebavedomie (predikované)		0,224*		0,013		-0,005		-0,035
		(0,112)		(0,038)		(0,098)		(0,054)
Dôvera v ekonomiku	-0,011	-0,014	-0,007	-0,000	0,013**	0,016	0,003	0,000
	0,008	0,022	0,004	0,009	0,005	0,018	0,008	0,013
Kontrolné premenné	Áno	Áno	Áno	Áno	Áno	Áno	Áno	Áno
Koeficient determinácie	0,282		0,049		0,052		0.084	
F štatistika inštrumentov (fin. gramotnosť)		22,084		22,084		14,989		3,969
F štatistika inštrumentov (fin. sebavedomia)		3,436		3,436		1,661		1,383
Sargan chí kvadrát test		3,899		0,325		0,622		0,189
P-hodnota Sargan chí kvadrát testu		0,133		0,614		0,521		0,696
P-hodnota testu exogenity		0,000		0,001		0,748		0,110
N	5 776	5 776	5 776	5 776	3 630	3 630	659	659

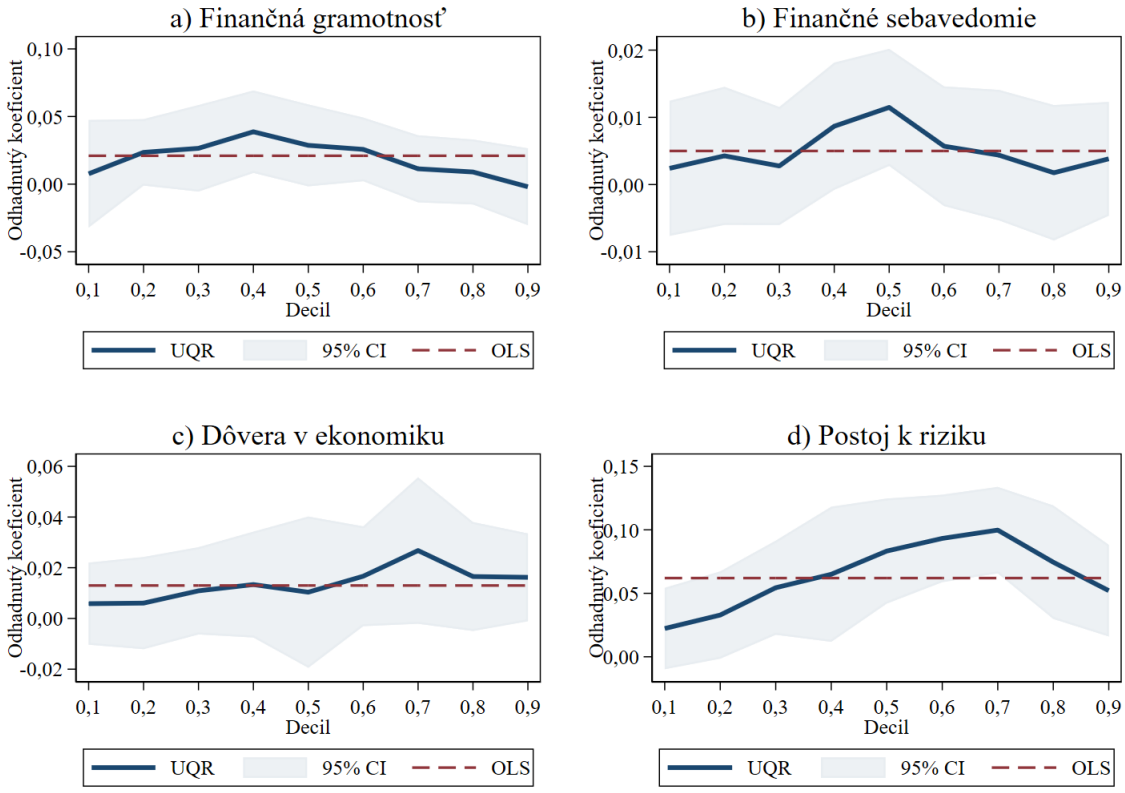
Poznámka: Štandardné chyby (uvádzané v zátvorkách) odhadnuté použitím bootstrapových techník. Regresie sú odhadnuté použitím váh zisťovania a viacnásobne imputovaných údajov. V regresiách sú zohľadnené vplyvy veľkého počtu charakteristík domácností (viď tabuľka 4). * $p < 0,10$; ** $p < 0,05$; *** $p < 0,01$.
Zdroj: SCF 2019.

Ďalšie empirické zistenia (dostupné v Cupak a iní, 2022) naznačujú, že ochota domácností investovať do veľkej miery súvisí aj s ich individuálnymi charakteristikami ako vek, pohlavie, rodinný status, etnicita, ale aj ekonomickými zdrojmi, ktoré domácnosti vedia použiť na investovanie ako disponibilný príjem, prípadne iné likvidné bohatstvo.

V rámci nášho empirického skúmania sa taktiež zaujímame, či je vplyv finančnej gramotnosti a ostatných determinantov rovnaký v rôznych častiach distribúcie našich hlavných závislých premenných – t.j. podielu majetku držaného v akciách a dlhopisoch. Pre účely tejto analýzy odhadujeme (nepodmienené) kvantilové regresie, ktorých výsledky sú prezentované na obrázku 8 (pre akcie) a obrázku 9 (pre dlhopisy).

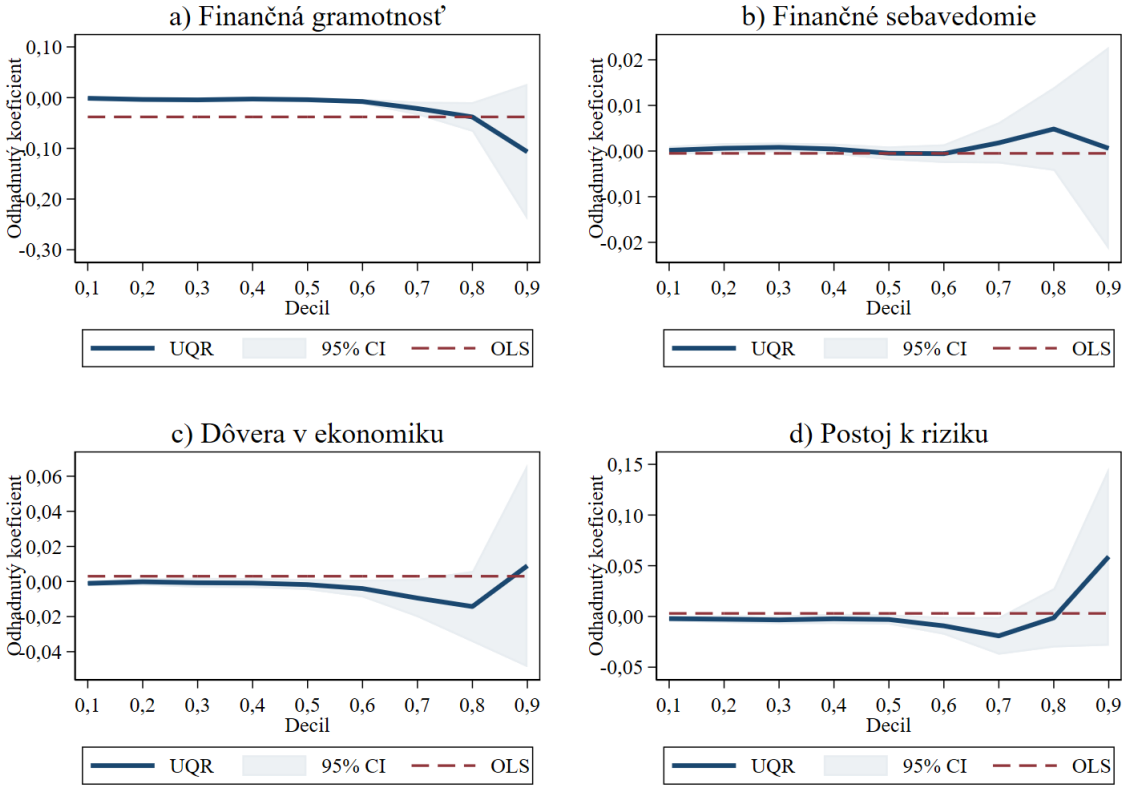
Obrázok 8 naznačuje, že v prípade akcií majú naše hlavné vysvetľujúce premenné (finančná gramotnosť, finančné sebavedomie, dôvera v ekonomiku a postoj k riziku) najväčší vplyv na našu závislú premennú (podiel akcií na celkovom finančnom majetku) v strednej časti distribúcie závislej premennej. Priebeh odhadnutých marginálnych efektov vo všetkých štyroch prípadoch pripomína tvar obráteného U. Inak povedané, vplyv vysvetľujúcich premenných v spodných a vrchných deciloch je menej výrazný, ako v piatom decile distribúcie. Naopak, ako je možné vidieť na obrázku 9, vplyv našich hlavných vysvetľujúcich premenných je takmer konštantný naprieč celou distribúciu podielu finančného majetku držaného v dlhopisoch.

Obr. 8: Kvantilové regresie – odhadnuté determinanty podielu celkových finančných aktív držaných v akciách (podmienené účasťou)



Poznámka: Regresné modely sú odhadnuté použitím váh zisťovania SCF. Kvantilové regresie sú odhadnuté použitím charakteristík, ktoré sú prezentované v tabuľke 4.
Zdroj: SCF 2019.

Obr. 9: Kvantilové regresie – odhadnuté determinanty podielu celkových finančných aktív držaných v dlhopisoch (podmienené účasťou)



Poznámka: Regresné modely sú odhadnuté použitím váh zisťovania SCF. Kvantilové regresie sú odhadnuté použitím charakteristík, ktoré sú prezentované v tabuľke 4.
Zdroj: SCF 2019.

Výsledky v Cupak a iní (2022) ďalej napríklad ukazujú[15], že existuje určitá interakcia medzi hlavnými premennými nášho záujmu vo vysvetľovaní pravdepodobnosti investovania a investovaním majetku do rizikových aktív. Interakčný člen medzi finančnou gramotnosťou a sebavedomím, ale aj dôverou v ekonomiku je štatisticky signifikantný vo väčšine odhadnutých špecifikácií, čo naznačuje určitú komplementárnosť medzi danými faktormi.

[15]Pre krátkosť priestoru tieto výsledky v práci neuvádzame, avšak detailné výsledky sú dostupné v Cupak a iní (2022).

1.6 Diskusia a záver

Ekonomická a finančná teória predpokladajú, že pre jednotlivcov a domácnosti je racionálne zúčastňovať sa na trhu s finančnými aktívami a dokonca držať svoje finančné bohatstvo v rizikových aktívach. I napriek tomu, iba malá časť populácie (dokonca aj vo vyspelých krajinách) využíva výhody finančných trhov. Napríklad, v eurozóne v priemere iba približne 11 % domácností drží akcie a iba 3 % populácie deklaruje držbu dlhopisov (ECB, 2023). Súčasne, všeobecná populácia disponuje iba priemernými znalosťami o financiách (Lusardi a Mitchell, 2014), častokrát aj v tých základných konceptoch ako úročenie, inflácia alebo diverzifikácia rizika. Ako tieto skutočnosti spolu súvisia?

V tejto habilitačnej práci empiricky analyzujeme dôležitosť finančnej gramotnosti pre niektoré dôležité ekonomické a finančné rozhodnutia jednotlivcov a domácností. V práci sa taktiež snažíme poukázať na zraniteľné skupiny populácie ohľadom ich nízkej úrovne finančného povedomia a finančného sebavedomia. Použitím unikátnych dátových zdrojov a mikroekonometrických dekompozičných metód a metód regresnej analýzy, táto práca (okrem iného) prináša niekoľko kľúčových zistení.

V prvom rade výsledky výskumu založeného na nových dostupných mikrodátach o finančných znalostiach dospelej populácie (OECD/INFE) naznačujú, že existujú významné rozdiely vo finančnej gramotnosti naprieč krajinami (viď Cupak a iní, 2021b), čo potvrdzuje zistenia predchádzajúcich štúdií (napr. Jappelli, 2010; Lusardi a Mitchell, 2011b). Navyše sa ukazuje, že medzery v gramotnosti nie sú nevyhnutne iba dôsledkom rozdielnych charakteristík populácií, ale do veľkej miery rozdielnymi ekonomickými a kultúrnymi prostrediami, čo potvrdzuje zistenia od Christelis a iní (2013) alebo De Beckker a iní (2019).

Detailné OECD/INFE mikrodáta taktiež naznačujú, že existujú výrazné rozdiely v úrovni finančnej gramotnosti a finančnom sebavedomí naprieč rôznymi skupinami obyvateľov (viď Cupak a iní, 2018, 2021a). Najvýraznejšou je rodová medzera vo finančnej gramotnosti, čo je celkovo v súlade so zahraničnými štúdiami (napr. Fonseca a iní, 2012; Bucher-Koenen a iní, 2017). Zaujímavosťou však je, že rodové medzery sú viac viditeľné vo vyspelých krajinách v porovnaní s post-socialistickými krajinami ako Chorvátsko, Maďarsko alebo Rusko, kde je však úroveň finančnej gramotnosti "levelovo" nižšie v porovnaní s vyspelými krajinami.

Výsledky založené na detailných mikrodátach o domácnostiach a jednotlivcoch (HFCS, SCF) taktiež naznačujú, že jedným z faktorov, ktorý zohráva dôležitú úlohu pri obozretnom ekonomickom a finančnom rozhodovaní (sporenie na dôchodok a diverzifikácia portfólií), je finančná gramotnosť (viď Cupak a iní, 2019, 2022). Tieto výsledky celkovo

potvrdzujú existujúce empirické zistenia o pozitívnych asociáciách (ale aj o kauzálnych vzťahoch) medzi finančnou gramotnosťou a ekonomickými a finančnými výsledkami jednotlivcov a domácností (podrobný prehľad literatúry je dostupný Fernandes a iní, 2014; Lusardi a Mitchell, 2014, 2023), väčšinou na strane aktív portfólií domácností. Zistilo sa napríklad, že finančná gramotnosť podporuje účasť na trhu so sofistikovanými finančnými aktívami (napr. Van Rooij a iní, 2011), diverzifikáciu finančných portfólií (napr. Abreu a Mendes, 2010; Gaudecker, 2015), ale taktiež plánovanie a sporenie na dôchodok (napr. Alessie a iní, 2011; Bucher-Koenen a Lusardi, 2011) čo následne pomáha akumulovať väčšie finančné bohatstvo (pozri Behrman a iní, 2012; Lusardi a iní, 2017) potrebné pre finančnú prosperitu jednotlivých domácností.

Výsledky tejto habilitačnej práce môžu byť užitočné pre tvorcov politík. V prvom rade, výsledky práce poukázali, že existujú výrazné rozdiely vo finančnej gramotnosti naprieč krajinami. Avšak nestačí brať do úvahy iba obyčajný "ranking" výsledkov finančnej gramotnosti, ale treba zohľadniť aj to, že populácie naprieč krajinami a taktiež politiky krajín nie sú rovnaké. Výsledky taktiež naznačujú, že ženy výrazne zaostávajú vo finančných vedomostiach za mužmi, čo sa prejavuje aj v ich nižšej účasti na investovaní a akumulovaní bohatstva. Pritom sa však podľa štatistík dožívajú výrazne dlhšieho veku, avšak nižšie akumulované bohatstvo (aj vďaka nízkej finančnej gramotnosti) môže zapríčiniť nedôstojné finančné podmienky v starobe. Jednou z dôležitých ciest k rodovej rovnosti môže byť riešenie súvisiacich noriem a rodových rolí v spoločnosti. Tieto normy sú základom rozdielov v sebadôvere, ktoré – okrem všetkých ostatných pozorovateľných charakteristík – vedú k nižšej účasti žien na rizikových trhoch s aktívami.

Navyše, nedávne trendy v oblasti digitalizácie a decentralizácie financií by mohli znížiť prekážky účasti jednotlivcov a domácností na finančných trhoch. Konvenčné kanály finančného sprostredkovania a poradenstva sa teda dajú ľahko obísť a preto sú pre finančnú prosperitu stále dôležitejšie individuálne finančné znalosti a sebadôvera, či už pre diverzifikáciu rizika ale aj pre dlhodobé finančné ciele, ako plánovanie a sporenie na dôchodok. Z tohto hľadiska je pre tvorcov politík kľúčové investovať do finančného vzdelávania, ideálne s cieľom budovať túto formu ľudského kapitálu už v školskom veku, ale taktiež nezabúdať na staršie generácie, ktoré sa potrebujú zorientovať v komplexnom svete financií.

Nadchádzajúci výskum. Prezentovaný výskum v tejto habilitačnej práci sa však nedotýka viacerých dôležitých a aktuálnych tém. V prvom rade, v spoločnosti sa stále nachádzajú skupiny obyvateľov, ktorí sú uväznení v extrémnej chudobe, napríklad marginalizované rómske domácnosti. Táto skupina obyvateľov pritom postráda základné ekonomické zručnosti. Napríklad, Želinský (2021) zistil, že ľudia z marginalizovaných

rómskych komunít vo výraznej miere preferujú súčasnú spotrebu pred budúcou a výskumy ukazujú, že takáto forma netrpezlivosti je často silno korelovaná s problémom sebakontroly a prijímaním nesprávnych ekonomických a finančných rozhodnutí. Na zlepšenie ich finančnej situácie a vybudovanie dobrých ekonomických návykov by mohlo v prvom rade dopomôcť začať zlepšovať ich celkovú úroveň ľudského kapitálu a finančnej gramotnosti konkrétne, k čomu vyzývajú aj Nemcovska a iní (2016). Bolo by preto užitočné začať zbierať údaje a monitorovať vývoj finančnej gramotnosti aj u tejto populácie.

Ďalšia aktuálna téma, na ktorú súčasná literatúra upozorňuje je, že prístup k inováciám a technológiám, napríklad vo forme umelej inteligencie, vie výrazne dopomôcť k zlepšeniu produktivity ekonomických subjektov, či už sú to firmy alebo jednotlivci (napr. Dell'Acqua a iní, 2023). Analogicky by sa dalo skúmať, ako použitie umelej inteligencie a nástrojov strojového učenia (napr. ChatGPT) ovplyvňuje budovanie ľudského kapitálu a finančnej gramotnosti. Napríklad, Niszczota a Abbas (2023) ukazujú, že použitie veľkých jazykových modelov (Large Language Models, LLM) vie takmer dokonale kopírovať správne odpovede na komplexné finančné problémy a tým pádom pomôcť populácii ako určitý zdroj finančného robo-poradcu.

Analýzy v tejto práci sa taktiež nedotkli strany pasív domácností. Hoci je literatúra v tomto smere pomerne skromná, existuje niekoľko dôležitých štúdií, ktoré poskytujú užitočné usmernenia pre výskumnú agendu v oblasti prepojenia finančnej gramotnosti a zadlženosti. Napríklad, Gathergood (2012) skúma vzťah medzi finančnou gramotnosťou, sebakontrolou a nadmerným zadlžením. Objavuje významnú súvislosť medzi nesplácaním spotrebiteľských úverov / nadmerným finančným zadlžením s nedostatočnou sebakontrolou aj finančnou negramotnosťou. Jednotlivci, ktorí vykazujú problémy so sebakontrolou, vykazujú sklon k využívaniu vysoko nákladných úverových nástrojov, ako sú napríklad karty do obchodov a pôžičky pred výplatou. Táto skupina je navyše náchylnejšia na šoky v príjmoch, čerpanie úverov a neočakávané výdavky na tovar dlhodobej spotreby, čo naznačuje zvýšenú expozíciu rôznym finančným rizikám. Okrem toho autor v rôznych špecifikáciách zdôrazňuje výraznejšiu úlohu nedostatočnej sebakontroly v porovnaní s finančnou negramotnosťou pri objasňovaní fenoménu nadmerného zadlžovania spotrebiteľov. Ďalším užitočným príkladom je štúdia od Lusardi a Tufano (2015), ktorá zdôrazňuje význam dlhovej gramotnosti pre finančnú zraniteľnosť domácností.

Skúmanie prepojenia finančnej gramotnosti a (nadmerného) zadlženia domácností je pomerne dôležitou témou v európskom kontexte, ale aj tom slovenskom, nakoľko Slovensko spolu s ostatnými stredoeurópskymi krajinami patria k jedným z najrýchlejšie sa zadlžujúcich krajín v Európe (Cesnak a iní, 2023) a budúci výskum by sa mohol

zamerať práve na túto problematiku.

Budúci výskum by sa taktiež mohol zamerať na vyhodnotenie efektívnosti finančného vzdelávania použitím kontrolovaných experimentov (v teréne alebo laboratóriu), nakoľko literatúra o finančnej gramotnosti naznačuje, že práve tento typ štúdie vie dokázať kauzálny (neskreslený) vplyv finančného vzdelávania a gramotnosti na individuálne ekonomické a finančné správania (viď Fernandes a iní, 2014; De Beckker a iní, 2021; Kaiser a iní, 2022). Napríklad, Bover a iní (2024) uskutočnili randomizovanú kontrolovanú štúdiu, v rámci ktorej 3 000 žiakov 9. ročníka zo 77 stredných škôl v Španielsku absolvovalo v rôznych obdobiach roka kurz finančného vzdelávania. Hneď po absolvovaní kurzu sa výsledky v testoch u žiakov 9. ročníka zvýšili o 18 % jednej štandardnej odchýlky a žiaci preukázali väčšiu trpezlivosť pri hypotetickom rozhodovaní o sporení. Pri motivovanej úlohe sporenia, ktorá sa uskutočnila tri mesiace po nej, sa žiaci v šetrenej skupine rozhodovali trpezlivejšie ako kontrolná skupina žiakov 10. ročníka.

2 Publikované vedecké práce

Táto časť habilitačnej práce uvádza samotné publikované vedecké články spolu s úvodným listom k publikáciám: t.j. názov publikácie, autorský kolektív, zdroj publikácie, scientometrické ukazovatele časopisu a držiteľa autorských práv. Navyše, v prílohe B je uvedené vyhlásenie o autorskom príspevku (CRediT) k publikovaným článkom.

Postupne prezentujeme nasledovné publikácie:

1. Cupak, A., Fessler, P., Silgoner, M. a Ulbrich, E. (2021). "Exploring differences in financial literacy across countries: the role of individual characteristics and institutions". *Social Indicators Research*, 158(2), 409–438.

2. Cupak, A., Fessler, P., Schneebaum, A. a Silgoner, M. (2018). "Decomposing gender gaps in financial literacy: New international evidence". *Economics Letters*, 168, 102–106.

3. Cupak, A., Fessler, P. a Schneebaum, A. (2021). "Gender differences in risky asset behavior: The importance of self-confidence and financial literacy". *Finance Research Letters*, 42, 101880.

4. Cupak, A., Kolev, G. I. a Brokešová, Z. (2019). "Financial literacy and voluntary savings for retirement: novel causal evidence". *The European Journal of Finance* 25(16), 1606–1625.

5. Cupak, A., Fessler, P., Hsu, J. W. a Paradowski, P. R. (2022). "Investor confidence and high financial literacy jointly shape investments in risky assets". *Economic Modelling*, 116, 106033.

2.1 Exploring differences in financial literacy across countries: the role of individual characteristics and institutions

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Publikované v *Social Indicators Research*, 2021, roč. 158, č. 2, s. 409–438. DOI: https://doi.org/10.1007/s11205-021-02713-8.

IF (2021):	2.935
SJR (2021):	0.907
JCR Best Q (2021):	Q2
ABDC ranking:	A

Social Indicators Research
https://doi.org/10.1007/s11205-021-02713-8

ORIGINAL RESEARCH

Exploring Differences in Financial Literacy Across Countries: The Role of Individual Characteristics and Institutions

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Accepted: 6 May 2021

Abstract

We explore microdata from the OECD/INFE survey on financial literacy of adult individuals. We find considerable differences in financial literacy across countries and decompose them into a part explainable by varying individual characteristics and a remainder. We show that individual characteristics matter with regard to differences in average financial literacy, but do not fully explain the gaps. We decompose financial literacy across its distribution and directly relate it to different policies. We then correlate the unexplained differences to institutional macroeconomic variables. We find strong correlations between unexplained differences and life expectancy, social contributions rate, PISA math scores, and internet usage, suggesting room for harmonization of environments across countries to close the financial literacy gap.

Keywords Financial literacy gaps · Decomposition analysis · Personal finance · Survey data

JEL Classification D14 · D91 · I20

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Published online: 15 May 2021

1 Introduction

The importance of financial literacy and education as a main ingredient of informed choices and sound financial behavior of consumers has been recognized in the literature (see e.g. Campbell 2006; Jappelli 2010; Hastings et al. 2013; Lusardi and Mitchell 2014; Urban et al. 2018; Berry et al. 2018). The meta-analyses by Kaiser and Menkhoff (2017) and Kaiser et al. (2020) confirmed that financial education significantly affects financial literacy and ultimately financial behavior.[1] As a result, financial literacy improves financial inclusion of individuals and households (see e.g. Grohmann et al. 2018) as well as their ability to accumulate more wealth (see e.g. Behrman et al. 2012). Financial literacy is crucial for financial behavior and therefore decisive for major contemporary economic problems such as the rise of inequality (e.g. Lusardi et al. 2017). Even though several studies have analyzed financial literacy with respect to household economic and financial outcomes, little research has been done exploring the possible causes of substantial differences in financial literacy across countries and population groups.

In the previous empirical literature, researchers have analyzed differences in financial literacy across countries and groups of individuals typically in a descriptive way. For example, according to the Standard and Poor's (2015) survey, the average percentage of adults that answered three out of four financial literacy questions correctly is 56% in the old EU member states; 63% in Australia, the USA, and Canada; and 45% in the Central and Eastern European (CEE) new EU member states. Likewise, results of the OECD PISA survey show worse results for high-school students from CEE countries compared to other Western European countries (OECD 2014). Recently, the OECD (2016) showed substantial differences in the financial literacy of the adult population across the world as well as across European countries. Other examples of descriptive studies on cross-country financial literacy gaps include Atkinson and Messy (2011), Lusardi and Mitchell (2011), Nicolini et al. (2013), Lusardi and Mitchell (2014) or Bucher-Koenen et al. (2017). Recently, Karakurum-Ozdemir et al.'s (2019) study provides empirical evidence on the evolution of financial literacy in five middle-income countries, namely Mexico, Lebanon, Uruguay, Colombia and Turkey.

Beyond descriptive research, there is only a handful of studies that attempt to provide an explanation of varying levels of financial literacy across countries. For example, Jappelli (2010) analyses the relationship between macroeconomic contextual variables and population's economic literacy using international panel data on 44 countries over the period 1998–2008. Despite the identification of important factors driving differences in economic literacy across countries (e.g. economic development, digitalization, etc.), the main shortcoming of Jappelli's (2010) study is that the level of economic literacy of the particular country is proxied by the economic literacy of interviewed business leaders, hence offering a potentially biased picture since business leaders can be expected to have above-average interest and routine in financial matters and thus a higher incentive to invest in financial literacy. Another example is a recent work of Ahunov and Van Hove (2020) finding that variations in the national culture (proxied by individualism and power distance) are another powerful determinant of financial literacy at the country level.[2] Yet again, the authors could

[1] Kaiser and Menkhoff (2020) find similar results for financial education programs at schools.

[2] At the country level, Brown et al. (2018) show that students in the French-speaking part of Switzerland have much lower level of financial literacy that students in the German-speaking parts and relate this finding to differences in financial socialization by parents.

not provide this kind of analysis for different population sub-groups, given the absence of microdata. Perhaps the closest study to ours in terms of applied dataset and microeconometric analysis is by De Beckker et al. (2020), who estimate the influence of culture and institutions on individual financial literacy levels in a multilevel setting.

While the observed differences in financial literacy arguably influence policies, the populations in different countries are not homogeneous. It remains unknown how much of the observed difference is country-specific and how much is driven by varying individual characteristics of the (sampled) population.

By employing microeconometric tools from the decomposition and policy-evaluation literature, we attempt to deliver estimates of how much of the observed difference is due to differences in the characteristics of the population. We seek to answer the following research questions:

1. how large are financial literacy gaps across countries?;
2. are the observed differences in financial literacy mainly due to differences in observable individual characteristics?; and
3. do institutional factors play a role in explaining financial literacy gaps across countries?

These fundamental questions are relevant for potential policies aimed at increasing financial awareness. There are two important mechanisms at work which need to be taken into account to go beyond the type of overall mean comparisons in cross country research on financial literacy. To illustrate the first one, we point to an example with regard to educational attainment. On the one hand, a gap in average financial literacy may exist across countries within education groups; this would be the case if financial literacy differed among the highly educated in country A versus country B. On the other hand, a gap could exist across countries even if the financial literacy within education groups is the same across countries: if the share of, say, highly educated individuals is higher in country A than in country B. From a policy perspective these gaps need to be dealt with differently. Whereas the first raises the question of why similarly educated groups have different financial literacy across countries, the second case can be addressed by increasing educational attainment.

The second mechanism has to do with different levels of literacy and the resulting additive structure of the financial literacy indices. Whereas educational attainment might be key to basic financial literacy, its relevance might be less important in the case of more advanced financial literacy. We argue that it is crucial to take this additive structure of financial literacy and therefore the shape of the distribution into account. At the bottom of the pyramid there are simple questions based on school knowledge; more up the ladder higher education, learning by doing or on the job training which all may alike provide the necessary knowledge to correctly answer the more difficult literacy questions. How common learning by doing or on the job training are depends on the institutional setting in countries. In a country with a larger financial sector the share of people who have on the job training will be higher. In a country with a less comprehensive social security net the need to invest in private wealth and therefore learning by doing will be more prevalent.

Differences in these patterns have important policy implications: a gap at the bottom indicates a lack in basic knowledge which is usually acquired in primary education. The policy advice would in this case be to improve the quality of primary education. A gap at the top, by contrast, rather points at weaknesses in secondary and higher education or at structural institutional issues, for example due to an abundant public pension system with

limited need to invest in private pension wealth. Those who have high financial resources are more likely to be interested in more complex financial products and therefore more likely to acquire the specific knowledge. To close gaps in the upper part, policies need to focus on the quality of higher education, including also specific financial literacy content within schools or for the general public. Our finding that individual characteristics explain more at the upper end of the distribution is suggestive evidence supporting this view.

That is why we proceed by asking which differences in institutions are correlated with cross-country gaps in financial literacy unexplained by individual characteristics. Characteristics might explain part of the gap, but their interplay with different environments across countries is potentially relevant when explaining financial literacy gaps. One potentially relevant institutional difference related to financial literacy may be different welfare state regimes. In some countries (such as Brazil, Russia, or the UK), investing privately for old age provision or other precautionary motives is more important than in others (such as Austria, Finland, or Germany). Moreover, the supply of financial services varies across countries. The intermediation of banks is stronger in some countries (such as in continental Europe) than in others (such as the UK).

In a nutshell, we devise a two-step empirical strategy to first decompose the differences in financial literacy into a part related purely to different individual characteristics across countries, and the remainder. Then, we use these remaining parts to analyze the potential linkage to institutions and a country's macroeconomic environment. Our methodological framework builds on the existing literature of Christelis et al. (2013), Bover et al. (2016a), and Sierminska and Doorley (2018).

Our study makes several important contributions to the empirical literature on financial literacy and household finances. Following up on the first insights using the 2014–2016 wave of the OECD/INFE database on financial competencies of individuals (Cupák et al. 2018; De Beckker et al. 2019, 2020), we are among the first to deliver a complex cross-country analysis of these data. The advantage of this database is its broad set of questions (focusing on an extended set of financial knowledge questions as well as aspects of financial attitudes and behavior) as well as country coverage as compared to the previous studies. This broad set of questions allows us to exploit the information content of the distribution of the financial literacy indices across countries and to derive policy conclusions. We are also among the first to employ counterfactual decomposition techniques to analyze the observed differences in financial literacy in a cross-country perspective. In our framework, we consider individuals from Finland as a benchmark (reference) for financial literacy of individuals from other countries in our dataset (Austria, Brazil, Canada, Croatia, Hong Kong, Hungary, Germany, Jordan, The Netherlands, Russia, and the UK).[3] We extend the analysis in OECD (2016) substantially by providing a detailed cross-country comparison accounting for differences in the underlying socio-economic structure. Therefore, our findings help to better understand the potential determinants of gaps in financial literacy between countries, which are as high as 20% in some cases (e.g. Finland vs. Croatia or Russia).

[3] We chose Finland as a reference category not only because of data availability, but also for other reasons. For example, the Finnish population (both adults and high-school students) ranks among the best in different financial literacy surveys (e.g. OECD 2014, 2016) compared to the population from other European countries. Furthermore, Finnish households show an intense interaction with financial markets, as 39% of households hold risky financial assets in their portfolios (Bover et al. 2016b).

The rest of this paper is structured as follows. Section 2 describes the dataset and the employed microeconomic and institutional variables. Section 3 outlines the applied methodological framework. Section 4 presents empirical results together with several robustness checks. Section 5 concludes and offers policy implications.

2 Data

The data used for the analysis of financial literacy gaps across countries come from the OECD/INFE (International Network for Financial Education) survey of adult financial literacy competencies, collected in the years 2014–2016. While the survey was conducted in more than 30 countries around the world, only a few countries made the data available for research purposes. Hence, we got access to individual-level data from Austria, Brazil, Canada, Croatia, Finland, Germany, Hong Kong, Hungary, Jordan, The Netherlands, Russia, and the UK, accounting together for more than 15,000 observations. A unique feature of this survey is that the questions are asked in a harmonized way across countries, making the results comparable—major advantage as compared to previous surveys on financial literacy. Also, the set of financial literacy questions is much broader than in previous studies. Other cross-country surveys typically focus on a small set of three/four basic financial literacy questions on interest rates, inflation and diversification/riskiness (Lusardi and Mitchell 2014). In the OECD/INFE survey, questions include concepts such as time value of money, interest paid on loans, interest and principal, compound interest, risk and return, inflation, and risk diversification. The data also contains standard socio-economic characteristics.

Table 1 shows basic information about the data collection in the countries were data is accessible. In 8 of the 12 countries face-to-face personal computer assisted interviews were conducted. Two countries used telephone interviews (Canada and Germany) whereas two gathered the data via online interviews or as a combination of telephone and online interviews (The Netherlands and the United Kingdom). The sample size ranges from 1000 (Hong Kong, Hungary and the United Kingdom) to 2002 (Brazil). In many countries the national central banks were responsible for gathering the data and delivering it to the OECD/INFE. In others also universities, ministries or other governmental institutions conducted the harmonized survey developed by the OECD/INFE.

For our analysis we use a set of variables which is fully harmonized in all countries (Table 2). Our main variable of interest, the financial literacy score, is calculated from the answers given to a set of seven knowledge questions examining the financial literacy of respondents. They deal with the understanding of inflation, interest, interest plus principal, compound interest, the relationship between risk and return and risk diversification. The detailed questions are listed in Appendix A. The financial literacy score of individuals is computed similarly to the extant literature on financial literacy (e.g. Lusardi and Mitchell 2014). Hence, the financial literacy score (as also used by the OECD/INFE) is computed as a sum of all correctly answered of the seven questions asked in the survey.

In our empirical analysis, we first use a set of exogenous socio-economic individual characteristics as predictors for the stock of financial literacy. In Sect. 4.4, we also consider a set of endogenous variables capturing the experience of respondents with financial products and financial planning. As individual characteristics we use dummies for age category, gender, marital status, university education and employment status. Furthermore, and as suggested by Monticone (2010), we use a variable on the income buffer, indicating that the individual has a financial buffer of at least three times the

Table 1 Survey details. *Source*: OECD/INFE international survey of adult financial literacy competencies

Country	Institution	Date of survey	Type of survey	Sampling method	Sample size
Austria	Oesterreichische Nationalbank	2014	Face-to-face	Stratified sampling	1994
Brazil	Banco Central do Brasil	2015	Face-to-face	Stratified cluster sampling	2002
Canada	Financial Consumer Agency of Canada	2015	Telephone interviews	Nested quotas using random digit dialing	1002
Croatia	Croatian National Bank and Croatian Financial Services Agency	2015	Face-to-face	Stratified sampling	1049
Finland	University of Tampere and University of Vaasa	2014	Face-to-face	Stratified cluster sampling	1533
Germany	Deutsche Bundesbank	2016	Telephone interviews	Stratified sampling	1001
Hong Kong	Investor Education Center	2015	Face-to-face	Stratified sampling	1000
Hungary	Magyar Nemzeti Bank	2015	Face-to-face	Quota sample from stratified probability starting point	1000
Jordan	INJAZ	2016	Face-to-face	Stratified sampling	1140
The Netherlands	Money Wise	2015	Online interviews	N.A.	1018
Russia	Ministry of Finance of the Russian Federation	2015	Face-to-face	Stratified sampling	1649
UK	Money Advice Service	2015	30% telephone, 70% online interviews	Stratified random sampling	1000
					15,388

Table 2 Description of variables used in empirical analysis. *Source*: OECD/INFE international survey of adult financial literacy competencies

Variable	Description
Financial literacy score	Number of correctly answered financial literacy questions (see Appendix A for details); score ranging from 0 to 7
Income buffer	Dummy variable: 1 if an individual has a financial buffer for at least three months in case he/she loses his/her job (a proxy for wellbeing)
Gender	Dummy variable: 1 if female and 0 otherwise
Single	Dummy variable: 1 if an individual lives alone and 0 otherwise
University education	Dummy variable: 1 if university education is the highest attained and 0 otherwise
Age category (18–29)	Dummy variable: 1 if an individual aged from 18 to 29 and 0 otherwise
Age category (30–49)	Dummy variable: 1 if an individual aged from 30 to 49 and 0 otherwise
Age category (50–69)	Dummy variable: 1 if an individual aged from 50 to 69 and 0 otherwise
Age category (70+)	Dummy variable: 1 if an individual aged 70 + and 0 otherwise
Employed	Dummy variable: 1 if paid employment (working for someone else) and 0 otherwise
Self-employed	Dummy variable: 1 if self-employed (working for him/herself) and 0 otherwise
Retired	Dummy variable: 1 if retired and 0 otherwise
Other, not-working	Dummy variable: 1 if unemployed or not-working (e.g. apprentice, looking for work, looking after home, unable to work due to sickness, student) and 0 otherwise
Having budget	Dummy variable: 1 if an individual is responsible for budget and has a budget and 0 otherwise
Active saver	Dummy variable: 1 if an individual actively saves in one of the following schemes (cash at home, savings account, informal savings club, investment products) and 0 otherwise
Holding risky financial assets	Dummy variable: 1 if an individual holds shares or bonds in his/her financial portfolio and 0 otherwise
Financial planning	Dummy variable: 1 if an individual sets long-term financial goals and 0 otherwise

monthly net income, which therefore is also a crude measure of financial wealth. To cover experience, we use dummies on having a budget plan, being an active saver, holding risky assets and engaging in long-term financial planning.

Figure 1 shows the distributions of the financial literacy score across all countries covered in our analysis. In most countries the majority of individuals are able to answer 5 or more questions correctly, and in some countries the distribution is more skewed than in others. Furthermore, in Table 3 we show average financial literacy scores broken down by socio-economic characteristics and countries. In all countries, men—on average—obtained higher financial literacy scores than women, a finding common in the literature (e.g. Lusardi and Mitchell 2014). Higher education goes along with higher financial literacy scores in all countries as well, which is not surprising given that Christelis et al. (2010) find that numeracy in general increases with education. Financial literacy seems to increase initially with age and to decrease again for the elderly, in line with previous research (e.g. Finke et al. 2017; Lusardi and Mitchell 2014). However, this pattern does not prevail in all countries (Brazil and Jordan). Regarding employment, in

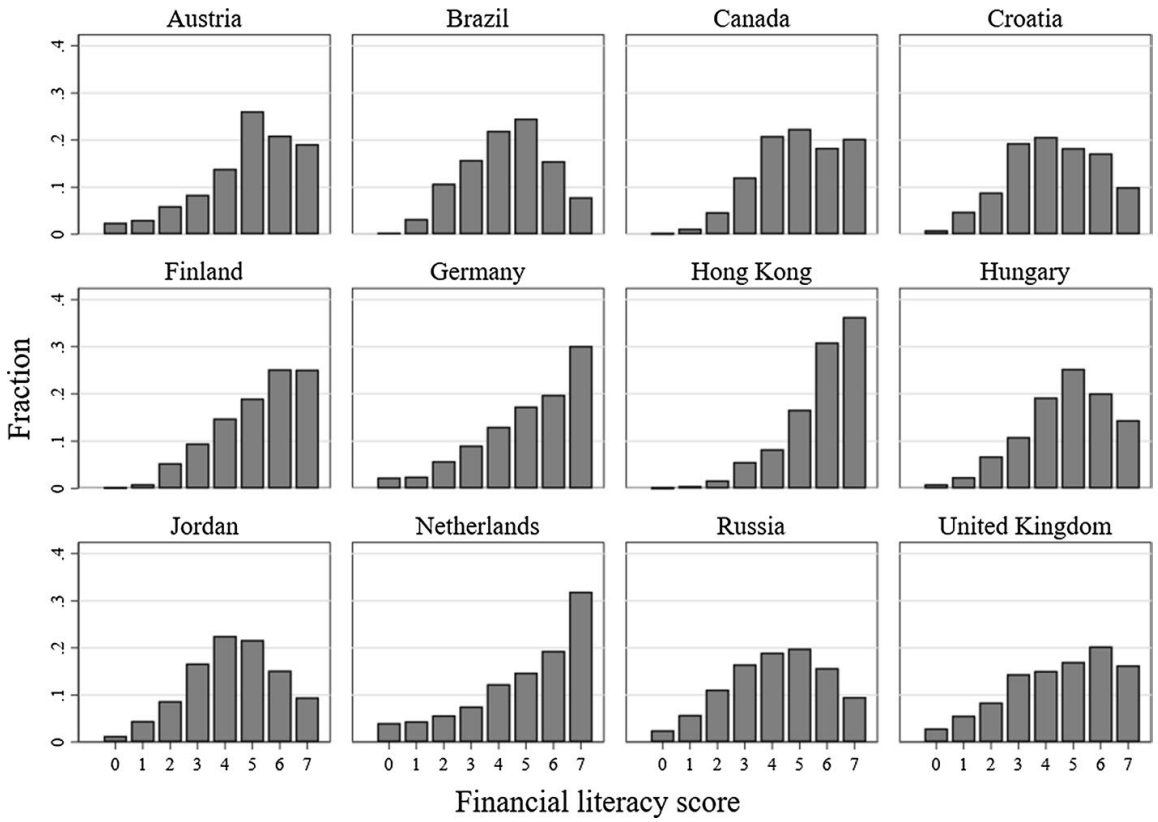

Fig. 1 Distribution of financial literacy score across countries. *Source*: OECD/INFE international survey of adult financial literacy competencies

many countries (8 out of 12) the self-employed have marginally higher financial literacy than the employed.

Table 4 shows descriptive statistics (means and standard deviations) for all countries and all variables used in our empirical analysis. Note that while the mean financial literacy score varies substantially across countries, it still lies between 4.1 and 5.8 (out of 7) correctly answered questions in all countries. Also, individual characteristics X vary substantially. In some countries (Brazil) less than 10% of the population have university degrees while in others (Canada, Jordan, The Netherlands and the UK) the share is above 30%. Similarly, the proxy for financial wealth, i.e. the income buffer variable identifying individuals with at least 3 months of their monthly income in financial assets, varies substantially. While in Russia only 24% report having such a financial buffer, 69% of Canadians do so. Also shares of singles and employment status show remarkable differences. Regarding the measure we use in order to capture experience, we find that the shares of individuals holding risky assets is rather different across countries. But also, the softer measures, such as having a budget, being an active saver as well as financial planning, reveal substantial cross-country variations which might potentially explain differences in financial literacy scores.

Table 3 Distribution of financial literacy score across selected socio-economic characteristics. *Source*: OECD/INFE international survey of adult financial literacy competencies

	AT	BR	CA	HR	FI	DE	HK	HU	JO	NL	RU	UK
Overall	4.8	4.3	4.9	4.3	5.2	4.8	5.8	4.7	4.3	4.9	4.1	4.2
Gender												
Male	5.1	4.4	5.4	4.3	5.4	5.3	6.0	4.8	4.7	5.5	4.2	4.6
Female	4.5	4.2	4.5	4.2	4.9	4.3	5.6	4.6	3.8	4.3	4.1	3.8
Education												
Primary	3.8	3.9	3.8	3.9	N.A.	4.1	4.6	4.3	3.4	4.0	3.4	3.1
Secondary	4.9	4.5	4.6	4.3	5.0	5.0	5.9	4.7	3.9	4.5	4.1	4.0
Tertiary	5.6	5.2	5.4	4.8	5.8	5.7	6.1	5.4	4.6	5.6	4.5	5.0
Age category												
18–29 years	4.6	4.4	4.5	4.1	5.0	4.4	5.5	4.7	3.5	4.3	3.8	3.7
30–49 years	4.8	4.4	5.0	4.4	5.4	4.7	5.9	4.8	4.1	4.9	4.2	4.6
50–69 years	5.0	4.2	5.1	4.4	5.2	5.0	5.8	4.7	4.6	5.2	4.3	4.4
70 + years	4.6	4.1	4.7	3.7	4.9	4.5	5.2	4.5	4.7	5.0	4.2	3.4
Employment status												
Employed	4.9	4.6	5.0	4.4	5.4	5.1	6.0	4.8	4.8	5.1	4.3	4.5
Self-employed	5.1	4.3	5.4	4.6	5.6	5.6	5.7	5.2	4.8	5.6	4.2	4.6
Retired	4.8	4.0	5.1	4.0	4.9	4.7	5.4	4.4	4.6	5.2	3.8	3.9
Other not working	4.3	4.2	4.3	4.2	5.2	4.1	5.5	4.8	3.8	4.5	4.0	3.5

Austria (AT), Brazil (BR), Canada (CA), Croatia (HR), Finland (FI), Germany (DE), Hong Kong (HK), Hungary (HU), Jordan (JO), The Netherlands (NL), Russia (RU), the United Kingdom (UK). Means are presented based on the sample of adult individuals aged 18–79. Summary statistics computed using survey weights

3 Empirical Strategy

To study differences in financial literacy we employ different empirical tools. In this section we lay out our empirical approach. We first estimate a conditional expectation function of financial literacy, controlling for country-level fixed effects. To do so we use a weighted[4] linear regression to estimate the population conditional expectation function:

$$L = \alpha + \beta X' + \gamma I + \varepsilon, \tag{1}$$

where L stands for financial literacy, α denotes a constant, X contains the predictors (socio-economic characteristics), β the slope parameters, I includes country fixed effects with parameter vector γ and ε is the error term. The estimates for the predictive effects β of different socio-economic characteristics on financial literacy are discussed in Sect. 4.1.

As a next step we decompose observed differences in financial literacy across countries and types of individuals by employing standard counterfactual decomposition techniques

[4] The OECD/INFE datasets provides survey weights to take into account the specific survey design as well as to reweight the sample to the overall population. This ensures that results can be interpreted as refering to the sampled target population and not the sample itself.

Table 4 Summary statistics of variables used in empirical analysis. *Source*: OECD/INFE international survey of adult financial literacy competencies

Variable	AT	BR	CA	HR	FI	DE	HK	HU	JO	NL	RU	UK
Financial literacy Score	4.79	4.31	4.93	4.27	5.19	4.75	5.76	4.72	4.28	4.89	4.14	4.21
	(1.80)	(1.55)	(1.54)	(1.67)	(1.56)	(1.95)	(1.32)	(1.62)	(1.65)	(2.06)	(1.79)	(1.86)
Basic socio-economic characteristics												
Income buffer	0.52	0.27	0.69	0.32	0.57	0.69	0.68	0.32	0.26	0.57	0.24	0.58
	(0.50)	(0.45)	(0.46)	(0.47)	(0.50)	(0.46)	(0.47)	(0.47)	(0.44)	(0.50)	(0.43)	(0.49)
Gender	0.52	0.52	0.52	0.53	0.50	0.54	0.54	0.53	0.44	0.50	0.53	0.52
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
Single	0.34	0.09	0.18	0.17	0.30	0.22	0.06	0.16	0.09	0.21	0.16	0.23
	(0.47)	(0.28)	(0.38)	(0.38)	(0.46)	(0.42)	(0.24)	(0.37)	(0.29)	(0.41)	(0.36)	(0.42)
University education	0.10	0.09	0.45	0.18	0.27	0.16	0.20	0.19	0.62	0.38	0.28	0.31
	(0.30)	(0.29)	(0.50)	(0.38)	(0.44)	(0.37)	(0.40)	(0.39)	(0.49)	(0.49)	(0.45)	(0.46)
Age category (18–29)	0.21	0.26	0.19	0.20	0.24	0.18	0.19	0.20	0.47	0.18	0.24	0.18
	(0.41)	(0.44)	(0.39)	(0.40)	(0.43)	(0.38)	(0.39)	(0.40)	(0.50)	(0.38)	(0.43)	(0.39)
Age category (30–49)	0.35	0.43	0.35	0.35	0.38	0.35	0.39	0.36	0.39	0.37	0.36	0.34
	(0.48)	(0.49)	(0.48)	(0.48)	(0.48)	(0.48)	(0.49)	(0.48)	(0.49)	(0.48)	(0.48)	(0.47)
Age category (50–69)	0.29	0.27	0.38	0.33	0.30	0.32	0.34	0.33	0.13	0.37	0.36	0.34
	(0.45)	(0.45)	(0.48)	(0.47)	(0.46)	(0.47)	(0.48)	(0.47)	(0.34)	(0.48)	(0.48)	(0.47)
Age category (70+)	0.15	0.04	0.09	0.12	0.09	0.15	0.07	0.10	0.01	0.08	0.03	0.14
	(0.36)	(0.20)	(0.28)	(0.32)	(0.28)	(0.36)	(0.26)	(0.30)	(0.09)	(0.27)	(0.17)	(0.35)
Employed	0.49	0.30	0.50	0.42	0.40	0.47	0.56	0.51	0.38	0.46	0.61	0.52
	(0.50)	(0.46)	(0.50)	(0.49)	(0.49)	(0.50)	(0.50)	(0.50)	(0.49)	(0.50)	(0.49)	(0.50)
Self-employed	0.07	0.33	0.10	0.07	0.06	0.08	0.04	0.05	0.13	0.07	0.08	0.07
	(0.25)	(0.47)	(0.30)	(0.25)	(0.24)	(0.27)	(0.19)	(0.22)	(0.34)	(0.25)	(0.27)	(0.26)
Retired	0.28	0.12	0.20	0.26	0.25	0.27	0.13	0.25	0.04	0.17	0.19	0.24
	(0.45)	(0.32)	(0.40)	(0.44)	(0.43)	(0.44)	(0.34)	(0.43)	(0.18)	(0.38)	(0.39)	(0.43)
Other, not-working	0.17	0.24	0.20	0.26	0.29	0.18	0.27	0.19	0.45	0.30	0.13	0.16
	(0.38)	(0.43)	(0.40)	(0.44)	(0.45)	(0.39)	(0.45)	(0.39)	(0.50)	(0.46)	(0.33)	(0.37)

Table 4 (continued)

Variable	AT	BR	CA	HR	FI	DE	HK	HU	JO	NL	RU	UK
Additional variables capturing experience												
Having budget	0.28	0.36	0.58	0.63	0.61	0.32	0.55	0.24	0.48	0.39	0.47	0.51
	(0.45)	(0.48)	(0.49)	(0.48)	(0.49)	(0.47)	(0.50)	(0.43)	(0.50)	(0.49)	(0.50)	(0.50)
Active saver	0.68	0.30	0.79	0.63	0.61	0.67	0.73	0.27	0.71	0.71	0.55	0.72
	(0.47)	(0.46)	(0.40)	(0.48)	(0.49)	(0.47)	(0.44)	(0.44)	(0.45)	(0.45)	(0.50)	(0.45)
Holding risky financial assets	0.12	0.01	0.46	0.13	0.30	0.29	0.38	0.05	0.14	0.09	0.02	0.37
	(0.33)	(0.09)	(0.50)	(0.33)	(0.46)	(0.46)	(0.48)	(0.22)	(0.34)	(0.28)	(0.14)	(0.48)
Financial planning	0.63	0.45	0.58	0.45	0.74	0.59	0.58	0.43	0.61	0.39	0.47	0.45
	(0.48)	(0.50)	(0.49)	(0.50)	(0.44)	(0.49)	(0.49)	(0.49)	(0.49)	(0.49)	(0.50)	(0.50)

Austria (AT), Brazil (BR), Canada (CA), Croatia (HR), Finland (FI), Germany (DE), Hong Kong (HK), Hungary (HU), Jordan (JO), The Netherlands (NL), Russia (RU), the United Kingdom (UK). Summary statistics computed using survey weights. Standard deviations presented in parentheses

(Blinder 1973; Oaxaca1973; B–O).[5] In our case, the B-O decomposition defines the mean difference in financial literacy scores of individuals from the particular country studied and individuals from the reference group, Finland. The mean difference is divided into two main parts—one explained by group differences in observable individual characteristics under consideration, and another that cannot be accounted for by differences in observed individual characteristics—i.e. differences in coefficients, or how literacy is "produced" in the country.

Formally, we want to answer the question of how much of the mean difference in financial literacy is accounted for by differences in characteristics of individuals between a benchmark country $c = j$ (Finland) and countries $c \in C$. The mean difference can be written as $\Delta\mu L_c = \mathbb{E}\left(L_{c=j}\right) - \mathbb{E}\left(L_c\right)$. Using the B–O framework, $\Delta\hat{\mu}L_c$ can then be estimated as

$$\Delta\hat{\mu}L_c = \underbrace{\left(\overline{X}_{c=j} - \overline{X}_c\right)' \hat{\beta}_{c=j}}_{\text{explained}} + \underbrace{\overline{X}_c' \left(\hat{\beta}_{c=j} - \hat{\beta}_c\right)}_{\text{unexplained}}. \tag{2}$$

where $\overline{X}_{c=j}$ and $\overline{X}_c$ are covariate group averages and $\hat{\beta}_{c=j}$ and $\hat{\beta}_c$ are coefficient vectors from regressions including only individuals of the reference country $c = j$ and country c, respectively.

We also employ the framework of unconditional quantile regressions (Firpo et al. 2007, 2009) to extend our approach beyond the mean. Reasons for differences in average financial literacy might be different for those in the lower or higher parts of the distribution. Whereas in the lower part it is mostly about very basic math (cognitive) skills (e.g. interest calculation) which are covered in the curricula of primary and lower secondary schools, it is rather knowledge about the functioning of certain sophisticated financial products at the top of the distribution. Basic schooling might help in the lower, but not so much in the upper part, where higher education, learning by doing and on the job training might be decisive to gain more advanced financial literacy. As we explained in the introduction, this additive nature of the financial literature index can be exploited to link financial literacy and different gaps across the distribution directly to potential policies to improve overall literacy.

We decompose distributions in the financial literacy scores between individuals from the benchmark country $c = j$ (Finland) and country c by using recentered influence function (RIF) regressions along with the B-O technique (Firpo et al. 2007, 2009). To do so, we basically replace the country-level regressions underlying our approach with RIF-regressions. A RIF regression is similar to a standard regression, except that the dependent variable is replaced by the recentered influence function of the statistic of interest (see Firpo et al. 2009).[6] Similarly to the standard B-O decomposition, we can decompose the difference in the quantile of financial literacy score (in our case 10th, 25th, 50th, 75th, and 90th percentile) into two additive parts, the explained and the unexplained:

[5] The B-O decomposition technique has been predominantly used in the labor economics literature to study gaps in wages and employment. Recently, this method has also been applied in the field of household finance to study differences in stock-holdings between US and euro-area households (Christelis et al. 2013), wealth differences across countries (Mathä et al. 2017; Sierminska and Doorley 2018), or to study financial literacy gaps between male and female populations in the US and across countries (e.g. Cupák et al. 2018; Fonseca et al. 2012).

[6] For readers interested in the details of the approach, we summarize the basic approach in the Appendix B.

Table 5 Selected country-level indicators relevant for financial literacy. *Source*: World Bank indicators; OECD 2012 PISA data (OECD 2014)

Country	Math score in the PISA survey (2012)	Internet users (% of the population, 2015)	Enrolment ratio, upper secondary (%, 2012)	Stock market total value to GDP (%, 2012)	Social contributions (% of revenue, 2015)	Life expectancy (years, 2015)	GDP per capita (current USD, 2015)
Austria	497	83.93	95.75	7.33	32.33	81.84	43,665
Brazil	377	59.08	90.97	31.19	31.68	74.68	8757
Canada	516	88.47	119.30	77.59	23.70	82.14	43,316
Croatia	464	69.80	97.66	1.25	35.32	77.28	11,580
Finland	511	92.65	115.23	56.61	33.67	81.39	42,405
Germany	506	87.59	106.68	38.25	54.61	81.09	41,177
Hong Kong	548	84.95	113.22	478.70	N.A.	84.28	42,351
Hungary	477	72.83	102.67	10.00	30.10	75.96	12,366
Jordan	380	53.40	77.88	10.73	0.27	74.20	4096
The Netherlands	512	93.10	124.47	54.45	36.69	81.70	44,293
Russia	494	70.10	98.77	20.26	21.00	70.91	9329
UK	492	92.00	83.20	103.06	21.23	81.60	43,930

The social contributions figure for Croatia refers to 2014 instead of 2015. Upper secondary school enrolment ratios can exceed 100% as it measures total enrollment in upper secondary education, regardless of age, expressed as a percentage of the total population of official upper secondary education age

$$\Delta\hat{L}_c^{Q\tau} = \underbrace{\left(\overline{X}_{c=j} - \overline{X}_c\right)' \hat{\beta}_{c=j}^{Q\tau}}_{\text{explained}} + \underbrace{\overline{X}_c' \left(\hat{\beta}_{c=j}^{Q\tau} - \hat{\beta}_c^{Q\tau}\right)}_{\text{unexplained}}. \tag{3}$$

Finally, we correlate the unexplained parts of the gaps in financial literacy with selected aggregate macroeconomic indicators which have been shown to influence financial literacy at the country-level. This last step of our empirical framework builds on the previous studies of Christelis et al. (2013), Bover et al. (2016), and Sierminska and Doorley (2018). Here we correlate the unexplained parts of the gaps with selected macroeconomic indicators that have been shown to be relevant for the financial literacy at the country-level (Jappelli 2010). Our chosen aggregate indicators include PISA math test scores, the share of internet users, (gross) enrolment ratio to secondary school, stock market capitalization, social contributions rate (a proxy for welfare state), life expectancy, and GDP per capita. For a detailed description, see Table 5.

4 Results

In this section we present our estimates of the conditional expectation function of financial literacy, controlling for country-level fixed effects in Sect. 4.1. Sect. 4.2 includes the core of our analysis, the decomposition of cross-country differences in financial literacy into parts explainable by individual characteristics and an unexplained part. We also decompose the gaps beyond the mean at the 10th, 25th, 50th, 75th, and 90th percentile of the financial literacy distribution. We employ the unexplained parts to correlate them with macroeconomic and institutional variables to shed further light on potential drivers of differences in financial literacy in Sect. 4.3. We also deliver an exercise, in which we add the potentially endogenous variables capturing experience to the analysis.

4.1 Determinants of Financial Literacy

Table 6 shows different estimates of the conditional expectation function (CEF) of financial literacy. It can be interpreted as a predictive production function of financial literacy. We estimate two specifications with basic socio-economic characteristics (see Table 4) as explanatory variables: (1) without country fixed effects, (2) with country fixed effects. Note, that due to missing values in some of the explanatory variables our sample shrinks from 15,388 observations to 12,298.

The results about the predictive effects of individual characteristics are robust to adding country fixed effects. The income buffer dummy, which is a raw measure of financial wealth is positively related to financial literacy (see, e.g. Monticone 2010) and translates to (depending on specification) about 0.4–0.6 (out of the 7) correct answers more for individuals with a financial buffer of at least 3 monthly incomes. The gender gap commonly found in the literature is clearly visible. Women score on average about 0.5 points less. Singles also tend to have slightly lower scores. Individuals with university

Table 6 Baseline OLS estimates of determinants of financial literacy. *Source*: OECD/INFE international survey of adult financial literacy competencies

	(1)	(2)
Income buffer	0.594***	0.433***
	(0.033)	(0.035)
Gender	−0.456***	−0.468***
	(0.032)	(0.031)
Single	−0.077*	−0.120***
	(0.043)	(0.043)
University education	0.569***	0.686***
	(0.034)	(0.035)
Age category (18–29)	−0.107	−0.065
	(0.081)	(0.080)
Age category (30–49)	0.124	0.113
	(0.076)	(0.076)
Age category (50–69)	0.268***	0.265***
	(0.065)	(0.064)
Employed	0.167***	0.204***
	(0.046)	(0.045)
Self-employed	−0.002	0.154**
	(0.059)	(0.061)
Retired	−0.126**	−0.062
	(0.064)	(0.064)
Constant	4.493***	4.911***
	(0.085)	(0.101)
Country fixed effects	No	Yes
Adjusted R^2	0.097	0.144
Observations	12,298	12,298

Robust standard errors presented in parentheses. Regressions estimated using survey weights. Dummy variables for Age category 70+, Other employment status, and Finland are the baseline categories for the respective dummy variable sets

*$p<0.10$; **$p<0.05$; ***$p<0.01$

degrees score about 0.6–0.7 questions better. The hump shaped age pattern we found in the descriptive tables is confirmed in the estimation of the CEF: The lowest age category scores lower than the oldest, but the age category between 50 and 69 scores even higher. Whereas the employed perform significantly higher than people not working (in line with e.g. Cupák et al. 2019), this is less clear for the self-employed and the retired. However, the coefficients of employed and self-employed are not significantly different from each other.

Table 7 Blinder-Oaxaca decomposition at mean (baseline). *Source*: OECD/INFE international survey of adult financial literacy competencies

	AT	BR	CA	CR	DE	HK	HU	JO	NL	RU	UK
I. Differential											
Benchmark (FI)	5.222***	5.222***	5.222***	5.222***	5.222***	5.222***	5.222***	5.222***	5.222***	5.222***	5.222***
	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)
Compared country	4.908***	4.510***	4.968***	4.348***	4.951***	5.773***	4.743***	4.483***	5.221***	4.430***	4.340***
	(0.044)	(0.045)	(0.044)	(0.054)	(0.066)	(0.040)	(0.052)	(0.048)	(0.061)	(0.054)	(0.061)
Difference (raw)	0.314***	0.712***	0.254***	0.874***	0.271***	−0.551***	0.479***	0.740***	0.002	0.792***	0.883***
	(0.071)	(0.071)	(0.071)	(0.077)	(0.086)	(0.069)	(0.076)	(0.073)	(0.082)	(0.077)	(0.082)
Difference (%)	6.20	14.63	4.99	18.26	5.33	−10.01	9.62	15.25	0.03	16.41	18.46
II. Decomposition											
Explained	0.160***	0.154**	−0.265***	0.188***	−0.004	−0.084	0.189***	−0.248***	−0.202***	0.166***	−0.061
	(0.039)	(0.069)	(0.057)	(0.052)	(0.042)	(0.063)	(0.056)	(0.080)	(0.060)	(0.057)	(0.051)
Unexplained	0.154*	0.558***	0.519***	0.686***	0.275***	−0.467***	0.290***	0.987***	0.204**	0.626***	0.944***
	(0.080)	(0.092)	(0.084)	(0.091)	(0.092)	(0.090)	(0.093)	(0.108)	(0.097)	(0.098)	(0.092)
N obs. (FI)	1131	1131	1131	1131	1131	1131	1131	1131	1131	1131	1131
N obs. (country)	1737	1158	952	950	915	970	914	858	853	962	898

Results for benchmark country are highlighted in grey. Austria (AT), Brazil (BR), Canada (CA), Croatia (HR), Finland (FI), Germany (DE), Hong Kong (HK), Hungary (HU), Jordan (JO), The Netherlands (NL), Russia (RU), the United Kingdom (UK). Decomposition using survey weights. "Age category 70+", and "Other employment status" are reference categories of the respective dummy variable sets. Only basic socio-economic characteristics (i.e. income buffer, gender, age, education, and working status) used as explanatory variables in the underlying regressions. Robust standard errors presented in parentheses

*$p<0.10$; **$p<0.05$; ***$p<0.01$

4.2 Decomposition Analysis

Results from the Blinder–Oaxaca (B–O) decomposition analysis are shown in Table 7.[7] As outlined in Sect. 3, we use Finland as a reference country. The largest gaps in financial literacy (about 15% or above) are observed in Brazil, Croatia, Jordan, Russia, and the UK. Hungary also shows relatively large gaps compared to Finland (almost 10%). Austria, Germany and Canada still show gaps of 5–6%, whereas The Netherlands hardly shows relevant deviation. Hong Kong exceeds average financial literacy in Finland.

In some countries, differences in observable individual characteristics with Finland significantly dampen the gap (Canada, Jordan and the Netherlands), while for other countries the gap is significantly larger because of differences in individual characteristics (Austria, Brazil, Croatia, Hungary and Russia). That means that if differences due to variations in the share of characteristics in the population are filtered out and only within-characteristic differences are considered, the gap reduces by this amount. In the same way the gap widens for countries where characteristics dampen the unconditional observed differences. In Germany the part of the lower score explained by these individual characteristics is not significantly different from Finland, whereas in Hong Kong individual characteristics do not significantly explain part of the higher score in Hong Kong.

All in all, it is rather obvious that individual characteristics matter when comparing financial literacy across countries. It is important to have 'apples to apples' comparison to design policies in an informed way. In the case of differences in educational attainment this is rather obvious. The policy recommendation would be completely different if financial literacy of the highly educated in one country falls short of that in other countries, as compared to the case where overall education attainment is lower than in other countries.

Given the different distributions of the financial literacy score across countries (Fig. 1), we decompose these distributions by means of RIF-regressions, as outlined in Sect. 3. That is important as higher levels of financial literacy build on basic financial literacy. It can well be that in some countries everybody has at least basic financial literacy but hardly anyone has the type of complex financial literacy needed to invest in more complex financial products such as shares or bonds. Behind the same mean many distributions of the financial literacy score are possible—all pointing to different situations and different ways to tackle certain literacy deficits. To design efficient policies to improve financial literacy, one needs to know the complete pattern across the full distribution of financial literacy and not only the mean. RIF-regression allows us to examine differences across countries at different points in the respective distributions and decompose them instead of average

[7] Note that the means of financial literacy are slightly different from the unconditional means due to the missing information on individual characteristics and experience. However, given the fact that the total sample size is still 12,298 observations in the case of individual characteristics and 10,810 observations in the case of individual characteristics and experience (see Sect. 4.4), the missing pattern is not highly correlated with our covariate set. Furthermore, our covariate set contains exclusively dummy variables, which means that we do not have a large amount of linear extrapolation but rather look at a set of conditional group specific means of combinations of dummies. We are therefore confident using the standard listwise deletion approach. Our RIF-regression based approach for the median serves as a robustness check as the median is a robust statistic in the sense that it has a bounded influence function, which means that it is less exposed to missing observations.

Table 8 RIF Blinder-Oaxaca quantile decomposition (baseline). *Source*: OECD/INFE international survey of adult financial literacy competencies

	AT	BR	CA	CR	DE	HK	HU	JO	NL	RU	UK
RIF B-O decomposition for 10th percentile											
I. Differential											
Benchmark (FI)	3.327***	3.327***	3.327***	3.327***	3.327***	3.327***	3.327***	3.327***	3.327***	3.327***	3.327***
	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)
Compared country	2.571***	2.438***	3.302***	2.479***	2.949***	4.194***	2.797***	2.696***	2.753***	2.344***	2.314***
	(0.075)	(0.037)	(0.050)	(0.072)	(0.132)	(0.077)	(0.075)	(0.048)	(0.145)	(0.058)	(0.102)
Difference (raw)	0.756***	0.889***	0.024	0.848***	0.378**	−0.867***	0.530***	0.631***	0.574***	0.983***	1.013***
	(0.112)	(0.091)	(0.098)	(0.110)	(0.157)	(0.113)	(0.112)	(0.096)	(0.167)	(0.102)	(0.132)
Difference (%)	25.64	30.85	0.73	29.21	12.03	−23.06	17.31	20.94	18.88	34.65	35.91
II. Decomposition											
Explained	0.048	0.048	−0.149*	0.031	−0.042	−0.084	0.059	−0.059	−0.149	0.141	−0.061
	(0.056)	(0.094)	(0.088)	(0.083)	(0.060)	(0.093)	(0.091)	(0.107)	(0.098)	(0.089)	(0.080)
Unexplained	0.708***	0.841***	0.174	0.817***	0.420***	−0.783***	0.471***	0.690***	0.723***	0.842***	1.073***
	(0.127)	(0.122)	(0.111)	(0.133)	(0.162)	(0.138)	(0.143)	(0.136)	(0.181)	(0.144)	(0.145)
RIF B-O decomposition for 50th percentile											
I. Differential											
Benchmark (FI)	6.017***	6.017***	6.017***	6.017***	6.017***	6.017***	6.017***	6.017***	6.017***	6.017***	6.017***
	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)
Compared country	5.483***	4.840***	5.417***	4.733***	5.728***	6.419***	5.328***	4.825***	6.228***	4.999***	4.951***
	(0.034)	(0.041)	(0.055)	(0.067)	(0.099)	(0.035)	(0.053)	(0.051)	(0.081)	(0.067)	(0.101)
Difference (raw)	0.535***	1.177***	0.600***	1.285***	0.290**	−0.402***	0.690***	1.193***	−0.211**	1.018***	1.066***
	(0.067)	(0.072)	(0.080)	(0.089)	(0.115)	(0.068)	(0.079)	(0.077)	(0.100)	(0.089)	(0.116)
Difference (%)	9.30	21.68	10.50	23.90	4.94	−6.46	12.16	22.00	−3.44	18.49	19.44
II. Decomposition											
Explained	0.140***	0.135*	−0.236***	0.176***	0.005	−0.073	0.174***	−0.261***	−0.189***	0.134**	−0.058
	(0.039)	(0.073)	(0.051)	(0.049)	(0.041)	(0.058)	(0.053)	(0.085)	(0.051)	(0.058)	(0.045)

Table 8 (continued)

	AT	BR	CA	CR	DE	HK	HU	JO	NL	RU	UK
Unexplained	0.394***	1.042***	0.837***	1.109***	0.285**	−0.329***	0.516***	1.454***	−0.022	0.884***	1.124***
	(0.077)	(0.093)	(0.088)	(0.100)	(0.120)	(0.088)	(0.094)	(0.112)	(0.108)	(0.106)	(0.121)
RIF B-O decomposition for 90th percentile											
I. Differential											
Benchmark (FI)	7.441***	7.441***	7.441***	7.441***	7.441***	7.441***	7.441***	7.441***	7.441***	7.441***	7.441***
	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
Compared country	7.364***	6.825***	7.442***	6.987***	7.528***	7.544***	7.255***	6.883***	7.805***	7.050***	7.104***
	(0.037)	(0.061)	(0.050)	(0.087)	(0.050)	(0.031)	(0.067)	(0.076)	(0.052)	(0.081)	(0.065)
Difference (raw)	0.077	0.616***	−0.001	0.454***	−0.087	−0.103*	0.186**	0.558***	−0.364***	0.391***	0.337***
	(0.060)	(0.077)	(0.069)	(0.099)	(0.069)	(0.056)	(0.082)	(0.090)	(0.070)	(0.094)	(0.081)
Difference (%)	1.04	8.63	−0.01	6.29	−1.16	−1.38	2.54	7.79	−4.77	5.39	4.64
II. Decomposition											
Explained	0.211***	0.121*	−0.198***	0.180***	0.072**	−0.023	0.177***	−0.373***	−0.144***	0.076*	0.003
	(0.036)	(0.064)	(0.043)	(0.040)	(0.035)	(0.047)	(0.042)	(0.068)	(0.042)	(0.043)	(0.037)
Unexplained	−0.134**	0.495***	0.197**	0.274***	−0.158**	−0.080	0.009	0.931***	−0.220***	0.315***	0.334***
	(0.064)	(0.090)	(0.082)	(0.102)	(0.074)	(0.075)	(0.088)	(0.116)	(0.083)	(0.102)	(0.087)
N obs. (FI)	1131	1131	1131	1131	1131	1131	1131	1131	1131	1131	1131
N obs. (country)	1737	1158	952	950	915	970	914	858	853	962	898

Results for benchmark country are highlighted in grey. Austria (AT), Brazil (BR), Canada (CA), Croatia (HR), Finland (FI), Germany (DE), Hong Kong (HK), Hungary (HU), Jordan (JO), The Netherlands (NL), Russia (RU), the United Kingdom (UK). Decomposition using survey weights. "Age category 70+", and "Other employment status" are reference categories of the respective dummy variable sets. Only basic socio-economic characteristics (i.e. income buffer, gender, age, education, and working status) used as explanatory variables in the underlying regressions. Robust standard errors presented in parentheses

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

differences. Results of the RIF-regression based B-O quantile decomposition analysis (for the 10th, 50th, and 90th percentile) are presented in Table 8.[8] The RIF-regression based approach for the median serves also as a robustness check for the standard B–O decomposition at the mean, as the median is a robust statistic in the sense that it has a bounded influence function, which means that it is less exposed to missing observations.

The B–O decomposition analysis at the median of financial literacy (Table 8) confirms the results of the decomposition at the mean (Table 7). However, results differ substantially for the upper (90th percentile) and lower (10th percentile) part of the distributions of the financial literacy score, pointing towards different mechanisms in place at different points of the distribution. Gaps in percentage are larger and individual characteristics can explain fewer of these observed gaps at the bottom (p10) than at the top (p90).

These findings clearly point to the importance of schooling for financial literacy. Basic financial literacy skills such as percentage or interest calculation are part of school curricula. Almost everybody has access to this basic education. These gaps coming from the school system show up already at the lower ends of the literacy distribution and personal characteristics cannot explain them very well as a large part of the population is exposed to the quality of primary education the same way. At the upper end of the financial literacy ladder, more complex and specific knowledge makes the difference. Gaps being smaller here shows that fewer individuals are closely concerned with financially complex issues and that especially in countries that are lagging behind in general these differences are better explainable through individual characteristics. That makes sense as it is certainly higher education, jobs, interests and experiences which form this type of knowledge.

This finding has strong policy implications. While the large gaps at the bottom, which also make up a large amount of differences at the mean, can be tackled with a better general primary education system, the gaps at the top which relate to more sophisticated knowledge call for policies which are more targeted towards knowledge specific to financial literacy. They could be tackled through specific financial literacy programs in secondary schools or general information campaigns. Otherwise these gaps will persist as they are related to certain higher education, specific jobs and personal interests.

4.3 Unexplained Gaps of Financial Literacy and the Role of Institutions

In this section we examine the role of institutions in explaining the unexplained parts of the gaps in financial literacy score across the countries compared. Following Christelis et al. (2013) and Sierminska and Doorley (2018), we correlate the unexplained parts (coefficient effects) obtained from the mean and quantile B–O decomposition analysis with the selected macroeconomic indicators influencing populations' financial literacy. We consider a set of aggregate indicators which have been shown as important determinants of financial literacy at country-level. Following Jappelli (2010), we consider PISA math test scores, the share of internet users, (gross) enrolment ratio to secondary school, stock market capitalization, social contributions rate, life expectancy, and GDP per capita.

Similarly to Christelis et al. (2013), we argue that the unexplained component of the gap in financial literacy might be attributed to different economic environments of countries. As an example, one could think of the education system's quality in the particular country

[8] See the online Appendix C for additional analysis for the 25th and 75th percentile, which confirms that the pattern found extends to the full distribution and is not just present in the tail regions.

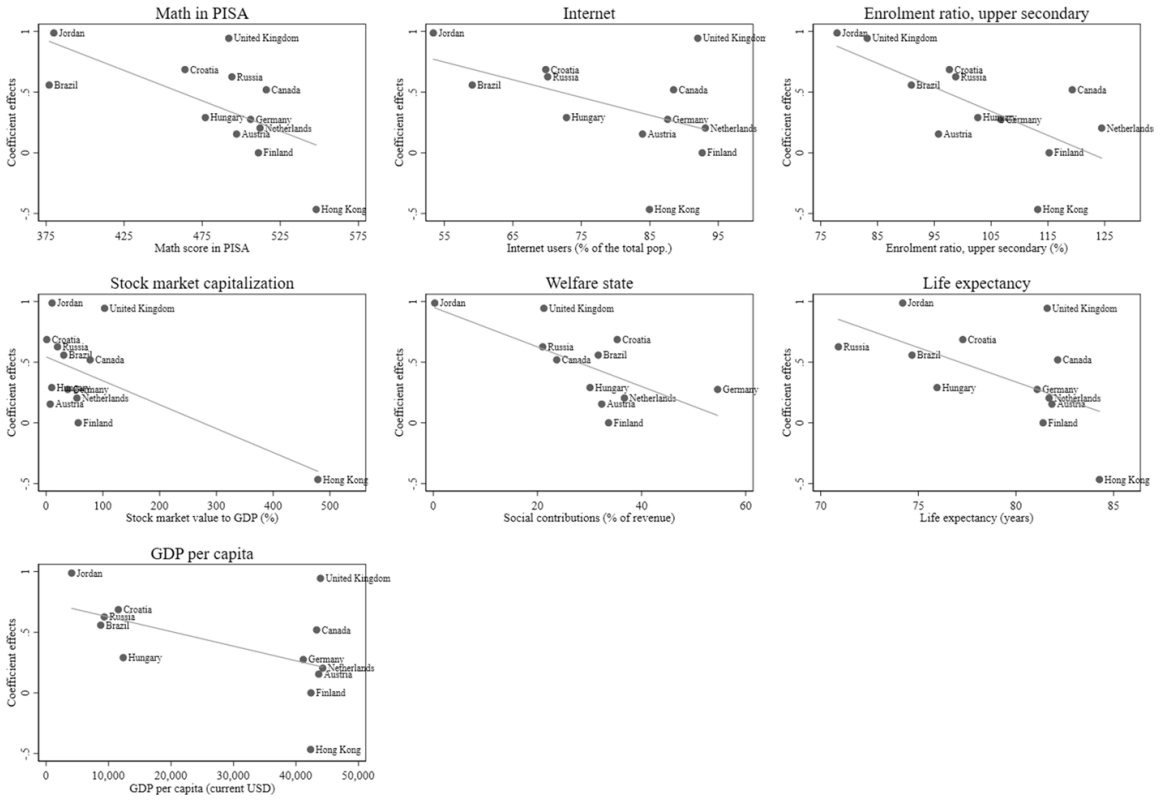

Fig. 2 Estimated coefficient effects from the mean B-O decomposition versus selected macroeconomic indicators (baseline). *Source*: OECD/INFE international survey of adult financial literacy competencies; World Bank data

which can have important implications for the population's financial literacy, which we proxy by an indicator on the PISA math test. According to Ciaian and Pokrivčák (2005), crucial sectors for economic development and human capital accumulation including the development of education systems in many transition countries have been lagging behind compared to Western European countries during the transition from a centrally-planned to a market economy. Furthermore, we may hypothesize that accumulating financial literacy does not only depend on personal characteristics such as the educational background, but also on whether it is easy to gather relevant information (proxied by the share of internet users in the country, which is below 60% in Brazil or Jordan) or whether there is a supportive intellectual environment (proxied by the enrolment ratio to secondary education). At the same time the enrolment ratio relates to individual education as it shows the relative value of individual education. The higher the enrolment ratio in secondary is, the less relative value has secondary education in a given country.

The unexplained part could also be interpreted as impacts of historic (behavioral) experiences of the market economy, which in turn could influence the financial literacy of individuals—proxied by an indicator on the stock market capitalization (e.g. Jappelli 2010). Finally, the incentive to invest in financial literacy may depend on the comprehensiveness of the welfare state (proxied by the social contributions as a share of total government revenues) and on life expectancy. Life expectancy, as well as GDP per

Table 9 Which institutions matter the most? (baseline). *Source*: OECD/INFE international survey of adult financial literacy competencies; World Bank data

Indicator	Mean		10th percentile		90th percentile	
	Std. effect	Rank	Std. effect	Rank	Std. effect	Rank
Math score in PISA	−0.261**	2	−0.267*	3	−0.268***	2
Internet users	−0.199*	7	−0.161	6	−0.257***	3
Gross enrolment ratio	−0.283***	1	−0.286*	2	−0.248***	4
Stock market capitalization	−0.258***	3	−0.400***	1	−0.084*	7
Social contributions rate	−0.217***	5	−0.077	7	−0.273***	1
Life expectancy	−0.235*	4	−0.265*	4	−0.214**	6
GDP per capita	−0.211*	6	−0.196	5	−0.232**	5

Country-level regressions of the unexplained parts of the gap (coefficient effects) estimated from the mean and quantile decomposition analysis on a set of aggregate indicators (one by one) which have been standardized (i.e. values demeaned and divided by their standard deviations)

*$p<0.10$; **$p<0.05$; ***$p<0.01$

capita, are often considered as indicators for the general level of development, health and well-being of a society. Our results suggest that besides the individual factors which explain financial literacy such as age, gender or education other institutional factors positively related to general development and well-being exist which also are positively related to financial literacy.

Having a glance at Fig. 2 one can observe the main finding from the decomposition analysis (see Sect. 4.2) and its relation to institutional differences. Overall, the unexplained part of the gaps estimated from the B–O analysis at the mean decreases with countries being institutionally closer to our benchmark category, Finland. This finding holds for the whole distribution of the financial literacy score, the 10th, 50th, and 90th percentile (see Figure D.2 in Appendix D). For a detailed discussion on how experience with financial products, financial planing and potential learning-by-doing might matter differently across the distribution of financial literacy see Appendix D.

As the last step of our empirical analysis, we examine which institutions matter the most for explaining the coefficient effects (the unexplained part of the gaps) estimated from the B-O analysis. To do so, we regress the unexplained part of the gaps estimated from the mean and quantile decomposition analysis, on a set of macroeconomic indicators (one-by-one) whose values have been standardized (i.e. de-meaned and divided by their standard deviations).[9]

A ranking of the importance of different institutions with regard to explaining the coefficient effects is presented in Table 9. Overall, we can see that all the macroeconomic and institutional variables under consideration are negatively correlated with unexplained differences in financial literacy. The higher the PISA math results, the share of internet users, enrolment to secondary school ratio, stock market capitalization, social contributions, life expectancy, and GDP per capita, the lower the unexplained differences with Finland. As

[9] As institutional characteristics are measured in different units, standardization of them is essential in order to be able to access their impact in a comparable way. A similar approach has been used by Bover et al. (2016a) to assess the role of institutions for the household debt behavior in Europe.

Finland also ranks among the highest in all these country level indicators, one can also interpret this result as unexplained differences in financial literacy being lower if institutional differences are smaller.

In most of the cases, indicators related to the level and quality of education (captured by enrolment ratio to upper-secondary schools and results of the PISA math tests) show the largest (standardized) correlation with the unexplained part of the financial literacy gaps. Similarly, the stock market capitalization is highly predictive for the size of the unexplained gaps. The life expectancy indicator—that we might consider as a proxy for a need to accumulate more pension wealth—also turns out to be highly important for explaining financial literacy gaps. Note that we added the correlations at the tails for the sake of completeness and as a way to check robustness. All correlations show the same negative sign.

All in all, these results point to the importance of the institutional environment when discussing cross-country differences in financial literacy. Environment not only matters in a direct way, by influencing financial literacy or creating more need—in the case of a smaller welfare state—for financial literacy, but also indirectly, by allowing individual characteristics to translate in different ways to financial literacy. Both, the direct and indirect importance of the personal and institutional environment are well documented in the literature (see De Beckker et al. 2020; Grohmann et al. 2018; Brown et al. 2018; Jappelli 2010).

As an example, one can imagine that an individual with higher educational attainment might be able to acquire financial literacy at lower cost with internet access rather than without. Or as another example, the incentive to engage in financial markets might be higher in a country where the need for private pension savings is higher. As discussed above, also policies to increase financial literacy can take these patterns into account and focus on the most promising policies depending on where the gaps are. Policies targeted at motivating individuals to participate in the stock market or to increase their share of risky asset holdings are a classic example of policies directly linked to a certain level of financial literacy. While the goal of such policies is often to increase benefits of the higher returns of the stock market to middle class households and their implementation is often done via tax incentives, they are also linked to financial literacy. The more financially literate individuals are, the easier it is for them to participate in these markets. Therefore, increasing the advanced forms of financial literacy may increase participation in stock markets and through learning by doing will in turn increase financial literacy. But also other policies such as different welfare state activities can increase or decrease the incentive to invest in financial literacy as they change the marginal return of additional financial literacy. Saving "for a rainy day" in some liquid savings account is different from saving for acquiring a home, old age provision or future health or education costs. If insurance against certain contingencies in life, which would call for a long-term organized savings plan, are organized by the state, people will have less need to invest in additional financial knowledge.

4.4 The Importance of Experience for Financial Literacy

So far, we have considered only basic socio-economic characteristics as predictors of financial literacy. We extend our multivariate and decomposition analysis by considering a set of variables capturing experience with finance (see Table 2, for exact definition). The inclusion of these (possibly) endogenous variables to further explain financial literacy gaps across countries is justified by the prior literature suggesting a potentially reverse causality between financial knowledge and financial outcomes of households and individuals (e.g. Fernandes et al. 2014; Jappelli and Padula 2013).

Table 10 OLS estimates of determinants of financial literacy (extension). *Source*: OECD/INFE international survey of adult financial literacy competencies

	(1)	(2)	(3)	(4)
Income buffer	0.594***	0.433***	0.465***	0.321***
	(0.033)	(0.035)	(0.036)	(0.037)
Gender	−0.456***	−0.468***	−0.410***	−0.432***
	(0.032)	(0.031)	(0.033)	(0.032)
Single	−0.077*	−0.120***	−0.036	−0.098**
	(0.043)	(0.043)	(0.045)	(0.045)
University education	0.569***	0.686***	0.483***	0.607***
	(0.034)	(0.035)	(0.035)	(0.036)
Age category (18–29)	−0.107	−0.065	−0.191**	−0.091
	(0.081)	(0.080)	(0.084)	(0.083)
Age category (30–49)	0.124	0.113	−0.015	0.027
	(0.076)	(0.076)	(0.080)	(0.079)
Age category (50–69)	0.268***	0.265***	0.103	0.136**
	(0.065)	(0.064)	(0.068)	(0.067)
Employed	0.167***	0.204***	0.090*	0.113**
	(0.046)	(0.045)	(0.046)	(0.046)
Self-employed	−0.002	0.154**	−0.109*	0.055
	(0.059)	(0.061)	(0.060)	(0.062)
Retired	−0.126**	−0.062	−0.183***	−0.120*
	(0.064)	(0.064)	(0.066)	(0.066)
Having budget			−0.059*	−0.009
			(0.033)	(0.034)
Active saver			0.070*	0.064*
			(0.036)	(0.037)
Financial planning			0.190***	0.147***
			(0.034)	(0.034)
Holding risky financial assets			0.375***	0.270***
			(0.040)	(0.042)
Constant	4.493***	4.911***	4.653***	4.881***
	(0.085)	(0.101)	(0.091)	(0.106)
Country fixed effects	No	Yes	No	Yes
Adjusted R^2	0.097	0.144	0.103	0.146
Observations	12,298	12,298	10,810	10,810

Robust standard errors presented in parentheses. Regressions estimated using survey weights. Dummy variables for Age category 70+, Other employment status, and Finland are the baseline categories for the respective dummy variable sets

*$p < 0.10$; **$p < 0.05$; *** $p < 0.01$

The multivariate analysis results on the effects of experience variables (Table 10, (3) without country fixed effects, (4) with country fixed effects) are remarkable in two dimensions. First, with regard to having a budget: This dummy variable indicates whether an individual is responsible for the budget. However, it interestingly relates to

Table 11 B-O decomposition at mean (extension). *Source*: OECD/INFE international survey of adult financial literacy competencies

	AT	BR	CA	CR	DE	HK	HU	JO	NL	RU	UK
I. Differential											
Benchmark (FI)	5.235***	5.235***	5.235***	5.235***	5.235***	5.235***	5.235***	5.235***	5.235***	5.235***	5.235***
	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)
Compared country	5.219***	4.510***	5.259***	4.536***	5.238***	5.773***	4.973***	4.603***	5.221***	4.437***	4.616***
	(0.043)	(0.044)	(0.047)	(0.057)	(0.068)	(0.039)	(0.057)	(0.049)	(0.060)	(0.053)	(0.067)
Difference (raw)	0.016	0.725***	−0.024	0.699***	−0.003	−0.538***	0.262***	0.632***	0.014	0.798***	0.619***
	(0.069)	(0.070)	(0.072)	(0.079)	(0.087)	(0.067)	(0.079)	(0.073)	(0.081)	(0.076)	(0.086)
Difference (%)	0.31	14.87	−0.46	14.30	−0.05	−9.77	5.14	12.84	0.27	16.51	12.56
II. Decomposition											
Explained	0.130**	0.274***	−0.428***	0.152**	−0.089	−0.197***	0.257***	−0.222***	−0.188**	0.231***	−0.179***
	(0.062)	(0.082)	(0.062)	(0.063)	(0.056)	(0.062)	(0.074)	(0.079)	(0.074)	(0.064)	(0.065)
Unexplained	−0.114	0.450***	0.404***	0.547***	0.086	−0.341***	0.005	0.853***	0.202*	0.568***	0.798***
	(0.094)	(0.100)	(0.085)	(0.096)	(0.100)	(0.086)	(0.104)	(0.107)	(0.105)	(0.101)	(0.102)
N obs. (FI)	1113	1113	1113	1113	1113	1113	1113	1113	1113	1113	1113
N obs. (country)	1344	1158	719	802	759	970	699	774	853	946	673

Results for benchmark country are highlighted in grey. Austria (AT), Brazil (BR), Canada (CA), Croatia (HR), Finland (FI), Germany (DE), Hong Kong (HK), Hungary (HU), Jordan (JO), The Netherlands (NL), Russia (RU), the United Kingdom (UK). Decomposition using survey weights. "Age category 70+", and "Other employment status" are reference categories of the respective dummy variable sets. In addition to basic socio-economic characteristics, variables capturing experience with finance (i.e. having budget, active saver, financial planning and holding risky financial assets) are considered in the underlying regressions. Robust standard errors presented in parentheses

*$p<0.10$; **$p<0.05$; ***$p<0.01$

marginally lower financial literacy (although not significant with country fixed effects). This could be for two reasons. Either low-income, low-educated households have a higher probability of having a budget because they make more cash transactions or because they have more urge to do so, for example as a precondition for getting a loan. Or the least financially literate person in a household typically is responsible for the households' budget. That would be worrisome as it would lead to less efficient budgeting. Second, all other experience variables are associated with higher financial literacy. Actively saving could be expected to positively contribute to financial literacy because of learning by doing effects, however the coefficient is only marginally/not significant. By contrast, holding risky financial assets and financial planning have economically significant effects of about 0.2 (financial planning) and 0.3–0.4 (holding risky assets) and these patterns are in line with the prior literature (e.g. Monticone 2010). Of course, these coefficients should not be interpreted as causal effects but rather as predictive effects or conditional correlations. We consider it likely that individuals learn before and while they are dealing with certain financial products and thereby increase their financial knowledge which is partly covered by our observed financial literacy scores.

One might also ask to what degree learning by doing, which we capture by experience, might further explain the observed gaps between countries. We investigate this by adding the experience covariates to our decomposition analysis. The results of this part are summarized in Table 11. In Canada, Hong Kong, Jordan, The Netherlands and the UK individual characteristics and experience still significantly dampen the observed differences, while for Austria, Brazil, Croatia, Hungary and Russia the gap appears still larger. The robustness of these results points towards the fact that different missing patterns of individual characteristics and experiences do not distort our analysis. Once experience is added, the gap is closed for Austria, Germany, and almost closed (92% explained) for Hungary. It also reduces strongly for Brazil (from 22 to 38% explained) and Russia (from 11 to 29% explained), while it stays almost the same for Croatia (about 12% explained). Canada is driven even further away, implying that when comparing individuals with similar 'experience' and characteristics in Canada and Finland, the within-group gap to Finland is even larger. The same, but to a lesser degree is true for the UK. The Netherlands and Jordan almost stay the same. Finally, in Hong Kong about 37% of the gap is explained by experience.

All in all, we can see that experience matters in the case of financial literacy. With our observational framework, we cannot clearly identify the causal pathway: Does experience lead people to learn more about financial products or do they learn more and then decide to apply the knowledge they learned by changing their investment behavior? However, it is important to know that some of the differences between countries are explainable by varying experience of individuals with financial products. One reason could be different welfare state regimes. In some countries (e.g. Brazil, Russia or the UK) private investment for old age provision or other precautionary motives is more important than in other countries (e.g. Austria, Finland or Germany). Also, supply of financial services varies across countries. In some countries, intermediation of banks is stronger (continental Europe) than in others (e.g. UK). All of these might induce more experience and therefore change financial literacy as well as the need for financial literacy. Additional results (quantile decompositions, and the role of institutions and their ranking) considering the role of experience are presented in Appendix D and confirm the findings from the baseline analysis.

5 Conclusion

The literature observes large differences in average financial literacy across countries (Lusardi and Mitchell 2014; Standard and Poor's 2015). While these observed differences arguably influence policies, the populations in different countries are not homogenous. So far, it had been unknown to what extent the observed differences are country-specific or driven by differences in the individual characteristics of the (sampled) population. To design the right policies, it is of the utmost importance to understand the reasons for observed differences of cross-country financial literacy gaps. By examining recently compiled harmonized OECD/INFE microdata on the financial literacy of individuals in 12 countries along with country level indicators, we delivered estimates of how much of these observed differences are due to differences in the characteristics of the population.

Our results indicate that differences in individual characteristics matter considerably. In some countries, differences in observable individual characteristics dampen much of the gap compared to Finland (in particular, Canada, Jordan and the Netherlands). For other countries, the gap is significantly larger because of differences in individual characteristics (in this case, Finland versus Austria, Brazil, Croatia, Hungary, and Russia). In the latter set of countries, between about 11% (Russia) and 59% (Austria) of the gap is explained by differences in individual characteristics. That means that if differences in financial literacy due to differences in the population's characteristics were filtered out and only within-characteristic differences were considered, the gap would be reduced by this amount.

A variety of robustness checks including extensions of the set of controls by potentially endogenous variables covering experience as well as analyses beyond the mean for different points of the distribution of financial literacy score confirm our results. Furthermore, we exploit the additive structure of the financial literacy score to link different gaps at different parts of the distribution to certain policies. While gaps at the lower end of the distribution call for more basic knowledge provided by high quality primary schooling, gaps at the upper end are related to more sophisticated knowledge which is either acquired in higher schooling or through learning by doing or on the job training. They could also be tackled through specific financial literacy programs in secondary schools or general information campaigns. The finding that individual characteristics explain more at the upper end of the distribution is suggestive evidence supporting this view.

We also correlated these unexplained parts of the financial literacy gaps (not explained by varying individual characteristics) obtained from decomposition analysis with macroeconomic and institutional country-level indicators. Following Jappelli (2010), we considered a set of indicators such as PISA math test scores, the share of internet users, enrolment ratio to secondary school, stock market capitalization, social contributions rate, life expectancy, and GDP per capita. Confirming the findings of Jappelli (2010), our results point to the importance of a country's institutional context when discussing cross-country differences in financial literacy.

It is important to emphasize that the country-level results obtained from the decomposition analysis and consequent linking to different economic environments do not necessarily imply causality. With this caveat in mind, our results offer interesting policy implications. Besides investing in individual-level factors important for human capital development (e.g. education, basic training in finance) it seems that there is room for harmonizing the economic and institutional environment across countries to decrease differences in financial literacy. Gaps at the upper end of financial literacy require different policy approaches than those at the lower end of the distribution.

We conclude that taking differences in population characteristics into account when comparing financial literacy across countries is important. If this is not done, it is difficult to draw useful policy conclusions, as it is impossible to disentangle differences based on country-specific variation from those based on variation in individual-level characteristics. Country rankings such as those presented in the OECD (2016) report are not very informative with regard to policy conclusions if differences stemming from basic individual characteristics cannot be identified.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11205-021-02713-8.

Acknowledgements We are grateful to the OECD/INFE working group for granting access to the individual-level data. We would like to thank the participants in the Household Finance and Consumption Network meeting at the European Central Bank (ECB), Joint ECB and Banque de France Conference on Household Finance and Consumption, National Bank of Slovakia Research Seminar, Oesterreichische Nationalbank Research Seminar, and Slovak Economic Association Annual Conference for their useful suggestions and comments. We further thank to Alyssa Schneebaum and Martin Šuster for their helpful comments on an earlier version of this paper. Most of all we would like to thank the three anonymous referees and the editor for their very useful comments and suggestions, which significantly improved the paper. Andrej Cupák was a visiting researcher at the Oesterreichische Nationalbank when this project started. Andrej Cupák acknowledges the financial support from the Ministry of Education, Science, Research and Sport of the Slovak Republic [VEGA 1/0221/21]. 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.

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2.2 Decomposing gender gaps in financial literacy: New international evidence

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Publikované v *Economics Letters*, 2018, roč. 168, s. 102–106. DOI: https://doi.org/10.1016/j.econlet.2018.04.004.

IF (2018):	0.876
SJR (2018):	0.767
JCR Best Q (2018):	Q3
ABDC ranking:	A

Economics Letters 168 (2018) 102–106

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Decomposing gender gaps in financial literacy: New international evidence

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HIGHLIGHTS

- On average, women score lower on financial literacy than men.
- The gender gap in financial literacy is more pronounced in more developed countries.
- Personal characteristics such as education explain only some of the gap.
- A larger part may be due to different socio-economic environments across countries.

ARTICLE INFO

Article history:
Received 7 November 2017
Received in revised form 26 March 2018
Accepted 2 April 2018
Available online 20 April 2018

JEL classification:
A20
D14
I20
G11

Keywords:
Survey data
Financial literacy
Gender gaps
Decomposition analysis

ABSTRACT

Using international OECD/INFE microdata, we show that the gender gap in financial literacy is highest in more developed countries. Only some of the gap can be explained by personal characteristics; the rest may be due to economic and social environment.

1. Introduction

A growing body of empirical literature has examined the role of gender in explaining differences in financial behavior of consumers (e.g. Almenberg and Dreber, 2015), including gender gaps in financial literacy. Lusardi and Mitchell (2008) were among the first to report that women in the U.S. have lower levels of financial literacy than men. Also using data from the U.S., Fonseca et al. (2012) show a significant gender gap in financial literacy and examine the role of household decision-making in explaining such differences. More recently, Bucher-Koenen et al. (2017) employ microdata from three different surveys from the U.S., Germany, and the Netherlands and report systematic gaps in financial literacy between men and women in all three countries under consideration.

However, the differences in financial literacy have not been examined using internationally comparable microdata covering more than only a few countries and employing more than the three financial literacy questions typically asked in the surveys (Lusardi and Mitchell, 2014). We contribute to the literature by examining an extended set of financial literacy questions for 12 countries. We employ counterfactual decomposition methods to decompose the gender gap in financial literacy into parts explainable by differences in observable individual characteristics across gender and parts that cannot be explained by individual characteristics.

2. Data

The data come from the OECD/INFE (International Network for Financial Education) survey of adult financial literacy

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https://doi.org/10.1016/j.econlet.2018.04.004
0165-1765/

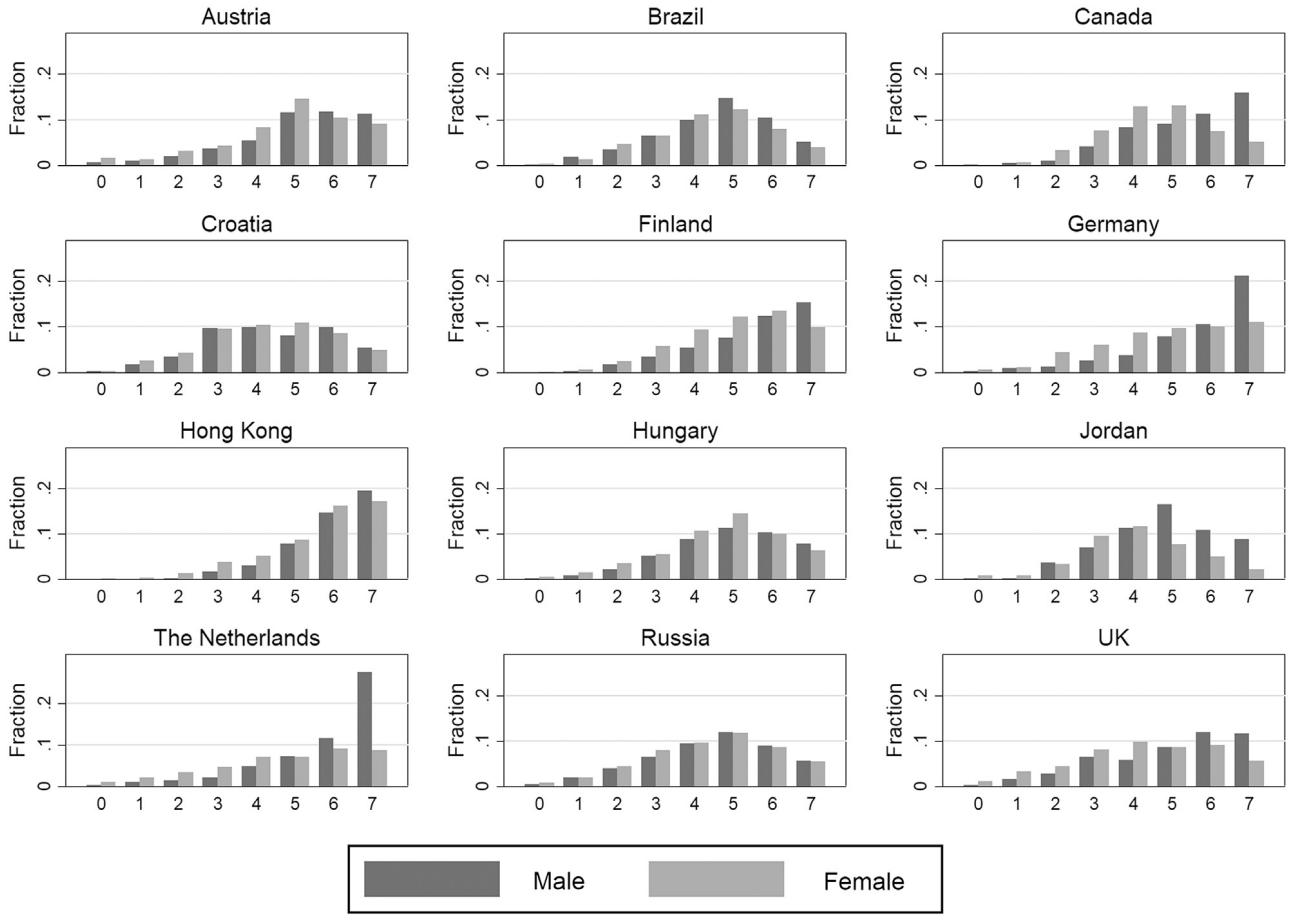


Fig. 1. Distribution of financial literacy by gender.
Source: OECD/INFE data

competencies.[1] While the survey was conducted in more than 30 countries around the world, only a few countries made the data available for research purposes. We use the individual-level data for Austria (AT), Brazil (BR), Canada (CA), Croatia (HR), Finland (FI), Germany (DE), Hong Kong (HK), Hungary (HU), Jordan (JO), the Netherlands (NL), Russia (RU), and the United Kingdom (UK), altogether comprising 12,250 observations without any missing information.[2] A unique feature of this survey is that the questions are asked in a harmonized way across countries. Furthermore, the set of financial literacy questions is much broader than in previous studies. The data also contain standard socio-economic demographic characteristics as well as information on financial behavior and attitudes towards money.

Similar to Lusardi and Mitchell (2014), our main variable of interest, the financial literacy score, is the sum of binary variables equal to 1 if the particular financial literacy question was answered correctly and 0 otherwise.[3] The constructed financial literacy score thus ranges from 0 to 7. The distribution of the financial literacy score by gender and across countries is shown in Fig. 1. A gender gap is clearly visible for most countries, especially at the highest levels of financial literacy.

Following the existing literature, we estimate financial literacy based on a set of individual-level socio-economic characteristics. Along with gender, we consider age, household size, working status, university education, and a financial buffer (relating financial assets to income) as explanatory variables. Furthermore, following Fonseca et al. (2012), we include a variable capturing responsibility for financial decisions within a household. Summary statistics of all variables used in our empirical analysis are presented in Table 1.

3. Empirical strategy

We decompose the difference in financial literacy between men and women in each country by means of a modified Blinder–Oaxaca (B–O) counterfactual decomposition method (Blinder, 1973; Oaxaca, 1973). This approach has already been used to study differences in financial literacy between men and women in the U.S. (e.g. Fonseca et al., 2012).

Consider two groups, men (M) and women (W), which have different outcomes in their financial literacy score. Following Jann (2008), at the mean of the financial literacy score, we can write the two-fold decomposition as follows:

$$R = \underbrace{\left(\overline{X}_M - \overline{X}_W\right)' \beta^*}_{\textit{Explained}} + \underbrace{\{\overline{X}'_M(\beta_M - \beta^*) + \overline{X}'_W(\beta^* - \beta_W)\}}_{\textit{Unexplained}} \quad (1)$$

where R represents the predicted difference in financial literacy between the compared groups M and W. X is a vector of socio-economic individual characteristics as listed in Table 1, β_M and β_W

[1] Detailed information about the survey can be found at http://www.oecd.org/pensions/oecd-infe-survey-adult-financial-literacy-competencies.htm. The dataset was made available for research beginning summer 2017.

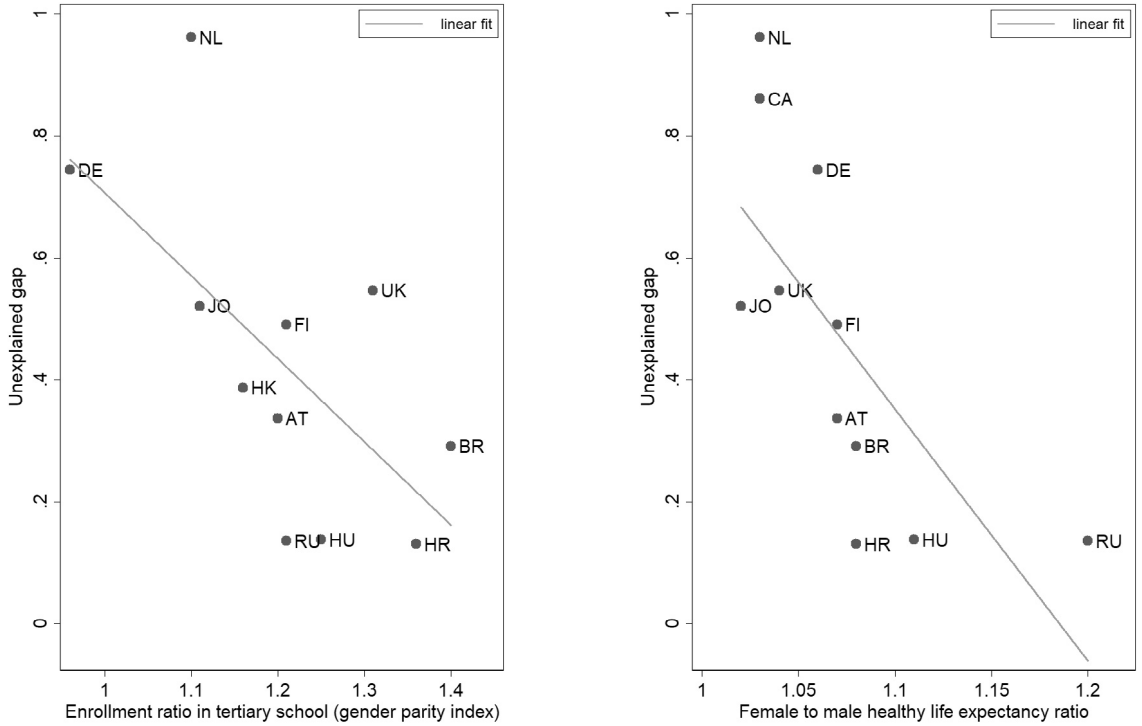
[2] The original data contain 15,350 observations, but we drop the observations where data for one or more variables are missing.

[3] In the OECD/INFE survey, there is one question for each of seven financial literacy topics: time value of money, interest paid on loan, interest and principal, compound interest, risk and return, inflation, and risk diversification. The full framing of the questions along with the possible answers is available in the statistical report of the OECD (2016, Annex 2).

Table 1
Summary statistics.
Source: OECD/INFE data

	AT	BR	CA	HR	FI	DE	HK	HU	JO	NL	RU	UK
Financial literacy score	4.91	4.51	4.97	4.35	5.22	4.97	5.77	4.74	4.52	5.22	4.44	4.35
	(1.74)	(1.54)	(1.52)	(1.65)	(1.52)	(1.80)	(1.31)	(1.59)	(1.53)	(1.86)	(1.68)	(1.79)
Dummy: financial buffer for at least 3 months (if lost income)	0.52	0.28	0.69	0.32	0.55	0.70	0.68	0.32	0.25	0.57	0.22	0.58
	(0.50)	(0.45)	(0.46)	(0.47)	(0.50)	(0.46)	(0.47)	(0.47)	(0.43)	(0.50)	(0.42)	(0.49)
Dummy: female	0.51	0.48	0.51	0.53	0.49	0.53	0.54	0.53	0.41	0.47	0.51	0.52
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.49)	(0.50)	(0.50)	(0.50)
Dummy: single person household	0.34	0.10	0.18	0.18	0.31	0.22	0.06	0.16	0.08	0.22	0.15	0.23
	(0.47)	(0.30)	(0.38)	(0.38)	(0.46)	(0.41)	(0.24)	(0.37)	(0.27)	(0.41)	(0.35)	(0.42)
Dummy: university education	0.11	0.11	0.45	0.18	0.27	0.17	0.20	0.19	0.64	0.40	0.28	0.31
	(0.31)	(0.31)	(0.50)	(0.38)	(0.44)	(0.38)	(0.40)	(0.39)	(0.48)	(0.49)	(0.45)	(0.46)
Dummy: age category (18–29)	0.21	0.23	0.18	0.18	0.27	0.18	0.19	0.18	0.45	0.16	0.31	0.18
	(0.41)	(0.42)	(0.38)	(0.39)	(0.44)	(0.38)	(0.39)	(0.38)	(0.50)	(0.36)	(0.46)	(0.38)
Dummy: age category (30–49)	0.35	0.45	0.36	0.36	0.45	0.35	0.40	0.37	0.42	0.38	0.47	0.34
	(0.48)	(0.50)	(0.48)	(0.48)	(0.50)	(0.48)	(0.49)	(0.48)	(0.49)	(0.49)	(0.50)	(0.47)
Dummy: age category (50–69)	0.29	0.28	0.38	0.34	0.19	0.34	0.35	0.35	0.12	0.38	0.18	0.34
	(0.45)	(0.45)	(0.49)	(0.47)	(0.39)	(0.47)	(0.48)	(0.48)	(0.33)	(0.49)	(0.38)	(0.48)
Dummy: age category (70+)	0.15	0.04	0.08	0.12	0.10	0.13	0.07	0.10	0.01	0.08	0.04	0.14
	(0.36)	(0.21)	(0.28)	(0.33)	(0.30)	(0.34)	(0.25)	(0.30)	(0.10)	(0.27)	(0.20)	(0.34)
Dummy: employed	0.50	0.37	0.51	0.43	0.39	0.49	0.57	0.53	0.42	0.48	0.60	0.54
	(0.50)	(0.48)	(0.50)	(0.49)	(0.49)	(0.50)	(0.50)	(0.50)	(0.49)	(0.50)	(0.49)	(0.50)
Dummy: self-employed	0.07	0.40	0.10	0.07	0.06	0.08	0.04	0.05	0.13	0.08	0.08	0.08
	(0.25)	(0.49)	(0.30)	(0.26)	(0.23)	(0.28)	(0.19)	(0.22)	(0.34)	(0.27)	(0.27)	(0.26)
Dummy: retired	0.27	0.12	0.20	0.26	0.24	0.25	0.13	0.26	0.03	0.17	0.17	0.23
	(0.44)	(0.32)	(0.40)	(0.44)	(0.43)	(0.43)	(0.34)	(0.44)	(0.18)	(0.38)	(0.38)	(0.42)
Dummy: other, not working	0.17	0.11	0.19	0.24	0.31	0.18	0.27	0.16	0.41	0.27	0.15	0.15
	(0.37)	(0.32)	(0.39)	(0.43)	(0.46)	(0.38)	(0.44)	(0.37)	(0.49)	(0.44)	(0.36)	(0.36)
Dummy: alone responsible for making financial decisions	0.53	0.42	0.35	0.28	0.53	0.39	0.35	0.31	0.33	0.47	0.40	0.55
	(0.50)	(0.49)	(0.48)	(0.45)	(0.50)	(0.49)	(0.48)	(0.46)	(0.47)	(0.50)	(0.49)	(0.50)
Observations	1,728	1,153	948	948	1,130	910	970	914	843	852	958	896

Note: Summary statistics based on non-missing values. Weighted figures, except Jordan (JO) and Russia (RU) where the weights were not provided.
Standard deviations presented in parentheses.



(a) Tertiary school enrollment ratio.

(b) Healthy life expectancy.

Fig. 2. Unexplained gaps and different economic environments. Note: For Canada there was no data for the tertiary school enrollment ratio whereas for Hong Kong female to male healthy life expectancy was missing.
Source: OECD/INFE data; World Bank data; World Economic Forum data

Table 2
Blinder–Oaxaca decomposition results.
Source: OECD/INFE data

	NL	CA	JO	DE	UK	FI	AT	HK	HU	BR	HR	RU
I. Differential												
Mean (men)	5.809***	5.430***	4.840***	5.718***	4.980***	5.534***	5.182***	5.982***	4.898***	4.605***	4.447***	4.502***
	(0.065)	(0.062)	(0.062)	(0.071)	(0.074)	(0.059)	(0.055)	(0.049)	(0.068)	(0.061)	(0.074)	(0.075)
Mean (women)	4.663***	4.536***	4.057***	4.826***	4.248***	5.043***	4.782***	5.597***	4.645***	4.403***	4.311***	4.371***
	(0.091)	(0.061)	(0.073)	(0.075)	(0.076)	(0.058)	(0.056)	(0.060)	(0.069)	(0.064)	(0.072)	(0.075)
Difference (raw)	1.146***	0.895***	0.783***	0.893***	0.732***	0.492***	0.400***	0.385***	0.253***	0.202**	0.136	0.131
	(0.112)	(0.087)	(0.095)	(0.104)	(0.106)	(0.083)	(0.079)	(0.078)	(0.097)	(0.088)	(0.103)	(0.106)
Difference (%)	22%	18%	18%	17%	16%	9%	8%	7%	5%	4%	3%	3%
II. Decomposition												
Explained	0.183***	0.034**	0.262***	0.149***	0.185***	0.001	0.063***	−0.002	0.115***	−0.089***	0.005	−0.005
	(0.034)	(0.014)	(0.060)	(0.025)	(0.018)	(0.014)	(0.010)	(0.038)	(0.025)	(0.027)	(0.019)	(0.025)
Unexplained	0.962***	0.861***	0.521***	0.744***	0.547***	0.491***	0.337***	0.387***	0.138	0.291***	0.131	0.136
	(0.119)	(0.090)	(0.110)	(0.109)	(0.107)	(0.084)	(0.080)	(0.089)	(0.099)	(0.093)	(0.106)	(0.110)

Note: Countries listed according to the size of the financial literacy gender gap. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

are the corresponding coefficient vectors estimated separately for M and W, and β^* is a coefficient vector estimated from a pooled regression over the two groups M and W. [4]

4. Results

The results of the B–O decomposition at the mean of the financial literacy score for men and women are presented in Table 2.[5] There is a significant gap in financial literacy between men and women in each country except Croatia and Russia. The gap ranges from 3% in Croatia and Russia to more than 20% in the Netherlands. Interestingly, the gap is generally higher in more developed countries (e.g. Canada, Germany, the Netherlands, and the U.K.). On the other hand, in the formerly communist countries (Croatia, Hungary, and Russia), the gaps in financial literacy are rather small and/or statistically insignificant.[6]

The other observation from the B–O results (Table 2) is that in every country, the unexplained part of the gap is larger than the part of the gap explained by differences in individuals' characteristics. In ten of the 12 countries, at least three-quarters of the overall gap is due to such unexplained factors. We suggest that this unexplained part might be related to social and economic environments and social norms across countries.[7]

Fig. 2 gives two examples for such potential relationships: it plots the unexplained part of the B–O decomposition against the parity index of tertiary school enrollment and the female to male healthy life expectancy ratio. Both of these ratios are (significantly) negatively correlated with the unexplained portion of the gap. The first relationship suggests that in countries in which more women are enrolled in tertiary education, an individual woman's education may translate better to financial literacy. This ratio might also pick up other social norms linked to women's financial literacy. The second relationship may be explained by the fact that in countries with a higher life expectancy for women, women invest more in their financial literacy, anticipating that they may one day be responsible for their finances alone.

Many other explanations are possible and offer interesting avenues for future research; we found, for example, a positive correlation between the unexplained portion of the gap and GDP per capita (statistically significant) as well as the female-to-male labor force participation ratio (statistically insignificant) (not shown).

5. Concluding remarks

Using microdata comparable across 12 countries, we find that, on average, women score lower on financial literacy. The financial literacy gap is lowest – sometimes statistically insignificant – in Eastern European countries. The more equal financial literacy scores in those countries may be related to social and economic norms left over from times of communism, when women were expected to be active participants in economic life and decision-making.

While some, but not all, of the western European countries in the sample have very large gender gaps in financial literacy (Germany and the Netherlands but not Austria and Finland), both Anglo-Saxon countries (Canada and the UK) have very high gaps. Thus, higher GDP does not necessarily come with more gender equality in financial literacy. It seems more likely that social norms about women's participation in economic life are a closer predictor of gender differences in financial literacy.

Acknowledgments

We are grateful to the OECD/INFE working group for granting access to the individual-level microdata. We would like to thank an anonymous referee for helpful comments and suggestions. The views expressed in the paper do not necessarily reflect the views of the Oesterreichische Nationalbank, the National Bank of Slovakia, the Eurosystem, or LIS Cross-National Data Center in Luxembourg.

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[4] Another approach of obtaining β^*, as suggested by Cotton (1988), would be weighting the coefficients by the considered group sizes.

[5] Due to space constraints, we show only part of the decomposition analysis. Full, detailed decomposition results are available upon request.

[6] As a robustness check (not shown here, but available upon request) we provide a similar exercise but using financial literacy scores based on the standard three Lusardi and Mitchell (2008) questions (interest rates, inflation, and diversification). The result that gender gaps in financial literacy are higher in more developed countries does not change when we limit the analysis to this set of questions.

[7] We motivate this argument by recent findings of Christelis et al. (2013) who show that differences in household portfolios are due to varying economic environments rather than differences in household characteristics.

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2.3 Gender differences in risky asset behavior: The importance of self-confidence and financial literacy

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Publikované v *Finance Research Letters*, 2021, roč. 42, 101880. DOI: https://doi.org/10.1016/j.frl.2020.101880.

IF (2021):	9.846
SJR (2021):	2.007
JCR Best Q (2021):	Q1
ABDC ranking:	A

Finance Research Letters 42 (2021) 101880

Contents lists available at ScienceDirect

Finance Research Letters

journal homepage: www.elsevier.com/locate/frl

Gender differences in risky asset behavior: The importance of self-confidence and financial literacy

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ARTICLE INFO

JEL codes:
D14
D91
I20
G11
G53

Keywords:
self-confidence
financial literacy
financial behavior
gender
decomposition

ABSTRACT

This paper studies the role of individuals' confidence in own financial literacy in explaining the gender gap in investment in risky assets, while controlling for actual financial literacy and risk aversion. It is the first paper to assess the role of confidence independent of actual financial knowledge for a large set of countries and it is the first to explore the role of confidence by using counterfactual decomposition techniques. Results from our analysis confirm recent findings of modern behavioral finance: confidence is a strong determinant of risky financial behavior and accounts for a large part of the gender gap.

1. Introduction

The literature on financial asset holdings has established that women are less likely than men to hold risky assets (Jianakoplos and Berasek, 1998; Charness and Gneezy, 2012).[1] Common explanations for this fact have been that women are more risk-averse (Dohman et al., 2011; Halko et al., 2012) and that women have less financial knowledge than men (Dwyer et al., 2002; van Rooij et al., 2011; Bucher-Koenen et al., 2017; Bollen and Posavac, 2018; Cupák et al., 2018; Almenberg and Dreber, 2015). More recent literature additionally considers the role of self-confidence (subjective financial literacy) (Barber and Odean, 2001; Bannier and Neubert, 2016; Bannier et al., 2019; Cupák et al., 2020) and financial self-efficacy (e.g. Montford and Foldsmith, 2016) to explain the gender differences in risky asset holdings. These studies show that an important factor in explaining why women are less likely to hold risky financial assets is that they are less confident about their financial skills.

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[1] There is also a strand of literature studying gender gaps in debt behavior. An example of such study is by Meyll and Pauls (2019) who found that women are less likely to be over-indebted even after controlling for financial literacy and risk-aversion.

https://doi.org/10.1016/j.frl.2020.101880
Received 2 September 2020; Received in revised form 30 October 2020; Accepted 3 December 2020
Available online 8 December 2020

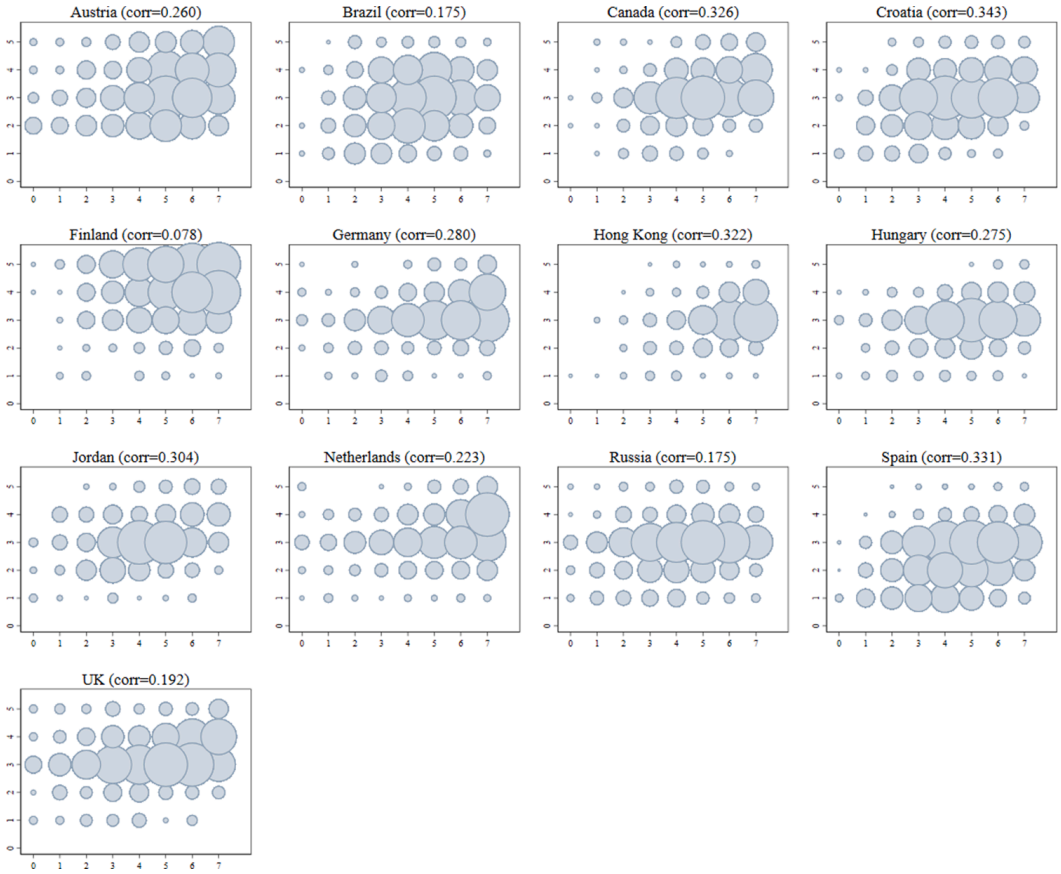

Fig. 1. Distributions of confidence in own financial knowledge and measured financial literacy.
Note: This graph shows scatter plots of measured financial literacy (0 to 7 score on the x-axis) and confidence in own financial knowledge (0 to 5 score on the y-axis) across countries, where dots are weighted by frequency of observation.
Source: OECD / INFE dataset.

The existing studies on the role of confidence in determining financial investments typically look at just one country at a time (e.g. Germany in Bannier and Neubert, 2016 and the U.S. in Cupák et al., 2020). This is the first paper to study the role of confidence in explaining the gender gap in the holding of risky assets for a large international set of 12 countries plus Hong Kong at once, decomposing the gender gap into several observable characteristics, including consumer confidence and measured financial literacy, while controlling for risk aversion.

2. Data and variables

To explore differences in participation in risky assets, we use recent international harmonized micro-data from the OECD / INFE (International Network on Financial Education) survey (OECD 2016).[2] The main goal of the survey is to monitor the financial capabilities of the adult population, with a special focus on financial knowledge, attitudes, and behavior. While the survey collects data in around 30 countries worldwide, not all countries have made their data publicly available for research purposes. Our final sample of countries includes Austria (AT), Brazil (BR), Canada (CA), Croatia (HR), Finland (FI), Germany (DE), Hungary (HU), Hong-Kong, China (HK), Jordan (JO), the Netherlands (NL), Russia (RU), Spain (ES), and United Kingdom (UK).

Following the literature on consumer finance (e.g. Guisso et al., 2002; Campbell, 2006), we model participation in risky assets (ownership of stocks and/or bonds) as a function of basic socio-economic characteristics such as economic resources and employment status, education, age, and marital status. Most importantly, we are able to control for measured financial literacy, risk aversion, and confidence in own financial capabilities.[3] A description of the variables entering our empirical analysis is provided in the appendix (Table A1).

Fig. 1 shows survey respondents' self-confidence in financial knowledge (vertical axis) and actual measured financial literacy

[2] Detailed information about the survey and the statistical report can be found at https://www.oecd.org/finance/oecd-infe-survey-adult-financial-literacy-competencies.htm.

[3] There is a close connection between financial literacy and self-perception of knowledge. Bazley et al. (2020) found that individuals who are financially illiterate and are aware of their limited knowledge tend to opt out from investing.

(horizontal axis) by country, where the size of the dots corresponds to the frequency of observations.[4] While the figure shows a weak positive correlation between self-confidence and financial literacy in all countries, there is wide variation in this relationship across countries. In Canada, Hong Kong, Jordan, and Spain, the correlation in these measures is relatively high (all with a correlation coefficient above 0.3), while in Brazil, Finland, Russia, and the UK, the correlation between confidence and ability is below 0.2.

Table 1 looks explicitly at the gender gap in these measures, as well as the share of respondents holding risky assets. In all countries, women are less confident in their financial capabilities on average and have lower financial literacy scores on average than men; these differences are statistically significant in most countries.

3. Estimation and results

We study differences in participation in risky assets between men (M) and women (W) by a counterfactual decomposition technique for non-linear models proposed by Fairlie (2005),[5] which is an extension of the classical Blinder-Oaxaca decomposition to the case of binary outcome variables. The method helps answer the question of how much of the observed gender gap in risky asset holdings is explained by differences in men and women's characteristics (and how much of a difference remains unexplained once these characteristics are taken into account). The gender gap in the probability of participation in risky assets can be decomposed as follows:

$$Pr\left(Y^M=1|X^M\right)-Pr\left(Y^W=1|X^W\right)=\underbrace{\left[\overline{\Lambda\left(X^M\beta^M\right)}-\overline{\Lambda\left(X^W\beta^M\right)}\right]}_{\text{difference in characteristics}}+\underbrace{\left[\overline{\Lambda\left(X^W\beta^M\right)}-\overline{\Lambda\left(X^W\beta^W\right)}\right]}_{\text{difference in parameters}},$$

where X^M and X^W represent row vectors of the control variables for men and women, alongside the vectors of coefficients (β^M and β^W) estimated separately for both groups. Λ is the distribution function of the logistic distribution. In our exercise, we are mostly interested in the contribution of the particular covariates explaining the "difference in characteristics."

Table 2 shows the results of this decomposition. In most countries, at least half of the raw gap in the holding of shares/bonds can be explained by differences in observable characteristics. While some characteristics can explain some portion of the gap (such as having a financial buffer and employment), in many countries, one's level of confidence in financial ability is the strongest or second strongest determinant of the gender gap in risky asset holdings. In almost all places, individual confidence is – besides risk attitude itself – the central predictor of the gender difference in risky asset holdings. Finland and Spain are the only countries in which differences in measured financial literacy explain more of the risky asset gap than confidence.

Bannier and Neubert (2016) show for Germany that controlling for measured financial literacy and self-confidence eliminates the significance of gender in predicting the probability of holding risky assets in a linear probability model. We can confirm the same phenomenon, albeit more directly, as we directly estimate the contribution of different observables in explaining the observed gender gap.

4. Conclusions

We employed comparable international microdata to explore the role of measured financial literacy and self-confidence in explaining the gender gap in risky asset holdings. While there has been increased awareness that self-confidence might play a role in these differences and resulting asset return patterns, empirical evidence using comparable microdata across countries is still scarce. This paper confirms the findings of the literature that self-confidence is a significant factor in explaining the risky asset gender gap. Our results suggest that its role might be much stronger than formerly thought.

We conclude that while education and financial literacy might be very important factors in lowering the gender gap in investments into risky assets, one crucial additional path to gender equality is addressing the related norms and gender roles in society. These norms underlie differences in self-confidence, which – on top of all other observable characteristics – lead to women's lower participation in risky asset markets.

CRediT authorship contribution statement

Andrej Cupák: Conceptualization, Software, Formal analysis, Data curation, Writing - review & editing. **Pirmin Fessler:** Conceptualization, Writing - review & editing. **Alyssa Schneebaum:** Conceptualization, Writing - original draft, Writing - review & editing.

Appendix

[4] Note that subjective literacy is asked before the knowledge questions in the OECD/INFE survey.

[5] Note that we are not claiming to provide causal effects. The method serves as a useful tool for understanding the complexities in financial decision-making between men and women, because it allows us to filter out differences explainable by observables in a rather flexible way.

Table 1
Summary statistics of selected variables by gender.

	AT (N=1,326)	BR (N=1,142)	CA (N=713)	HR (N=782)	FI (N=1,097)	DE (N=747)	HK (N=960)	HU (N=692)	JO (N=764)	NL (N=775)	RU (N=862)	ES (N=4,898)	UK (N=650)
Ownership of shares/bonds													
Men	0.149	0.013	0.495	0.145	0.343	0.350	0.565	0.075	0.173	0.163	0.071	0.187	0.423
Women	0.095	0.007	0.412	0.110	0.268	0.260	0.460	0.032	0.096	0.047	0.123	0.157	0.348
Difference	0.054***	0.006	0.083**	0.034	0.076**	0.090**	0.105***	0.043**	0.076***	0.117***	-0.053***	0.031**	0.075*
Self-rated confidence													
Men	3.462	3.050	3.413	3.096	4.084	3.350	3.081	3.035	3.343	3.468	2.936	2.677	3.460
Women	3.375	2.936	3.148	3.014	3.998	3.113	2.920	2.837	2.870	3.169	2.904	2.509	3.101
Difference	0.087	0.114**	0.266***	0.081	0.087	0.237***	0.161***	0.198***	0.473***	0.299***	0.032	0.167***	0.359***
Measured financial literacy													
Men	5.369	4.624	5.718	4.625	5.429	5.762	6.010	5.074	4.842	5.880	4.554	5.125	5.125
Women	5.075	4.420	4.783	4.519	5.051	4.759	5.612	4.879	4.259	4.776	4.429	4.384	4.185
Difference	0.294***	0.203**	0.934***	0.106	0.378***	1.003***	0.398***	0.195	0.583***	1.104***	0.125	0.742***	0.940***
Risk attitude score													
Men	2.408	2.748	3.402	3.082	2.879	2.561	4.153	1.761	3.579	2.576	2.677	2.896	2.671
Women	2.026	2.728	2.783	3.054	2.488	2.119	4.145	1.524	3.229	1.924	2.265	2.746	2.132
Difference	0.381***	0.020	0.619***	0.028	0.391***	0.442***	0.009	0.237***	0.350***	0.653***	0.412***	0.149***	0.540***

Note: Descriptive statistics are based on samples of non-missing observations. Differences in means between men and women and their statistical significance (Wald test) computed using survey weights.
* $p < 0.10$,
** $p < 0.05$,
*** $p < 0.01$.*Source*: OECD / INFE dataset.

Table 2
Fairlie decomposition results for ownership of stocks / bonds by gender.

	AT	BR	CA	HR	FI	DE	HK	HU	JO	NL	RU	ES	UK
Prob. of owning stocks/bonds (men)	0.149***	0.013***	0.495***	0.145***	0.343***	0.350***	0.565***	0.075***	0.173***	0.163***	0.071***	0.187***	0.423***
Prob. of owning stocks/bonds (women)	0.095***	0.007**	0.412***	0.110***	0.268***	0.260***	0.460***	0.032***	0.096***	0.047***	0.123***	0.157***	0.348***
Raw gap	0.054***	0.006	0.083**	0.034	0.076**	0.090**	0.105***	0.043**	0.076***	0.117***	-0.053***	0.031**	0.075
Explained	0.040***	0.005	0.113***	0.002	0.036*	0.081***	0.069**	0.036***	0.099***	0.090***	-0.009	0.054***	0.068**
Confidence in own fin. knowledge	0.002	-0.000	0.031***	0.005	0.002	0.020**	0.015***	0.014**	0.017*	0.011*	-0.001	0.010***	0.006
	(0.002)	(0.002)	(0.008)	(0.004)	(0.004)	(0.008)	(0.005)	(0.006)	(0.010)	(0.006)	(0.002)	(0.002)	(0.012)
Measured fin. literacy	0.002	-0.001	0.021	-0.001	0.018*	0.011	0.002	-0.001	-0.001	0.015	-0.000	0.027***	0.026
	(0.002)	(0.002)	(0.019)	(0.002)	(0.010)	(0.018)	(0.008)	(0.003)	(0.006)	(0.010)	(0.001)	(0.004)	(0.020)
Risk attitude score	0.024***	0.000	0.052***	0.001	0.021***	0.042***	0.001	0.020**	-0.001	0.054***	-0.001	0.006***	0.029**
	(0.005)	(0.001)	(0.012)	(0.002)	(0.008)	(0.010)	(0.002)	(0.008)	(0.005)	(0.010)	(0.004)	(0.002)	(0.012)
Has financial buffer	0.002	0.001	0.007*	0.006	0.008*	0.008	-0.002	0.013**	0.008**	0.007**	-0.000	0.004***	0.012**
	(0.003)	(0.002)	(0.004)	(0.004)	(0.004)	(0.005)	(0.003)	(0.006)	(0.004)	(0.003)	(0.001)	(0.001)	(0.006)
Single person household	0.000	0.000	0.001	-0.001	-0.002	-0.000	-0.003	-0.000	-0.001	0.000	-0.002	0.000	-0.001
	(0.001)	(.)	(0.003)	(0.003)	(0.004)	(0.002)	(0.004)	(0.002)	(0.003)	(0.004)	(0.003)	(0.000)	(0.003)
Age	0.001	0.000	-0.004	0.002	-0.007	-0.002	-0.001	-0.001	0.020**	-0.004	0.011	0.003	-0.001
	(0.003)	(0.001)	(0.005)	(0.007)	(0.005)	(0.005)	(0.005)	(0.005)	(0.008)	(0.005)	(0.013)	(0.003)	(0.009)
Employment	0.006	0.002	0.007	-0.006	-0.003	-0.001	0.052*	-0.004	0.056***	0.011*	-0.013	0.008*	-0.005
	(0.003)	(.)	(0.006)	(0.010)	(0.005)	(0.006)	(0.027)	(0.007)	(0.015)	(0.006)	(0.014)	(0.005)	(0.009)
Education	0.003*	0.003	-0.001	-0.004	-0.002	0.004	0.005	-0.004	0.000	-0.004	-0.003	-0.004*	0.002
	(0.002)	(0.004)	(0.003)	(0.005)	(0.002)	(0.006)	(0.006)	(0.009)	(0.002)	(0.004)	(0.005)	(0.002)	(0.005)
N (men)	662	595	370	393	511	366	450	337	463	445	424	2,535	331
N (women)	664	547	343	389	586	381	510	355	301	330	438	2,363	319
N (total)	1,326	1,142	713	782	1,097	747	960	692	764	775	862	4,898	650

Note: significance levels are based on 500 bootstrap replicates. Decomposition using survey weights. "Age category 70+", "Other employment status", and "No or primary education" are reference categories of the respective dummy variable sets. Standard errors in parentheses.

* $p < 0.10$,
** $p < 0.05$,
*** $p < 0.01$.*Source*: OECD / INFE dataset.

Table A1
Description of variables entering empirical analysis.

Variable	Description
Risky financial assets	Dummy variable: 1 if an individual holds stocks, shares, or bonds
Confidence in own financial knowledge	Self-rated confidence in own knowledge about financial matters: ranging from 1 “very low” to 5 “very high”
Measured financial literacy	Financial literacy score: ranging from 0 to 7; based on correct answers to 7 financial literacy questions (time value of money, interest paid on loan, interest plus principal, compound interest, risk and return, definition of inflation, diversification), see OECD (2016) for details
Risk attitude	Willingness to risk some of the own money when saving or making an investment: ranging from 1 “completely disagree” to 5 “completely agree”
Financial buffer	Dummy variable: 1 if an individual has financial buffer covering at least three months in a case that he/she loses job (proxy for wealth)
Single	Dummy variable: 1 if an individual lives alone
Age	Dummy variables set for age categories: age category (18-29), age category (30-49), age category (50-69), age category (70+)
Employment	Dummy variables set for employment status: employed, self-employed, retired, not working / other (student, disabled, house keeper)
Education	Dummy variables set for education categories: no or primary education, secondary education, tertiary education

Source: own processing based on the OECD/INFE toolkit.

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2.4 Financial Literacy and Voluntary Savings for Retirement: Novel Causal Evidence

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Publikované v *The European Journal of Finance*, 2019, roč. 25, č. 16, s. 1606–1625.
DOI: https://doi.org/10.1080/1351847X.2019.1641123.

IF (2019):	1.217
SJR (2019):	0.474
JCR Best Q (2019):	Q3
ABDC ranking:	A

The European Journal of Finance

ISSN: 1351-847X (Print) 1466-4364 (Online) Journal homepage: https://www.tandfonline.com/loi/rejf20

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To cite this article: Andrej Cupák, Gueorgui I. Kolev & Zuzana Brokešová (2019) Financial literacy and voluntary savings for retirement: novel causal evidence, The European Journal of Finance, 25:16, 1606-1625, DOI: 10.1080/1351847X.2019.1641123

To link to this article: https://doi.org/10.1080/1351847X.2019.1641123

THE EUROPEAN JOURNAL OF FINANCE
2019, VOL. 25, NO. 16, 1606–1625
https://doi.org/10.1080/1351847X.2019.1641123

Routledge
Taylor & Francis Group

Financial literacy and voluntary savings for retirement: novel causal evidence

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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.

ARTICLE HISTORY
Received 30 May 2018
Accepted 6 June 2019

KEYWORDS
Retirement savings; financial literacy; endogeneity; instrumental variables; survey data

JEL CLASSIFICATIONS
D14; D91; I2

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 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.

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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 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 status,[4] 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 saving and planning (e.g. Bernheim and Garrett 2003; Lusardi and Mitchell 2007; Banks 2010; Van Rooij, Lusardi, and Alessie 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) concludes, 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, Jappelli, and Padula (2010), Van Rooij, Lusardi, and Alessie (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 loses 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, Morrill, and Allen 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 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 optimisation 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):

$$y_j = e_j + ra_j, \quad j\epsilon\{S,\ldots,R-1\}$$
$$y_j = SS_j(R) + PP_j(R) + ra_j, \quad j\epsilon[R,\ldots,D].$$

Consumption (c_j) depends on income, assets, and benefits. As concluded by Lusardi and Mitchell (2011c), to solve the optimisation 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, Lusardi, and Alessie 2012; Guiso and Viviano 2015).

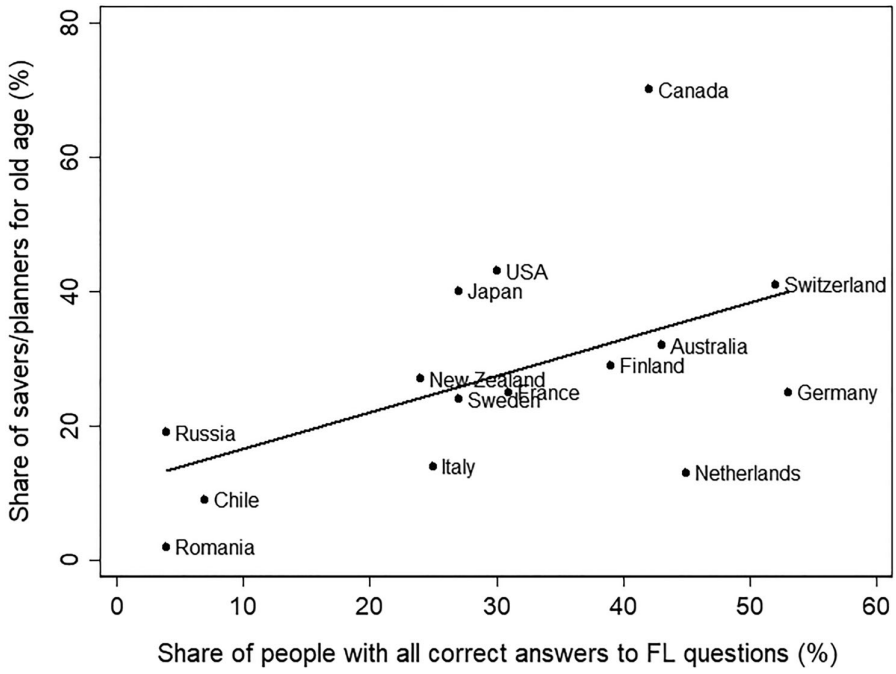

Figure 1. Financial literacy and saving/planning for retirement across countries. Source: Empirical studies on financial literacy and retirement saving/planning (see Table B1 for the list of studies).

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, Campbell, and Ramadorai 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.

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 the 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 to 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 2135 households along with 4658 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.

3.1. Measuring financial literacy

In the survey, each household represented by the reference person is asked a set of questions on financial literacy.[8] 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 the 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 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 Bucher-Koenen and Lusardi 2011; Lusardi and Mitchell 2011b; Boisclair, Lusardi, and Michaud 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

Table 1. Financial literacy across individuals.

	Financial literacy question					
	Interest rates	Inflation	Diversification	Riskiness	# of correct answers	All correct
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
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
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
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
Education						
Primary or no education	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
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

Notes: 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

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, Van Rooij, and Lusardi 2011; Sekita 2011; Agnew, Bateman, and Thorp 2013; Moure 2016) and current retirement savings (e.g. Fornero and Monticone 2011; Brown and Graf 2013; Boisclair, Lusardi, and Michaud 2017) have been used as proxies for the retirement financial security of individuals.

Table 2. Descriptive statistics ($N = 1235$).

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	15,000
Household net real estate wealth	46,860.35	42,231.90	−28,000	480,000
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

Notes: 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.

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 montly 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 D1.

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,

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	*NA*	*NA*
Secondary education	0.14	0.19
Tertiary education	0.21	0.22

Notes: 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.

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

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***	0.195***			0.020*	0.228***		
	(0.011)	(0.068)			(0.012)	(0.079)		
Financial literacy: all correct answers			0.100***	0.737***			0.042	0.692**
			(0.030)	(0.261)			(0.030)	(0.284)
Net monthly income (IHS†)	0.042***	0.033***	0.044***	0.033**	0.029**	0.016	0.029**	0.018
	(0.011)	(0.011)	(0.010)	(0.013)	(0.014)	(0.017)	(0.014)	(0.016)
Net real estate wealth (IHS†)	0.002	0.002	0.001	0.001	0.004*	0.004	0.004	0.003
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
Dummy: age 16–34	0.170***	0.185***	0.169***	0.201***	0.052	0.073	0.052	0.084
	(0.050)	(0.056)	(0.050)	(0.073)	(0.056)	(0.066)	(0.056)	(0.079)
Dummy: age 35–44	0.189***	0.222***	0.185***	0.240***	0.130**	0.175***	0.129**	0.180**
	(0.045)	(0.053)	(0.045)	(0.070)	(0.054)	(0.065)	(0.054)	(0.079)
Dummy: age 45–54	0.132***	0.173***	0.125***	0.184***	0.141***	0.200***	0.139***	0.196***
	(0.040)	(0.050)	(0.040)	(0.065)	(0.048)	(0.062)	(0.049)	(0.075)
Dummy: age 55–62	0.132***	0.160***	0.132***	0.209***	0.116**	0.160***	0.117**	0.194**
	(0.041)	(0.048)	(0.041)	(0.068)	(0.049)	(0.061)	(0.049)	(0.078)
Dummy: dependent children	−0.011	0.004	−0.012	0.031	0.042	0.071**	0.042	0.089**
	(0.026)	(0.029)	(0.026)	(0.036)	(0.028)	(0.033)	(0.028)	(0.039)
Dummy: male	0.002	0.003	0.003	0.010	−0.023	−0.023	−0.022	−0.016
	(0.025)	(0.027)	(0.025)	(0.031)	(0.026)	(0.029)	(0.026)	(0.031)
Dummy: single member household	−0.041	−0.028	−0.042	−0.012	0.057*	0.079**	0.057*	0.087**
	(0.029)	(0.032)	(0.029)	(0.039)	(0.031)	(0.037)	(0.031)	(0.041)
Dummy: employed for wage	0.034	0.001	0.039	−0.012	0.199***	0.149***	0.200***	0.147***
	(0.025)	(0.033)	(0.025)	(0.039)	(0.026)	(0.035)	(0.026)	(0.039)
Dummy: self-employed	0.025	0.005	0.031	0.007	0.003	−0.031	0.004	−0.022
	(0.035)	(0.040)	(0.035)	(0.044)	(0.027)	(0.034)	(0.027)	(0.037)
Dummy: university degree	0.062**	0.039	0.063**	0.006	0.028	−0.010	0.028	−0.030
	(0.026)	(0.030)	(0.027)	(0.041)	(0.029)	(0.034)	(0.029)	(0.042)
Dummy: positive risk attitude	0.038	0.073	0.026	0.050	0.047	0.107*	0.043	0.074
	(0.049)	(0.054)	(0.049)	(0.056)	(0.053)	(0.064)	(0.053)	(0.061)
Dummy: city	0.061**	0.068**	0.062**	0.082**	0.026	0.034	0.027	0.046
	(0.028)	(0.029)	(0.029)	(0.036)	(0.031)	(0.035)	(0.031)	(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

Notes: 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.

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

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

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

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 D1. Based on the existing literature, we hypothesise the effect of financial literacy to be positive ($\beta_1 > 0$) and statistically different from 0.

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 B1). 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. Bucher-Koenen and Lusardi 2011; Arrondel, Debbich, and Savignac 2013).

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 Fernandes, Lynch, and Netemeyer 2014; Lusardi and Mitchell 2014). Note that only several empirical studies have accounted for the potential endogeneity of financial literacy (see Table B1 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

$$SAVING_i = \beta_0 + \beta_1 FL_i + \beta_2 X_i + u_i \tag{2}$$

and

$$FL_i = \pi_0 + \pi_1 X_i + \pi_2 Z_i + v_i, \tag{3}$$

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. Alessie, Van Rooij, and Lusardi 2011; Fornero and Monticone 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 D1 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 the 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

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.
Source: HFCS 2014, National Bank of Slovakia; own calculations.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

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 squares 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.

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 D2 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 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, and are able to prematurely withdraw, 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.

Notes

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.
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.
4. A non-exhaustive list of examples includes Bernheim, Skinner, and Weinberg (2001), Browning and Crossley (2001), or Ameriks, Caplin, and Leahy (2003).
5. For an interested reader, the importance of financial literacy and education in consumers' financial decisions is comprehensively reviewed by Campbell (2006), Fernandes, Lynch, and Netemeyer (2014), Jappelli (2010) and Lusardi and Mitchell (2014).
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.
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.
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.
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 1 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% to 6%.
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.

Acknowledgements

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 number APVV-16-0321]. Zuzana Brokešová acknowledges the financial support from the Ministry of Education, Science, Research and Sport of the Slovak Republic under [grant number VEGA 1/0466/19].

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Appendices

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 capitalisation of 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 capitalised 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]

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.

Appendix B. Studies on financial literacy and retirement savings

Table B1. 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, Bateman, and Thorp (2013)	Australia	43%	Planning (32%)	(+)	YES
Boisclair, Lusardi, and Michaud (2017)	Canada	42%	Actual saving (70%)	(+)	NO
Moure (2016)	Chile	7%	Planning (9%)	(+)	NO
Kalmi and Ruuskanen (2015)	Finland	39%	Planning (29%)	(+)	NO
Arrondel, Debbich, and Savignac (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, Van Rooij, and Lusardi (2011)	Netherlands	45%	Planning (13%)	(+)	YES
Crossan, Feslier, and Hurnard (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-Soderbergh (2011)	Sweden	27%	Planning (24%)	(+)	NO
Brown and Graf (2013)	Switzerland	52%	Actual saving (41%)	(+)	NO
Lusardi and Mitchell (2011a)	U.S.A.	30%	Planning (43%)	(+)	YES

Notes: 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.

Appendix 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 1000 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 1000 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

Appendix D. Additional tables

Table D1. 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 D2. 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***	0.365**			0.022	0.275*		
	(0.019)	(0.165)			(0.020)	(0.165)		
Financial literacy: all correct answers			0.131***	0.905**			0.072	0.486
			(0.050)	(0.438)			(0.050)	(0.385)
Net monthly income (IHS†)	0.044***	0.033	0.045***	0.032	0.042**	0.032	0.042**	0.036*
	(0.017)	(0.022)	(0.016)	(0.025)	(0.019)	(0.021)	(0.018)	(0.019)
Net real estate wealth (IHS†)	0.002	0.003	0.002	0.002	−0.001	−0.000	−0.001	−0.000
	(0.004)	(0.005)	(0.004)	(0.006)	(0.004)	(0.005)	(0.004)	(0.005)
Dummy: dependent children	−0.035	−0.044	−0.034	−0.029	0.039	0.033	0.039	0.043
	(0.052)	(0.071)	(0.050)	(0.066)	(0.055)	(0.060)	(0.055)	(0.057)
Dummy: male	−0.000	−0.004	0.002	0.011	−0.123***	−0.128**	−0.122***	−0.117**
	(0.041)	(0.055)	(0.041)	(0.055)	(0.045)	(0.052)	(0.045)	(0.048)
Dummy: single member household	−0.044	−0.021	−0.040	0.008	−0.020	−0.001	−0.017	0.012
	(0.046)	(0.060)	(0.047)	(0.066)	(0.045)	(0.058)	(0.045)	(0.057)
Dummy: employed for wage	−0.018	−0.113	−0.016	−0.099	0.183***	0.108	0.182***	0.137**
	(0.043)	(0.082)	(0.043)	(0.076)	(0.040)	(0.067)	(0.041)	(0.057)
Dummy: self-employed	0.047	−0.023	0.053	0.024	−0.016	−0.070	−0.014	−0.037
	(0.066)	(0.093)	(0.066)	(0.084)	(0.046)	(0.063)	(0.045)	(0.050)
Dummy: university degree	0.013	−0.056	0.010	−0.079	0.031	−0.026	0.028	−0.018
	(0.046)	(0.066)	(0.046)	(0.079)	(0.047)	(0.064)	(0.046)	(0.065)
Dummy: positive risk attitude	−0.106*	0.015	−0.131**	−0.167*	−0.004	0.099	−0.016	−0.029
	(0.055)	(0.105)	(0.053)	(0.087)	(0.088)	(0.126)	(0.088)	(0.093)
Dummy: city	0.105**	0.120**	0.112**	0.163**	−0.068	−0.057	−0.064	−0.035
	(0.047)	(0.056)	(0.047)	(0.068)	(0.043)	(0.051)	(0.044)	(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

Notes: 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, and the region of Košice are the reference categories for the respective dummy sets.

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

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

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

2.5 Investor confidence and high financial literacy jointly shape investments in risky assets

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Publikované v *Economic Modelling*, 2022, roč. 116, 106033. DOI: https://doi.org/10.1016/j.econmod.2022.106033.

IF (2022):	4.7
SJR (2022):	1.303
JCR Best Q (2022):	Q1
ABDC ranking:	A

Economic Modelling 116 (2022) 106033

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.journals.elsevier.com/economic-modelling

Investor confidence and high financial literacy jointly shape investments in risky assets

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ARTICLE INFO

JEL classification:
D14
D31
D91

Keywords:
Financial literacy
Investor confidence
Portfolio diversification
Risky assets
Household finance
US

ABSTRACT

Households consistently invest less in equities and bonds than predicted by economic theory. We explain this from a behavioral economics perspective and distributional analysis using rich US survey microdata. We find that higher investor self-confidence in her financial abilities and financial literacy jointly increase the probability of investing in equities. Conditional on participation, confidence in the macroeconomy additionally drives portfolio shares in equities. We extend the existing research to bonds, for which these relationships are weaker. Unconditional quantile regression estimates reveal substantial heterogeneity in effects across the distribution of bond holdings. These relationships are not explained by risk preferences. Our results are consistent with lack of investor self-confidence, or fear of risk, posing a barrier to investing in risky assets, particularly for stock market participation. Promoting investor self-confidence along with financial literacy potentially encourages more diversified household portfolios.

1. Introduction

The composition of household portfolios differs substantially across households and countries (e.g., Christelis et al., 2013; Badarinza et al., 2016). While economic theory predicts that household portfolios should generally be diversified and include more sophisticated financial instruments like equities and bonds, empirical evidence shows that few households actually hold such assets (Haliassos and Bertaut, 1995). Low engagement of households in equity markets could yield significant welfare losses—nonparticipation can generate welfare losses of up to 2% of annual household consumption (Cocco et al., 2005). Similarly, "financial ignorance" can also be costly. For example, one might under-diversify one's financial assets, thus generating unnecessary portfolio risk or choosing unfavorable mortgages (Campbell, 2006; Calvet et al., 2007).

With emerging high-quality microdata on household balance sheets, researchers have related stock market participation and investment in financial assets more generally to household characteristics such as gender, education, income, or risk aversion (e.g., Campbell, 2006). More recently, financial literacy has been highlighted as a key input for sound financial behavior (see Lusardi and Mitchell, 2014 for a comprehensive overview). However, fewer empirical studies have shown that *self-confidence* in one's own financial skills matters for investment decisions (e.g., Xia et al., 2014; Allgood and Walstad, 2016; Bannier and Schwarz, 2018). In both individual and macroeconomic terms, evidence on the role of confidence in household behavior remains rather limited.

In this paper, we investigate the influence of financial literacy and confidence on household portfolio choice using recent data from the 2019 Survey of Consumer Finances (SCF) conducted in the United States. We examine two different dimensions of confidence: self-confidence in one's financial abilities (henceforth "self-confidence"), and confidence in the economy, as measured through expectations of the

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https://doi.org/10.1016/j.econmod.2022.106033
Received 1 June 2021; Received in revised form 23 August 2022; Accepted 25 August 2022
Available online 7 September 2022

future performance of the U.S. economy. We focus on investment in equities and bonds, two assets with varying levels of risk. First, we analyze how financial literacy and confidence affect the extensive margin choice of holding equities and bonds. Second, we analyze – conditional on participation in these markets – how investor confidence and financial literacy influence the intensive margin decision of how much financial resources to allocate to these assets. Our findings show that self-confidence influences the extensive margin decision for equities and to a lesser extent bonds (summarized in Figs. 3 and 4), whether or not we control for objective financial literacy and confidence in the economy. In contrast, investor self-confidence influences the intensive margin decision only for equities (Figs. 5 and 6). These results suggest that a lack of self-confidence could be a barrier to investing in risky assets but play a lesser role for less risky assets like bonds. Even though households are not professional forecasters, confidence in the economy is positively related to the share of assets invested in equities, with little influence on less-risky bonds (Tables 2 and 3). Our main findings are robust across descriptive analysis and standard regression techniques. Using unconditional quantile regressions based on the recentered influence function, we show that the null effect of financial literacy and confidence on shares of wealth allocated to bonds obscures heterogeneity across the distribution of holdings; the influence of these factors is inconsistent across investors.

Next, we examine the interaction of financial literacy and confidence to understand the distinction between sound self-confidence – confidence when financial literacy is high – versus overconfidence when financial literacy is low, in order to investigate the mechanism by which confidence operates. We find that sound confidence is associated with greater participation in both equities and bonds, as well as larger investments in equities. Interestingly, overconfident investors are actually less likely to participate in stock or bond markets, relative to those with more financial literacy (and are thus more soundly confident)—we do not have evidence of reckless participation. Taken together, our findings suggest that confidence plays a separate role from financial literacy for investment behavior, and in fact, the effect of confidence varies by level of financial literacy. Our results point to a mechanism: lack of confidence, or fear, can be a barrier to incorporating risk into one's portfolio, even when financial literacy is high and controlling for risk tolerance.

Finally, we address concerns about the possible endogeneity of financial literacy and investor self-confidence through an instrumental variables approach. We employ standard instruments, including parental education attainment, to account for the endogeneity of objective financial literacy (see, e.g., Behrman et al., 2012; Ćumurović and Hyll, 2018). In addition, we also employ a novel instrumental variable—the survey interviewer's assessment of how often the respondent consulted records and other documents during the interview to provide answers—to address the potential endogeneity of investor self-confidence. Results from instrumental variables regressions confirm the findings of the baseline OLS estimates and provide suggestive evidence of a possible causal link.

While we analyze the latest data from 2019 SCF to study these relationships, we interpret our estimates as lower bounds for the true relationships today. Recent trends in the digitalization and decentralization of finance have lowered barriers to investing in complex financial products. Consequently, individuals can increasingly invest at a low cost and execute portfolio decisions quickly and easily, which means that other barriers, like fear or lack of confidence, would rise in importance. Moreover, in an environment where conventional financial intermediation and advising channels are easily avoided, individual financial knowledge and self-confidence become ever more critical for financial well-being.

Our analysis advances our understanding of the behavioral factors underlying household investment choice. The results support recent work arguing that structural changes in financial attitudes (including literacy and sophistication) could explain the increase in stock-market participation in the US (Bilias et al., 2017). Yet, the overall engagement of households in markets for risky assets (primarily via direct participation) remains far lower than predicted by economic theory. Given that more-diversified households holding assets with varying levels and sources of risk are better buffered against shocks, understanding the determinants of investment behavior—including the separate and interactive roles of financial literacy and confidence—would help policymakers design policies to promote diversification and, thus, household financial resilience.

We study these factors in the contemporary US context, where reliance on individual financial decision-making is particularly important. In addition to the relatively weaker social safety net in the US, the continued decline of employer-provided defined benefit pension plans has increased the importance of personal savings for retirement financial security. As such, our focus on US households expands the empirical literature on the role of financial literacy and investor confidence in household investment behavior; previous studies have focused on households in China (Xia et al., 2014; Chu et al., 2017), Germany (Bannier and Schwarz, 2018), and the Netherlands (Kramer, 2016).

Our paper makes several contributions to the literature. We consider an unusually rich set of variables to advance our understanding of household portfolio diversification. We investigate equities and bond holdings at both the extensive and intensive margins, and we show differences between the two types of assets consistent with their relative risk. Furthermore, we take a more comprehensive approach to investor confidence by including a measure of confidence (trust) in macroeconomic development. Our study is apparently the first to account for confidence in the economy when analyzing household investment behavior. Second, we investigate possible heterogeneity in effects by analyzing the entire distribution of the intensive margin using unconditional quantile regressions rather than limiting our analysis to means or other aggregate measures. Third, to the best of our knowledge, our study is among the first to correct for the endogeneity of investor self-confidence for holding (risky) financial assets using a plausibly exogenous instrumental variable – drawn from paradata from the SCF: survey interviewer assessments about the respondent and the interview.[1] Finally, our study is among the first to utilize the most recent SCF data from 2019 to analyze the complex role of financial literacy and investor confidence as determinants of household investment behavior in the United States, which provides an important setting given the growing opportunities for individual investors to trade in risky assets.[2]

The paper proceeds as follows. In the next section, we contextualize our study within the literature and develop our testable hypotheses. Section 3 describes the data, and Section 4 presents the empirical approach and specifications. The univariate and multivariate analysis results are presented and discussed in Section 5. Finally, Section 6 concludes and offers policy implications.

2. Related literature and conceptual framework

2.1. Financial literacy

Financial literacy has been highlighted as a key input for sound financial decision-making; one mechanism for this relationship is that financial literacy is a form of human capital that enables investors to increase the productivity of their financial capital. The positive impact of financial literacy and cognitive abilities on wealth accumulation, including stock market participation specifically, has been documented in several empirical studies (see Lusardi and Mitchell, 2014, for a

[1] There is a growing empirical literature advocating for the use of survey paradata (i.e., interviewer ratings about the survey quality or even the interviewer characteristics) to account for endogeneity and measurement error of objective financial literacy (see, e.g., Cupák et al., 2019; Crossley et al., 2021).

[2] Examples of recent studies analyzing household financial behavior using SCF data are by Sierminska and Silber (2020) or Bazley et al. (2020).

comprehensive overview). For example, Christelis et al. (2010) used survey microdata on older populations in 11 European countries and found that higher cognitive ability is positively related to direct and indirect stockholding. In another influential study, Van Rooij et al. (2011) found that in a sample of Dutch households, those with lower levels of financial literacy are less likely to invest in stocks, and vice versa. Yuan (2018) uses older SCF data and finds that higher financial literacy is associated with stock market participation. Furthermore, Von Gaudecker (2015) found that households in The Netherlands that score high on financial literacy or rely on professional financial advice achieve better investment outcomes and more diversified portfolios. In the Chinese context, studies have documented that investors who use investment advisors — who presumably have more financial sophistication than the investors themselves — are more likely to have more diversified portfolios (Lu et al., 2020). Shin et al. (2020) find that, controlling for financial literacy and self-confidence, the use of financial planners is associated with more diversified portfolios. Finally, research has also documented the positive impact of financial literacy and financial education on long-term financial behaviors such as pension savings and retirement planning (Van Rooij et al., 2012; Wagner and Walstad, 2019; Cupák et al., 2019), as well as reduced probabilities of frequent gambling (Watanapongvanich et al., 2021), an example of excessive risk taking.[3]

We advance the literature by expanding our current understanding of stock investment behavior to bond markets as well as stock markets. Based on the robust empirical evidence of the positive impacts of financial literacy on financial wealth accumulation and participation in financial instruments, we hypothesize that *the ability to understand financial concepts of interest rates, inflation, and risk diversification (captured by the financial literacy index) is associated with a higher propensity to hold sophisticated financial instruments such as equities and bonds as well as larger conditional values invested in these financial instruments.*

2.2. Investor confidence

In addition to the importance of financial literacy for household financial outcomes, other research has focused more on the psychological aspects of household investment behavior. For example, in their foundational works, Barber and Odean (2000, 2001) stressed the importance of retail investors' self-confidence (proxied by gender) for trading behavior. The authors conclude that overconfidence can explain a large part of the high trading levels but, at the same time, can result in poor performance of individual investors.

Recent empirical studies have documented the importance of investor confidence in financial decision-making worldwide. In China, studies demonstrate that investor (over)confidence (proxied by a difference between subjective and objective financial literacy) is positively related to stock market participation (Xia et al., 2014; Chu et al., 2017). More confident households have been shown to have higher levels of financial wealth in a sample of German households (Bannier and Schwarz, 2018). Kramer (2016) found that, in the sample of Dutch households, people with confidence in their own financial literacy are less likely to seek financial advice, which in turn has implications for their wealth accumulation. Finally, Allgood and Walstad (2016) examined web-based survey data of US households and found that investor confidence in her financial knowledge matters on top of measured financial literacy, especially for investment decisions.[4]

While the impact of financial literacy and cognitive abilities on household financial outcomes is well documented in the empirical literature, there are fewer studies on the role of investor confidence in portfolio choice and other investment decisions, perhaps due to a lack of available data. Nevertheless, given the available empirical evidence from multiple countries, we hypothesize that investor *self-confidence—that is, confidence in one's own financial knowledge—is associated with a higher propensity to hold risky financial assets. Conditional on holding those assets, self-confidence is associated with a larger share of overall financial wealth held in these assets.*

Finally, investor confidence in the future performance of the economy influences a variety of household decisions. Although few households are professional traders or economic forecasters, their beliefs about future economic development and business cycles likely shape their financial decisions. Indeed, the available literature shows that household expectations play an important role in determining individual economic behaviors such as life-cycle consumption (e.g., Jappelli and Pistaferri, 2000) or choosing an optimal level of debt (e.g., Brown et al., 2005), and can be influenced by trust in institutions such as central banks (see Rumler and Valderrama, 2020). Guiso et al. (2008) found that in Italy and The Netherlands, individuals who have less trust in the stock market are less likely to buy stocks and, among those who do so, hold less wealth in stocks.

From a macro-level perspective, Ng et al. (2016) analyzed 60 countries and found that trust is a positive determinant of stock market depth and liquidity. Extrapolating from the macro to micro, this finding supports the idea that investor trust or confidence in the economy would lead to more households participating in stock markets or increasing their degree of participation. Our data include information on the expectations of households about the development of the US economy in 5 years, which we use as a proxy for confidence in the macroeconomic environment. Our variable captures the investor confidence in the overall performance of the economy and not stock markets specifically, so the confidence we measure may be secondary to the decision to participate in financial markets. That said, the empirical evidence suggests that the interdependence between stock markets and economic growth is positive (e.g., Levine and Zervos, 1998). We, therefore, hypothesize that *households that have confidence in the economy — the belief that the economy will perform better in 5 years than today — are more likely to invest in risky assets and also to invest more in these assets conditional on participation.*

3. Data and variables

We use microdata from the 2019 wave of the Survey of Consumer Finances (SCF), covering 5777[5] US households. The SCF is a nationally representative survey of households in the US conducted triennially by the Board of Governors of the Federal Reserve System to gather comprehensive data on household wealth. The data include many details of the household balance sheet, including the ownership specific assets and debts as well as the size of those holdings. The survey also includes information on families' pensions, income, and demographic characteristics.[6] The unit of our analysis is the household, which is

[3] While investing and gambling are both risky activities, frequent gambling is much more inherently speculative and excessively risky than investing. As such, this result supports the overall positive relationship between high financial awareness for sound and responsible financial behavior, and hence one's financial wellbeing.

[4] Overconfidence has also been found to have a significant impact on households' mortgage payment delinquency in the US (Kim et al., 2020).

[5] After a detailed inspection, we have identified and excluded one influential observation, resulting in an analysis sample of 5776 households.

[6] For more information about the survey, visit https://www.federalreserve.gov/econres/scfindex.htm. For a detailed overview of the main results from the 2019 SCF data, see Bhutta et al. (2020).

Table 1
Summary statistics.

	Mean	SD	Min	Max
Holds equities*	0.53	0.50	0	1
Share of financial assets in equities	0.23	0.30	0	1
Share of financial assets in equities (conditional on participation)	0.43	0.28	0	1
Holds bonds*	0.08	0.28	0	1
Share of financial assets in bonds	0.01	0.05	0	1
Share of financial assets in bonds (conditional on participation)	0.06	0.14	0	1
Financial literacy score	2.17	0.87	0	3
Fin. literacy (risk) correct*	0.61	0.49	0	1
Fin. literacy (interest) correct*	0.81	0.40	0	1
Fin. literacy (inflation) correct*	0.76	0.43	0	1
Investor self-confidence	7.14	2.17	0	10
Investor confidence in the economy	2.11	0.77	1	3
Risk tolerance*	0.23	0.42	0	1
Net real estate wealth (in 1000 US $)	220.79	1043.66	−5774	363000
Privately-held businesses*	0.13	0.34	0	1
Disposable household income (in 1000 US $)	71.91	150.12	−17200	58100
Inheritance/gift received*	0.24	0.42	0	1
Number of household members	2.28	1.37	1	12
Presence of children under 18*	0.29	0.45	0	1
Age	51.28	17.40	18	95
Female*	0.50	0.50	0	1
Employed for wage*	0.67	0.47	0	1
Primary or no education*	0.09	0.29	0	1
High school graduate*	0.40	0.49	0	1
College graduate*	0.51	0.50	0	1
White*	0.68	0.47	0	1
Black*	0.16	0.36	0	1
Hispanic*	0.11	0.31	0	1
Other race/ethnicity*	0.05	0.23	0	1
Married*	0.56	0.50	0	1
Single*	0.19	0.39	0	1
Divorced/separated*	0.17	0.37	0	1
Widowed*	0.08	0.28	0	1

Notes: Descriptive statistics estimated using survey weights and multiple-imputation techniques. * denotes dummy variables.
Source: Survey of Consumer Finances 2019.

represented by the original respondent to the SCF survey questions.[7]

One main advantage of the SCF compared to other wealth microdata is that the SCF includes comprehensive measures of household balance sheets as well as a rich set of covariates. Indeed, the SCF has long been a key source of data on stock market participation and household financial behavior in the US.[8] The survey recently added financial literacy and confidence measures to its comprehensive data on wealth and risk tolerance, which allows us to advance our understanding of why households do or do not diversify their portfolios. We report summary statistics in Table 1, and the Appendices include a detailed description of all variables, including the text of the survey questions and details on how we constructed our measures.

3.1. Dependent variables

The primary outcomes of interest are investments in risky financial assets, measured at the household level. These investments include financial instruments and accounts with directly or indirectly held stocks, bonds, and other debt securities.[9] While different financial instruments involve varying levels of risk, we group instruments into two broad categories: equities and bonds. Our first set of outcome variables contains a dummy variable taking a value of 1 if household holds equities and 0 otherwise, and a dummy variable taking a value of 1 a household holds bonds and 0 otherwise. Our second set of outcome variables consists of the shares of total financial assets (including retirement accounts) held in equities or bonds, conditional on holding those financial assets.

3.2. The main explanatory variables

We focus on levels of financial literacy and confidence, which were recently added to the SCF. The survey asks the standard three questions proposed by Lusardi and Mitchell (2014), covering inflation, interest rates, and riskiness. We construct an objective (or measured) financial literacy score by counting the number of questions answered correctly.

We also construct two confidence measures. First, we follow Bannier and Schwarz (2018) and proxy for the level of investor self-confidence in her own financial skills by using the self-assessed level of financial knowledge.[10] In the SCF, the household respondents were asked the following question:

> "On a scale from zero to ten, where zero is not at all knowledgeable about personal finance and ten is very knowledgeable about personal finance, what number would you (and your husband/wife/partner) be on the scale?"

The SCF also includes another variable on expectations about the future macroeconomic development of the US economy in 5 years' horizon, which we employ as a measure of a different kind of confidence. Respondents were asked the following:

> "I'd like to start this interview by asking you about your expectations for the future. Over the next five years, do you expect the U.S. economy as a whole to perform better, worse, or about the same as it has over the past five years?"

Dominitz and Manski (2004) describe this kind of variable as confidence in the economy. See, again, Appendix A and B for the creation of financial literacy and investor confidence scores.

Fig. 1 shows the univariate distributions of these three variables. Fig. 2 shows the joint distribution of measured financial literacy as well as investor self-confidence. The size of each bubble is proportional to the number of respondents with such a combination of measured financial and self-confidence. We see a positive, albeit imprecisely measured correlation $(\rho = 0.189)$ between measured financial literacy and investor self-confidence. A considerable proportion of observations are also observed in the lower right area, namely individuals with relatively high self-confidence but rather low measured financial literacy. These individuals could be described as "overconfident" with regard to their financial literacy. Our multivariate analysis will further investigate the impact of (over)confidence and financial literacy on equity and bond holdings.

3.3. Control variables

In our analyses, we control for a rich set of covariates that could also

[7] In the original survey a household unit is composed of all individuals who are financially interdependent and referred to as the "primary economic unit" (PEU). For all individual-level characteristics, we use the respondent, who is generally the most financially knowledgeable person in the PEU. We do not use in our analysis the notion of head as it is described in the SCF codebook, namely "the head is taken to be the single core individual in a PEU without a core couple; in a PEU with a central couple, the head is taken to be either the male in a mixed-sex couple or the older individual in the case of a same-sex couple."

[8] Examples include Bertaut (1998), Bonaparte and Kumar (2013), and Bergstresser and Poterba (2004).

[9] A full overview of all the considered assets is listed in Appendix A.

[10] Measuring subjective confidence directly in a survey is possible but generally challenging. See Dominitz and Manski (2004) for a detailed discussion on measuring consumers' confidence with micro and macro data.

Fig. 1. Distributions of financial literacy score and investor confidence measures. Note: Statistics estimated using survey weights.
Source: Survey of Consumer Finances 2019.

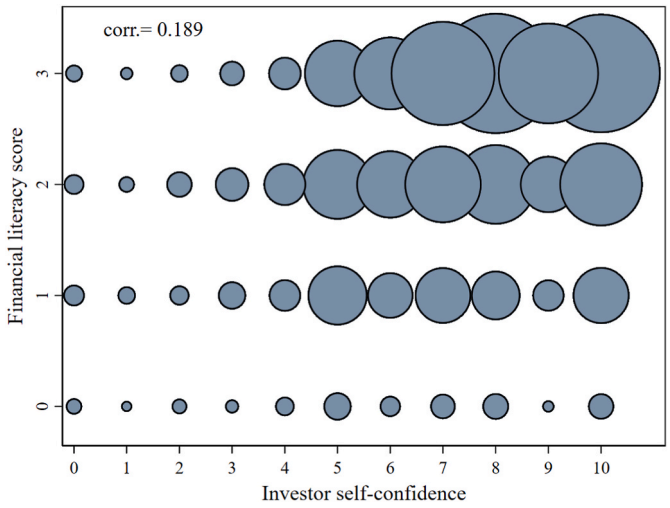

Fig. 2. Correlation between measured financial literacy score and investor self-confidence. Notes: This graph shows a scatter plot of measured financial literacy and investor self-confidence, where dots are weighted by frequency of observation.
Source: Survey of Consumer Finances 2019.

drive the investment choices of households. Following prior literature, we include variables capturing economic resources of the household, both net real estate wealth and income.[11] We also consider whether or not a household owns a closely-held business or received an inheritance. We also control for an extensive set of demographic characteristics (age, gender, education, marital status, ethnicity, and employment status of the respondent) and family composition, defined as the household size, and presence of children under the age of 18. Furthermore, we include a subjective measure of risk aversion, which has been identified as an important factor determining risky behavior. Detailed explanations of the construction of all control variables are included in Appendix A, while the descriptive statistics are presented in Table 1.

4. Empirical strategy

Our empirical strategy is motivated by standard theories of household portfolio choice (see Guiso et al., 2002). A household faces a two-step decision: the binary participation decision (extensive margin probability of holding an asset; see Section 4.1) and a continuous allocation decision (intensive margin share of total financial wealth invested in the particular asset; see Section 4.2). We model these two decisions

[11] As our outcome variable covers financial wealth, our control variable uses non-financial wealth to avoid endogeneity due to simultaneity. Furthermore, we subtract liabilities to generate a measure of net real estate wealth. Since our income and wealth variables have highly skewed distributions, and a significant share of households have negative wealth, we employ the inverse hyperbolic sine (IHS) transformation to these two variables. Note that the interpretation of the coefficients of the IHS transformed variables is very similar to that of a natural log.

focusing on financial literacy and investor confidence by using several econometric techniques. We employ standard regression models as well as unconditional quantile regressions based on a recentered influence function to assess the relative importance of financial literacy and investor confidence over the distribution of the equity/bond shares (see Section 4.2). We also analyze regression models with interaction terms to distinguish confidence from overconfidence. Additionally, we address potential endogeneity using standard and novel instrumental variable approaches (see Section 4.3), which confirm our main findings.

4.1. Participation decision

In our baseline model, we estimate the relationship between participation in equities/bonds and financial literacy, and investor confidence measures (controlling for a large set of covariates) by a Linear Probability Model,[12] which takes the following general form:

$$Pr(P_k = 1|x) = \delta_0 + \delta_1 FL + \delta_2 Conf_1 + \delta_3 Conf_2 + \delta_4 FL \times Conf_1 + \delta_5 FL \times Conf_2 + \vartheta X + \eta, \quad (1)$$

where P_k denotes the participation in the k-th asset class, FL is the level of measured financial literacy and $Conf_1$ and $Conf_2$ represent the investor self-confidence and confidence in the economy, respectively, as described in section 3. X includes a large set of control variables usually used to predict financial behavior of households, such as education, gender, age, race, employment status, income, wealth, closely-held business ownership, inheritance, risk tolerance, household size and the number of children, etc., and η is the error term. We first analyze financial literacy, investor self-confidence, and confidence in the economy one at a time then in combination with each other, omitting the δ_4 and δ_5 terms. Lastly, we estimate the full specification including all terms.

4.2. Allocation decision

For those households holding equities and bonds, we model the relationship between the share of financial wealth invested in the asset type and our explanatory variables of interest by the following linear regression model:

$$S_k = \beta_0 + \beta_1 FL + \beta_2 Conf_1 + \beta_3 Conf_2 + \beta_4 FL \times Conf_1 + \beta_5 FL \times Conf_2 + \theta X + \varepsilon, \quad (2)$$

where S_k represents the share of financial wealth allocated to the k-th asset class. The notation of right-hand-side variables remains the same as in the participation equation (1), except the new set of coefficients to be estimated and the error term ε. Again, we first analyze financial literacy, investor self-confidence, and confidence in the economy one at a time then in combination with each other, omitting the β_4 and β_5 terms. Lastly, we estimate the full specification including all terms.

Next, we estimate the influence of our regressors at different parts of the distribution of our outcome variables, S_k. We employ unconditional quantile regressions (UQR) developed by Firpo et al. (2009), which are based on recentered influence functions (RIF). This framework has several advantages over standard conditional quantile regressions and is an attractive tool for researchers studying distributional impacts. The UQR estimator can be written as follows:

$$RIF(S_k, \tau) = X\beta^{UQR} + \varepsilon. \quad (3)$$

We estimate UQRs for τ taking decile values of 0.1–0.9.[13]

Finally, we note that missing values in some of the SCF variables (mostly related to assets, debts, and incomes) were imputed and replaced 5 times.[14] Multiple-imputed data allow us to consider imputation uncertainty related to item non-response while obtaining statistical inference. We follow the standard procedure suggested by Rubin (1987) to obtain point estimates and variance estimation of the statistics of interest.[15] We describe the applied multiple-imputation technique in Appendix D.

4.3. Addressing potential endogeneity of financial literacy and investor self-confidence

One might be concerned about potential endogeneity—that holding equities or bonds might inherently lead to an increase in measured financial literacy or investor self-confidence. Possible channels include learning-by-doing for financial literacy or self-affirmation for self-confidence. Once individuals participate in certain markets, they might tend to believe they actually have the necessary knowledge to do so. Another source of endogeneity proposed by recent empirical literature is measurement error in self-reported variables (e.g., Lusardi and Mitchell, 2014; Crossley et al., 2021), which would lead to attenuation bias in the standard OLS estimates.

One approach to deal with such endogeneity concerns is to use instrumental variables techniques to isolate the causal effects of endogenous variables. In the SCF data, the educational attainment of the respondent's mother and father (a dummy variable for attaining a college degree) can be used as an instrument for measured financial literacy. Our approach follows Behrman et al. (2012), who include parental education as an instrument for financial literacy in an analysis of wealth accumulation, arguing that family background factors such as these only affect wealth accumulation via their endogenous variables, schooling and financial literacy. Similarly, Ćumurović and Hyll (2018) use maternal education to instrument for financial literacy in an analysis of self-employment. Ćumurović and Hyll (2018) address the possibility that maternal education fails the exclusion restriction by controlling for these additional channels, including intergenerational wealth transfers.

While finding instruments correlated with the endogenous variable may be straightforward, it is often difficult to convincingly argue that the instrument meets the necessary exclusion restriction, namely that there is no other channel through which the instrument might have a direct or indirect effect on the outcome variable. Indeed, one might be skeptical about the exclusion restriction in an analysis of wealth, given that more educated parents are likely to be wealthier, and wealth can be transmitted across generations. However, our analysis focuses on the *allocation* of wealth—the participation decision for equity and bond markets and the portfolio share allocated to these asset classes. Finally, we believe the parental education instrument is the best option given our data constraints to correct for endogenous measured financial literacy. Still, following Ćumurović and Hyll (2018), we do include control variables, detailed in Section 3.3, to address potential channels by which parental education could affect the portfolio choice decision, including levels of non-financial wealth and receipt of large gifts and inheritances.

In addition to parental education, we also employ a novel instrumental variable for investor self-confidence; this variable is drawn from survey paradata, which are data collected about the interview itself and the survey process. Cupák et al. (2019) used the interviewer-recorded paradata, including the interviewer's assessment of the respondent's understanding of the survey questions, to instrument for endogenous

[12] As a robustness check, we re-estimated the baseline participation-stage equations (Tables 2a and 2b) by employing Probit models. The estimated marginal effects at the mean of explanatory variables are qualitatively similar to the Linear Probability Model estimates. Because of its more straightforward interpretation, we prefer the Linear Probability Model for the baseline estimates. Results of the Probit estimates are available upon request.

[13] We briefly describe the UQR framework in Appendix C.

[14] The imputation procedure in the SCF data is described in detail by Kennickell (1998).

[15] We use the Stata 'mi' package to do so.

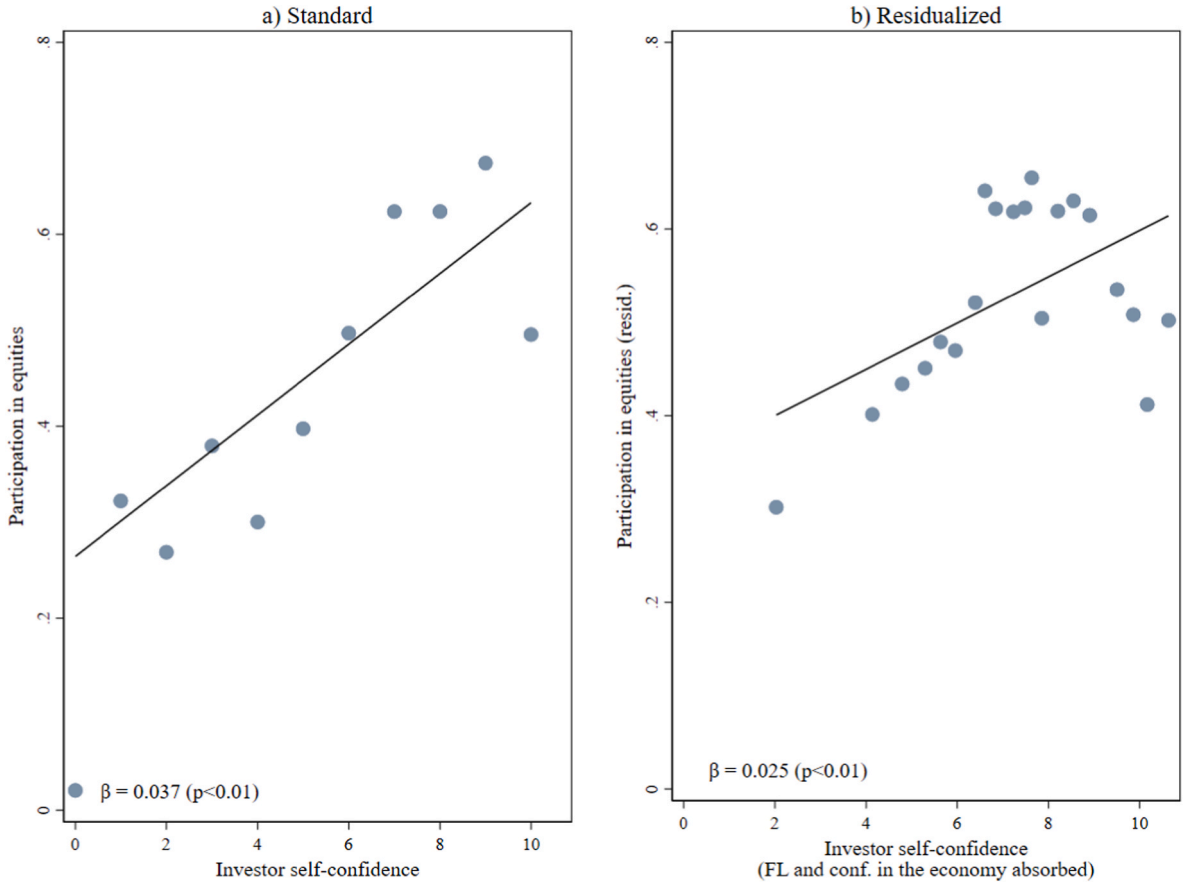

Fig. 3. Correlation between investor self-confidence and participation in equity markets. Notes: Figure (a) shows the share of households holding stocks and other equities across investor self-confidence. Figure (b) shows the residualized share of households holding stocks and other equities across self-confidence, where measured financial literacy and confidence in the economy are controlled for. Relationships are estimated using survey weights.
Source: Survey of Consumer Finances 2019.

financial literacy in a study about voluntary retirement savings. The authors argue that the survey paradata offer plausibly exogenous variation with respect to endogenous variables, and we extend their approach to the case of endogenous investor self-confidence.

We exploit information reported by the interviewer about how often (1 – never, 4 – frequently) a respondent consulted records and documents to assist with answering questions during the interview.[16] We believe this variable arguably meets both requirements of a valid instrument. First, it likely conveys some information about the respondent's self-confidence, which we verify. Second, we believe that the risk of the exclusion restriction failing is negligible, as it is implausible that the interviewer's assessment of the respondent's use of records should impact the respondent's past investment decisions. Furthermore, as the interviewer's assessment occurs after the very end of the interview, it cannot retroactively influence the respondent's financial behavior or survey responses.

We estimate the causal impacts of measured financial literacy and investor self-confidence by a Two-Stage Least Squares (2SLS) instrumental variables framework, when the first-stage regression is given by:

$$FL = \pi_0 + \pi_1 EDU\_M + \pi_2 EDU\_F + \pi_3 RATING + \lambda X + u \quad (4a)$$

and

$$CONF = \gamma_0 + \gamma_1 EDU\_M + \gamma_2 EDU\_F + \gamma_3 RATING + \xi X + v. \quad (4b)$$

The instrumented variables are then plugged in the second-stage regression:

$$Y = \rho_0 + \rho_1 \widehat{FL} + \rho_2 \widehat{CONF} + \psi X + \varepsilon, \quad (5)$$

where $\widehat{FL}$ and $\widehat{CONF}$ represent the predicted measured financial literacy and investor self-confidence. X is a set of exogenous control variables also considered in our baseline regressions. *EDU_M* and *EDU_F* are binary instrumental variables taking value of 1 if the respondent's mother/father has completed college education. *RATING* is another instrument – the interviewer rating (from 1 – never, to 4 – frequently) about how often a respondent used consulting materials to provide answers in the interview. Our outcome variable Y indicates one of four variables: participation in stock (or bond) markets, or allocation of wealth to stocks (or bonds). As usual u, v and ε denote the first-stage and the second-stage error terms. We assume π_1 and π_2 to be larger than 0, i.e. higher parental education positively impacts respondents' financial knowledge. Likewise, we assume $\gamma_3 > 0$, i.e. the more frequently a respondent turns to consulting documents, the more confident about financial matters she is.

Due to the challenges of identifying strong and convincing instruments in this complex setting, we interpret our 2SLS analysis as supplemental and suggestive of a causal link rather than definitive evidence thereof.

[16] Because the SCF asks very detailed questions about a family's finances, respondents are encouraged (but not required) to bring records and documents to consult during the interview.

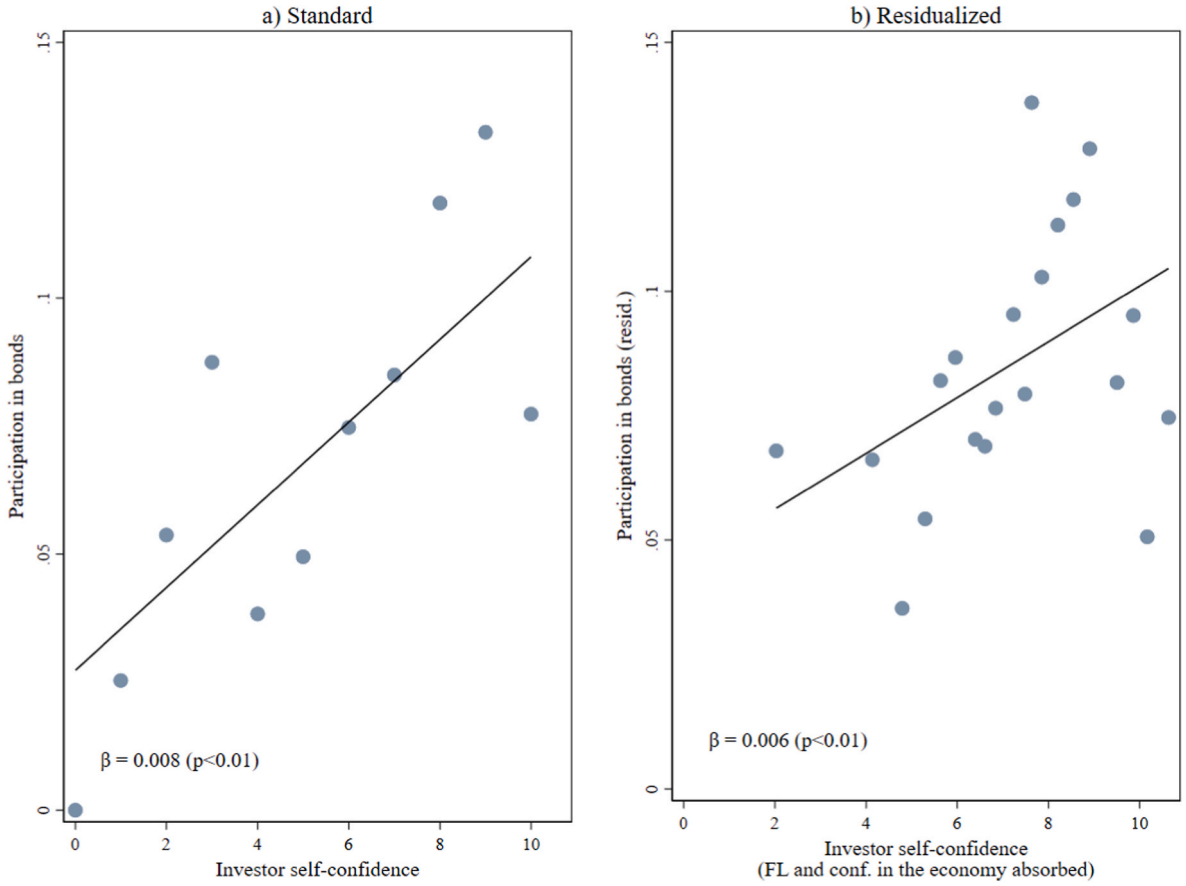

Fig. 4. Correlation between investor self-confidence and participation in bond markets. Notes: Figure (a) shows the share of households holding bonds and other secured debt assets across investor self-confidence. Figure (b) shows the residualized share of households holding bonds and other secured debt assets across self-confidence, where measured financial literacy and confidence in the economy are controlled for. Relationships are estimated using survey weights.
Source: Survey of Consumer Finances 2019.

5. Results

5.1. Descriptive analysis

According to our data, around 53% of households in the US participate in equity markets, and around 8% of households hold bonds and other secured financial assets. The conditional share of total financial assets held in equities is about 43%, with about 6% in bonds. About 43% of US households can correctly answer all three financial literacy questions on the survey. About 76% of the respondents can correctly answer the question on inflation, and about 81% the question on interest rates. The concept of riskiness of financial instruments is less understood, with around 61% of respondents correctly answering this question. At the same time, US households appear fairly self-confident in their own financial skills, with an average self-rating of 7.14 on a scale of zero to 10. We find a weak correlation between investor self-confidence and objective financial literacy (0.189), consistent with previous empirical studies. In addition, about 36% of households are confident that the US economy will be doing much better in 5 years relative to 2019, the year of the survey.

Figs. 3 and 4 show the relationship between investor self-confidence and the probability of holding the two types of assets through binned scatterplots. The figures summarize our main findings: investor self-confidence is positively related to the probabilities of holding equities and bonds (left panels of Figs. 3 and 4). Given the correlation of 0.037, a 10 percent increase in confidence translates to a 7 percent increase in equity market participation ($p < 0.01$). Likewise, the correlation of 0.008 in the case of bonds means that a 10 percent increase in confidence is associated with a 6 percent increase in bond market participation ($p < 0.01$). These economically sizable results remain after absorbing variation explainable by measured financial literacy and investor confidence in the economy (right panels of Figs. 3 and 4, both 5 percent of the mean and $p < 0.01$). As we will see in Section 5.2, this relationship holds even if we control for a more extensive set of socio-economic variables relevant to household financial behavior.

Analogously, for the intensive margin, Figs. 5 and 6 show the relationship between investor self-confidence and the share of financial assets held in equities and bonds for those who actually hold those assets.

These descriptive results show that investor self-confidence matters for holding equities as well as bonds beyond the effects of objective financial knowledge and confidence in the country's economy. In particular, our results are consistent with fear or lack of confidence serving as a hurdle to participating in investing in stocks and bonds. At the same time, self-confidence appears to play a much smaller role with the allocation decision for those who actually participate. Once

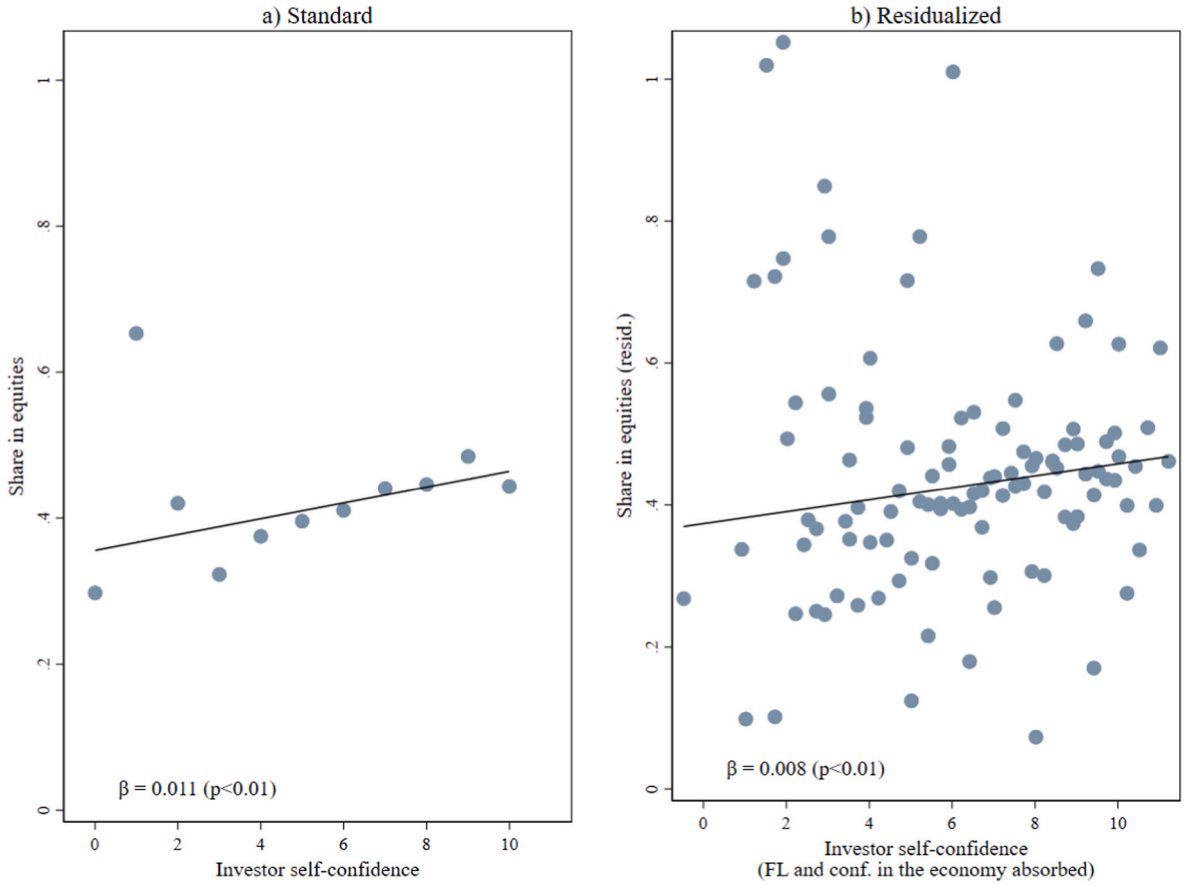

Fig. 5. Correlation between investor self-confidence and share of total financial assets held in equities. Notes: Figure (a) shows the share of households' financial wealth held in equities across investor self-confidence. Figure (b) shows the residualized share of households' financial wealth held in equities across self-confidence, where measured financial literacy and confidence in the economy are controlled for. Relationships are estimated using survey weights.
Source: Survey of Consumer Finances 2019.

investors overcome the hurdle of the extensive margin, how much money to allocate does not appear to be influenced as strongly by fear or lack of confidence.

5.2. Regression analysis

The baseline results of our multivariate analyses are presented in Tables 2–3. The first three columns display results in which financial literacy, investor self-confidence, and confidence in the economy appear separately; columns (4) through (6) include them in combination; column (7) includes all three explanatory variables simultaneously. All specifications include risk tolerance and a rich set of additional controls.

Tables 2a and 2b show the results of the Linear Probability Model estimates for participation in equity and bond markets as outlined in Section 4 (equation (1)). We find that financial literacy and investor self-confidence are both positively related to the probability of holding equities (Table 2a). Across specifications, a one-question increase in the financial literacy score is associated with a 13 percent (coefficients of around 0.07 combined with mean of 0.53) increase in the probability of holding equities ($p < 0.01$). A 10 percent increase in investor self-confidence has a smaller effect on equity market participation. The estimated coefficients between 0.006 and 0.008 translate to around 1.5 percent increase in the probability of holding stocks ($p < 0.01$). When all three explanatory variables are included, confidence in the economy does not have a measurable effect at the 5 percent level. The effect of financial literacy remains stable over the various specifications, all of which control for a rich set of covariates relevant for household financial behavior.

Most importantly, in specifications (4) and (7), we see that the effect of self-confidence remains positive and significant even when controlling for objective financial literacy. The finding that self-confidence matters above and beyond the influence of actual financial literacy (graphically demonstrated in Fig. 3) holds even if we control for a large set of covariates. Therefore, lack of self-confidence appears to present its own barrier to stock market participation. This barrier is not explained by risk aversion, suggesting that fear plays a role, and that our results are not just a reflection of general preferences.

Results from the linear probability models for participation in bonds and other debt securities (Table 2b) reveal that the impact of objective financial literacy is positive and rather large. The coefficient of 0.016 means that a one-unit (correct answer) increase in the financial literacy score is associated with a 20 percent higher probability of holding bonds

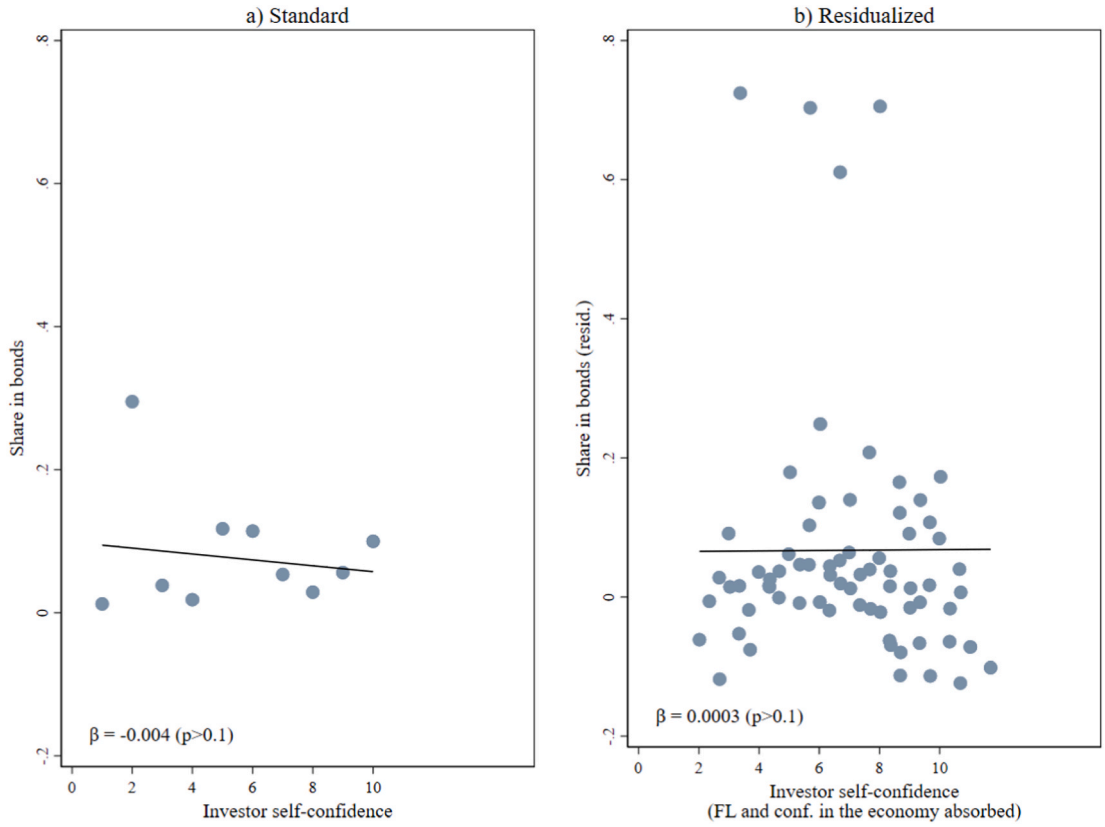

Fig. 6. Correlation between investor self-confidence and share of total financial assets held in bonds. Notes: Figure (a) shows the share of households' financial wealth held in bonds and other secured debt assets across investor self-confidence. Figure (b) shows the residualized share of households' financial wealth held in bonds and other secured financial assets across self-confidence, where measured financial literacy and confidence in the economy are controlled for. Relationships are estimated using survey weights.
Source: Survey of Consumer Finances 2019.

($p < 0.01$). Confidence in the economy (coefficient of −0.008) is associated with a *reduction* in bond market participation (−10 percent of the mean, $p < 0.10$ in specification 3). This is sensible, as stocks are likely to be more profitable than bonds in a rising economy, and bonds can be used as a hedge during a downturn. Meanwhile, investor self-confidence does not exert any measurable influence. Overall, these measured effects of confidence are robust across specifications, though the precision of macroeconomic confidence is reduced in the full specification.

A possible reason why self-confidence operates differently for stocks and bonds is that bonds are considerably less risky than equities, and so higher self-confidence may not be as critical of a barrier to participation. Indeed, we similarly find that self-rated risk tolerance is positively associated with holding equities but has no effect on holding bonds, and hence suggests that households' assessments of their risk aversion are consistent with the risk levels of their financial behavior.

The estimated effects of other covariates are in line with the previous literature. Risk tolerance is positively associated with investing in stocks and bonds. For the intensive margin, risk tolerance promotes larger investments in stocks but smaller investments in bonds, consistent with the relative risk of the two asset classes. The probability of holding equities and bonds significantly rises with economic resources: wealth, income (only for equities), employment, education, as well as inheritance receipt. Owners of privately-held businesses are less likely to participate in equity markets, which is unsurprising given that equities and privately-held businesses can be considered risky assets. Black respondents are 13–15 percentage points less likely to own stocks and 6 percentage points less likely to own bonds than white groups. This result is in line with Thompson and Suarez (2015), who document substantial financial wealth gaps by race in the US.

Tables 3a and 3b display the OLS regression estimates of the determinants of the share of total financial assets held in equities and bonds, respectively, conditional on participating in those markets. The results confirm the descriptive analysis from Figs. 5 and 6. A one-unit increase in objective financial literacy is associated with a 5% increase in the overall share of wealth held in equities (coefficient of 0.02, $p < 0.05$ in the full specification). Both confidence measures exert positive but modest effects of about 1% for investor confidence in her financial knowledge (coefficient of 0.005, $p < 0.10$ in the full specification) and 6% for confidence in the economy (coefficient of 0.013, $p < 0.05$ in the full specification) on the share of wealth held in equities. In contrast, we find a small negative and precisely measured effect of financial literacy for bond holdings, with no measurable effect for either form of confidence. These results provide further evidence that confidence may matter most for the riskiest assets.

Still, further investigation using UQRs reveals that the lack of measurable relationships between confidence and portfolio share in bonds at the conditional mean masks substantial heterogeneity. Figs. 7 and 8 show the effects of our three main variables of interest plus the

Table 2a
OLS estimates of determinants of participation in equity markets.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Financial literacy score	0.071***			0.070***		0.071***	0.069***
	(0.007)			(0.007)		(0.007)	(0.007)
Investor self-confidence		0.008***		0.006**	0.008***		0.006**
		(0.003)		(0.003)	(0.003)		(0.003)
Investor confidence in the economy			−0.013		−0.014*	−0.009	−0.010
			(0.008)		(0.008)	(0.008)	(0.008)
Risk tolerance	0.090***	0.100***	0.103***	0.088***	0.100***	0.091***	0.088***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Net real estate wealth (IHS)	0.011***	0.012***	0.012***	0.011***	0.012***	0.011***	0.011***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Privately-held businesses	−0.035**	−0.033**	−0.031**	−0.037**	−0.034**	−0.035**	−0.037**
	(0.015)	(0.016)	(0.016)	(0.015)	(0.016)	(0.015)	(0.015)
Disposable household income (IHS)	0.054***	0.056***	0.056***	0.053***	0.055***	0.054***	0.053***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Inheritance/gift received	0.038***	0.041***	0.040***	0.038***	0.040***	0.037***	0.037***
	(0.013)	(0.013)	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)
Number of household members	−0.023***	−0.025***	−0.024***	−0.023***	−0.024***	−0.023***	−0.023***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Presence of children under 18	0.045**	0.040**	0.039**	0.045**	0.040**	0.045**	0.045**
	(0.018)	(0.019)	(0.019)	(0.018)	(0.019)	(0.018)	(0.018)
Age	0.002	0.003	0.003	0.002	0.003	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age squared	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	−0.007	−0.023**	−0.024**	−0.008	−0.024**	−0.008	−0.008
	(0.011)	(0.012)	(0.012)	(0.011)	(0.012)	(0.011)	(0.011)
Employed for wage	0.125***	0.128***	0.127***	0.126***	0.129***	0.125***	0.126***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
High school graduate	0.103***	0.115***	0.124***	0.097***	0.115***	0.103***	0.098***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
College graduate	0.249***	0.283***	0.292***	0.243***	0.282***	0.249***	0.242***
	(0.021)	(0.021)	(0.021)	(0.022)	(0.021)	(0.021)	(0.022)
Black	−0.127***	−0.149***	−0.146***	−0.129***	−0.148***	−0.126***	−0.128***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Hispanic	−0.173***	−0.186***	−0.187***	−0.172***	−0.185***	−0.173***	−0.172***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Other race/ethnicity	0.000	−0.002	−0.003	0.001	−0.001	0.001	0.002
	(0.025)	(0.025)	(0.025)	(0.024)	(0.025)	(0.024)	(0.024)
Married	0.077***	0.080***	0.086***	0.074***	0.080***	0.077***	0.074***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Divorced/separated	−0.031*	−0.032*	−0.030	−0.033*	−0.032*	−0.031*	−0.033*
	(0.018)	(0.019)	(0.019)	(0.018)	(0.019)	(0.018)	(0.018)
Widowed	0.001	−0.012	−0.010	−0.001	−0.013	0.001	−0.002
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
Constant	−0.602***	−0.572***	−0.509***	−0.625***	−0.541***	−0.582***	−0.602***
	(0.103)	(0.105)	(0.109)	(0.101)	(0.106)	(0.104)	(0.102)
R squared	0.282	0.271	0.270	0.282	0.271	0.282	0.283
N	5776	5776	5776	5776	5776	5776	5776

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Dummy variables for less than high school education, non-Hispanic white ethnicity, and being single are reference categories of the respective dummy variables sets. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.
Source: Survey of Consumer Finances 2019.

control for risk tolerance across the distributions of portfolio shares from estimates of equation (3).

For equities, Fig. 7 shows that the effects are broadly similar across the distribution of portfolio shares held in equities, indicating little heterogeneity along the intensive margin. That said, there is some evidence that financial literacy and self-confidence may matter more for middle deciles of equity holdings, though any differences are imprecisely measured. For bonds (Fig. 8), while our OLS show a precisely measured negative relationship with objective financial literacy, the quantile regression shows that this effect is exclusively driven by the top 20 to 30 percent of bond holdings. For all other households, the effect of financial literacy is a precisely measured zero, and similarly so for both measures of confidence.

Both results confirm our main findings visualized in the binned scatter plots in Figs. 3–5. While confidence seems to play an economically and statistically significant role in driving participation, it does not seem to play a substantial role in driving portfolio shares.

5.3. Interaction between financial literacy and investor confidence

Next, we re-estimate our main equations adding interaction terms between financial literacy and investor confidence to shed further light on their joint roles in household investment behavior. In Table 4, the odd numbered columns reproduce the coefficients from column (7) in Tables 2a, 2b, 3a, and 3b, while the even numbered columns display coefficients from estimating a model augmenting each preceding specification with interaction terms for financial literacy and investor self-confidence, and financial literacy and investor confidence in the economy. All specifications include risk tolerance and other control variables, as in our main specifications.

In the interaction specifications, the level term for financial literacy is the marginal effect of additional literacy when individuals have no confidence at all, and vice versa for the level term for the two confidence measures. In column (2) on the participation decision for equities, the negative, imprecisely measured coefficient on financial literacy

Table 2b
OLS estimates of determinants of participation in bond markets.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Financial literacy score	0.017***			0.016***		0.016***	0.016***
	(0.003)			(0.003)		(0.003)	(0.003)
Investor self-confidence		0.002		0.001	0.002		0.001
		(0.001)		(0.001)	(0.001)		(0.001)
Investor confidence in the economy			−0.008*		−0.008*	−0.007	−0.007
			(0.004)		(0.004)	(0.004)	(0.004)
Risk tolerance	0.018**	0.020**	0.021**	0.017**	0.020**	0.018**	0.017**
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Net real estate wealth (IHS)	0.001**	0.001**	0.001**	0.001**	0.001**	0.001**	0.001**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Privately-held businesses	0.011	0.012	0.012	0.011	0.011	0.011	0.010
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Disposable household income (IHS)	0.008***	0.009***	0.009***	0.008***	0.008***	0.008***	0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Inheritance/gift received	0.034***	0.035***	0.034***	0.034***	0.034***	0.034***	0.034***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Number of household members	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Presence of children under 18	0.026**	0.025**	0.025**	0.026**	0.025**	0.026**	0.026**
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Age	−0.002*	−0.002	−0.002	−0.002*	−0.002	−0.002*	−0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age squared	0.000**	0.000*	0.000**	0.000**	0.000*	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.003	−0.001	−0.001	0.003	−0.001	0.003	0.002
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Employed for wage	0.016**	0.017**	0.017**	0.016**	0.017**	0.016**	0.016**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
High school graduate	0.002	0.004	0.007	0.000	0.005	0.002	0.001
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
College graduate	0.036***	0.043***	0.045***	0.034***	0.043***	0.035***	0.034***
	(0.010)	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.011)
Black	−0.057***	−0.062***	−0.061***	−0.057***	−0.061***	−0.056***	−0.056***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Hispanic	−0.062***	−0.065***	−0.065***	−0.062***	−0.065***	−0.062***	−0.062***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Other race/ethnicity	−0.085***	−0.085***	−0.085***	−0.084***	−0.085***	−0.084***	−0.084***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Married	−0.008	−0.007	−0.006	−0.009	−0.007	−0.008	−0.009
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Divorced/separated	−0.025**	−0.025**	−0.025**	−0.025**	−0.025**	−0.025**	−0.025**
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Widowed	−0.033**	−0.036***	−0.036***	−0.034**	−0.037***	−0.033**	−0.034**
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Constant	−0.046	−0.039	−0.014	−0.051	−0.022	−0.031	−0.036
	(0.038)	(0.037)	(0.039)	(0.038)	(0.039)	(0.039)	(0.039)
R squared	0.049	0.047	0.048	0.049	0.048	0.050	0.050
N	5776	5776	5776	5776	5776	5776	5776

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Dummy variables for less than high school education, non-Hispanic white ethnicity, and being single are reference categories of the respective dummy variables sets. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.
Source: Survey of Consumer Finances 2019.

indicates that for those with no confidence, additional financial literacy is not associated with stock market participation. Likewise, looking at the second row, the coefficient on level terms of investor self-confidence indicate that when individuals have low financial literacy (a score of zero), higher self-confidence (or overconfidence) is associated with *lower* likelihood of participating in the stock market. In contrast, both interaction terms are positive: for those with some financial literacy, greater confidence—that is, confidence that is sound—is associated with higher likelihood of stock market participation.

In fact, for both the participation and allocation decisions for bonds (columns 4 and 8, respectively), the positive interaction terms on financial literacy and self-confidence indicate that sound confidence is associated with more investment in bonds. Finally, the interaction of financial literacy and confidence in the economy is negative and precisely measured for both the extensive and intensive margins of bond investments, which is sensible given that financial literate investors are likely to understand that if the economy is expected to grow, stocks would generally yield higher returns than bonds. Taken together, our findings suggest that the effect of confidence is distinct from that of financial literacy for investment behavior, and in fact, the effect of confidence varies by level of financial literacy. Furthermore, the negative or statistically insignificant effects of the level term of self-confidence suggest that lack of confidence, or fear, can be an emotional barrier to incorporating risk into one's portfolio, even when

Table 3a
OLS estimates of determinants of share of total financial assets held in equities (conditional on participation).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Financial literacy score	0.022***			0.020**		0.023***	0.021**
	(0.008)			(0.008)		(0.008)	(0.008)
Investor self-confidence		0.007**		0.006*	0.006**		0.005*
		(0.003)		(0.003)	(0.003)		(0.003)
Investor confidence in the economy			0.013**		0.012**	0.014***	0.013**
			(0.005)		(0.005)	(0.005)	(0.005)
Risk tolerance	0.064***	0.066***	0.067***	0.062***	0.065***	0.063***	0.062***
	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)
Net real estate wealth (IHS)	0.003*	0.003	0.003*	0.003	0.003	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Privately-held businesses	−0.005	−0.006	−0.003	−0.007	−0.005	−0.005	−0.006
	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)
Disposable household income (IHS)	0.011***	0.011***	0.012***	0.011***	0.011***	0.011***	0.011***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Inheritance/gift received	−0.016	−0.013	−0.013	−0.015	−0.012	−0.014	−0.014
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Number of household members	0.004	0.003	0.003	0.004	0.003	0.003	0.003
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Presence of children under 18	0.019	0.018	0.017	0.019	0.018	0.019	0.019
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Age	0.006**	0.007**	0.007**	0.006**	0.007**	0.006**	0.006**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age squared	−0.000*	−0.000**	−0.000**	−0.000**	−0.000**	−0.000**	−0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	−0.029**	−0.034***	−0.034***	−0.029**	−0.033***	−0.028**	−0.028**
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Employed for wage	−0.010	−0.005	−0.008	−0.007	−0.006	−0.010	−0.008
	(0.018)	(0.019)	(0.018)	(0.018)	(0.019)	(0.018)	(0.018)
High school graduate	−0.018	−0.014	−0.010	−0.021	−0.013	−0.018	−0.020
	(0.043)	(0.042)	(0.042)	(0.043)	(0.042)	(0.043)	(0.043)
College graduate	−0.002	0.008	0.016	−0.005	0.010	0.001	−0.002
	(0.044)	(0.042)	(0.042)	(0.044)	(0.042)	(0.043)	(0.043)
Black	−0.005	−0.013	−0.014	−0.006	−0.014	−0.006	−0.006
	(0.023)	(0.023)	(0.023)	(0.024)	(0.023)	(0.024)	(0.024)
Hispanic	0.005	−0.000	0.001	0.004	−0.001	0.005	0.004
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Other race/ethnicity	−0.029	−0.028	−0.029*	−0.028	−0.028	−0.028	−0.027
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Married	−0.031	−0.033	−0.029	−0.034	−0.033	−0.030	−0.033
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Divorced/separated	0.016	0.015	0.016	0.015	0.015	0.016	0.015
	(0.024)	(0.024)	(0.024)	(0.024)	(0.025)	(0.024)	(0.024)
Widowed	−0.020	−0.023	−0.022	−0.020	−0.022	−0.018	−0.019
	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
Constant	0.039	0.026	0.030	0.009	−0.004	−0.001	−0.025
	(0.071)	(0.072)	(0.074)	(0.072)	(0.075)	(0.074)	(0.074)
R squared	0.050	0.049	0.048	0.051	0.050	0.051	0.052
N	3630	3630	3630	3630	3630	3630	3630

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Dummy variables for less than high school education, non-Hispanic white ethnicity, and being single are reference categories of the respective dummy variables sets. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.
Source: Survey of Consumer Finances 2019.

financial literacy and risk tolerance are high.[17]

[17] In a robustness check, we also estimate our models using a more explicit measure of overconfidence. Following, for example, Xia et al. (2014) and Allgood and Walstad (2016), we combine the objective financial literacy score (on a scale from 0 to 4, average equal to 2.17) with the subjective investor confidence score (on a scale from 0 to 10, average equal to 7.14) to create a four-category measure of overconfidence. We create the following dummy variables set: I) above-average confidence and above-average financial literacy (Conf-High/FL-High), II) above-average confidence and below-average financial literacy (Conf-High/FL-Low), III) below-average confidence and above-average financial literacy (Conf-Low/FL-High), and IV) below-average confidence and below-average financial literacy (Conf-Low/FL-Low). Results (see Appendix E) are qualitatively similar to our main results; in particular, we see that overconfident individuals (Conf-High/FL-Low) are again less likely to participate in equity markets as those with similarly low financial literacy but also low confidence as well.

5.4. Addressing endogeneity

Financial literacy and investor self-confidence may be endogenous determinants of investment in risk assets. Therefore, we seek further evidence of the effect of these variables on financial behavior by instrumenting for objective financial literacy by parental education and self-confidence using a novel instrument based on metadata gathered by the interviewer, as described in Section 5.4.

Table 5a shows estimates from the first stage of the 2SLS IV approach. These results indicate that our instruments are relevant for the two possibly endogenous regressors,[18] especially for the participation stage. The relationship between parental education and financial

[18] One can see that according to the Durbin–Wu–Hausman test for endogeneity (p-values smaller than 0.01), our two suspicious variables are indeed endogenous, and this holds for the participation stage (see Table 5b).

Table 3b
OLS estimates of determinants of share of total financial assets held in bonds (conditional on participation).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Financial literacy score	−0.039***			−0.039***		−0.038***	−0.038***
	(0.013)			(0.013)		(0.013)	(0.013)
Investor self-confidence		−0.003		−0.000	−0.003		−0.000
		(0.004)		(0.003)	(0.004)		(0.003)
Investor confidence in the economy			0.007		0.007	0.003	0.003
			(0.008)		(0.008)	(0.008)	(0.008)
Risk tolerance	0.004	−0.005	−0.007	0.004	−0.006	0.003	0.003
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Net real estate wealth (IHS)	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Privately-held businesses	0.025**	0.023*	0.021*	0.025**	0.023*	0.025**	0.025**
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Disposable household income (IHS)	0.001	0.000	0.000	0.001	0.001	0.001	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Inheritance/gift received	−0.016	−0.022	−0.020	−0.017	−0.020	−0.016	−0.016
	(0.013)	(0.014)	(0.014)	(0.013)	(0.014)	(0.013)	(0.013)
Number of household members	−0.005	−0.005	−0.005	−0.005	−0.005	−0.005	−0.005
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Presence of children under 18	−0.007	−0.005	−0.002	−0.007	−0.003	−0.007	−0.007
	(0.017)	(0.018)	(0.018)	(0.017)	(0.018)	(0.017)	(0.017)
Age	−0.008***	−0.007***	−0.007***	−0.008***	−0.007***	−0.008***	−0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age squared	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	−0.005	0.003	0.004	−0.006	0.003	−0.005	−0.005
	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)	(0.011)
Employed for wage	0.004	0.005	0.006	0.004	0.005	0.004	0.004
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
High school graduate	−0.038	−0.047	−0.048	−0.038	−0.049	−0.038	−0.039
	(0.072)	(0.072)	(0.074)	(0.072)	(0.073)	(0.072)	(0.072)
College graduate	−0.034	−0.058	−0.057	−0.034	−0.057	−0.034	−0.034
	(0.069)	(0.070)	(0.071)	(0.069)	(0.071)	(0.070)	(0.070)
Black	0.029	0.046	0.044	0.029	0.044	0.028	0.028
	(0.045)	(0.046)	(0.045)	(0.045)	(0.045)	(0.044)	(0.044)
Hispanic	−0.007	−0.018	−0.020	−0.007	−0.019	−0.007	−0.007
	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)	(0.017)	(0.017)
Other race/ethnicity	0.078	0.074	0.074	0.078	0.075	0.078	0.078
	(0.082)	(0.082)	(0.082)	(0.081)	(0.082)	(0.082)	(0.082)
Married	−0.005	−0.007	−0.008	−0.005	−0.008	−0.005	−0.005
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Divorced/separated	0.087**	0.090**	0.088**	0.087**	0.088**	0.086**	0.086**
	(0.038)	(0.038)	(0.037)	(0.038)	(0.037)	(0.037)	(0.037)
Widowed	0.034	0.035	0.036	0.034	0.037	0.034	0.034
	(0.038)	(0.039)	(0.039)	(0.038)	(0.039)	(0.038)	(0.038)
Constant	0.353***	0.297***	0.264***	0.355***	0.282***	0.345***	0.348***
	(0.101)	(0.097)	(0.097)	(0.103)	(0.100)	(0.105)	(0.107)
R squared	0.083	0.079	0.080	0.083	0.080	0.084	0.084
N	659	659	659	659	659	659	659

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Dummy variables for less than high school education, non-Hispanic white ethnicity, and being single are reference categories of the respective dummy variables sets. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.
Source: Survey of Consumer Finances 2019.

literacy is consistent with other studies using these instruments. For our novel instrument, consulting documents during the interview is positively related to self-confidence. A possible explanation is that a respondent who is confident in her financial skills may be particularly motivated to provide accurate responses to the survey and also feel secure enough to reveal to the interviewer that they need to look up information in their documents to do so. This first stage is inconsistent with the alternative relationship, where confidence leads to pretending to have a perfect memory of one's balance sheet.

Table 5b shows the results of the 2SLS IV regressions, which are consistent with our main results and suggest a potential causal link. Financial literacy and investor self-confidence are positively associated with participating in equity markets; both are also positively associated with holding bonds, though not statistically significantly for investor self-confidence. Again, we do not find economically significant positive associations of financial literacy with the intensive margin for either asset class. Neither form of investor confidence exerts a positive effect on the allocation of assets to bonds or equities, and the coefficients are both imprecisely measured. The fact that the IV estimates for financial literacy are larger than the OLS estimates points to an attenuation bias problem, a result typically found in the empirical literature (see Lusardi and Mitchell, 2014).

While one may interpret our results as suggestive evidence of a causal link, we note that even in the presence of valid instruments (in our case p-values of the Sargan test are always larger than 0.10, see Table 5b), models with multiple endogenous variables at the same time (measured financial literacy and investor confidence in our case) are extremely difficult to identify and to interpret (Angrist and Pischke, 2008). The measured effects should therefore be interpreted as conditional correlations or predictive effects rather than causal effects; such an interpretation is consistent with our main results. In our case, we believe that further investigation is required using more robust instruments with a tighter argument for the exclusion restriction; unfortunately, such instruments are not available in our dataset.

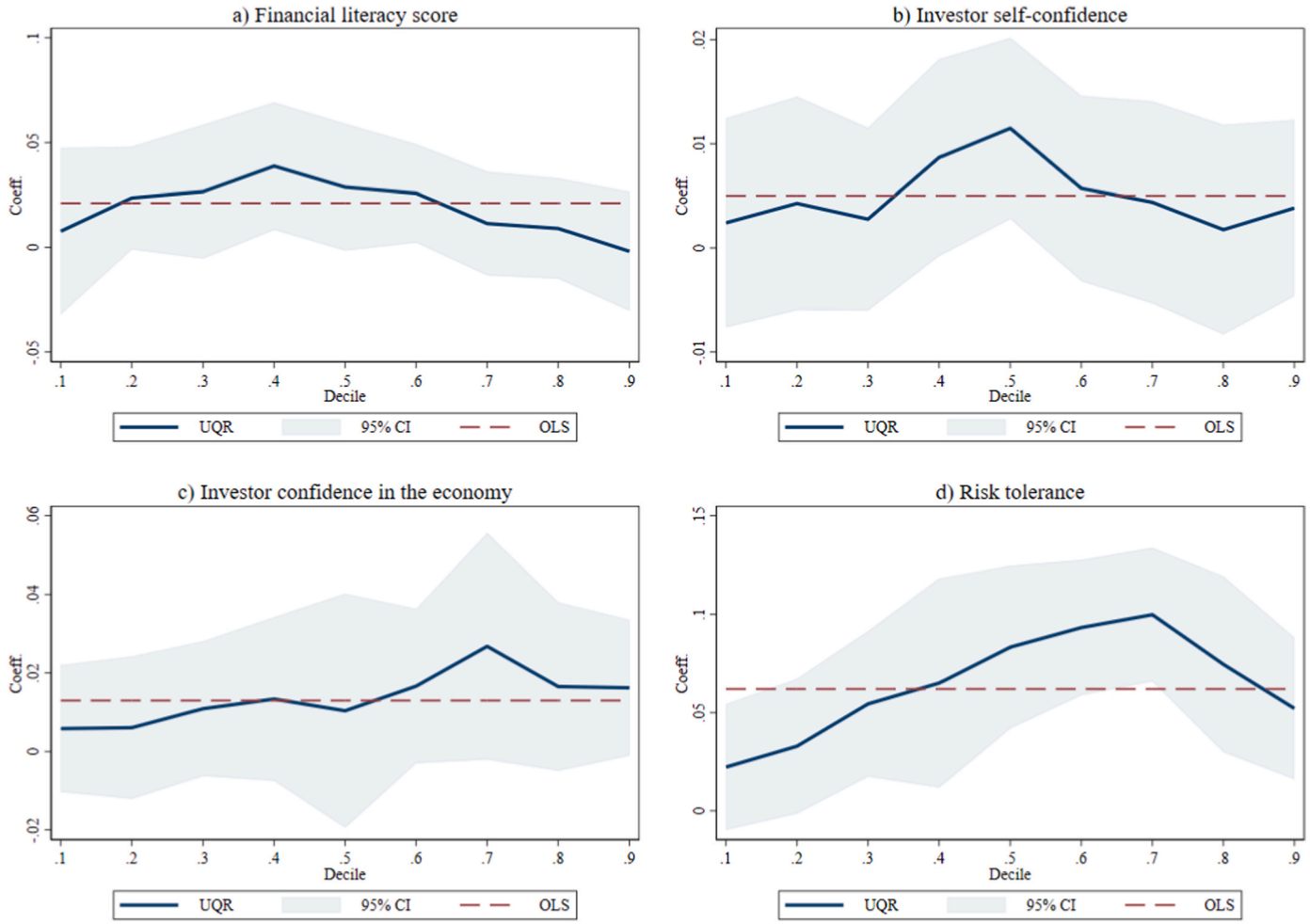

Fig. 7. Unconditional quantile regression estimates of determinants of share of total financial assets held in equities (conditional on participation). Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped confidence intervals are based on 999 replicate weights. Quantile regressions are based on the same set of covariates and sample as in Table 3a.
Source: Survey of Consumer Finances 2019.

6. Conclusion

In this paper, we analyzed unique data on financial literacy, investor self-confidence as well as confidence in the economy, and investment in risky assets (equities and bonds) using the recent 2019 Survey of Consumer Finances wealth microdata from the US. We examined how investors' financial literacy and confidence relate, individually and jointly, using questions recently added to the SCF on financial literacy (Lusardi and Mitchell, 2014), a self-assessment of financial abilities, and future economic expectations. These novel data allow us to distinguish sound confidence—that is, confidence coupled with high measured financial literacy—from overconfidence, which is confidence in spite of having low measured financial literacy. We contribute to the literature on portfolio allocation by linking this rich set of behavioral variables on financial literacy and confidence with detailed, disaggregated information on assets held in stocks or bonds.

Our results show that financial literacy and investor self-confidence are both positively related to the probability of investing in equities, whether analyzed separately or included together. The financial literacy patterns are consistent with studies in China (Lu et al., 2020; Shin et al., 2020) and the Netherlands (Van Rooij et al., 2011). We expand our understanding of investment behavior by extending the existing analysis to bond market participation, which yields similar results for financial literacy. We show that confidence in the economy matters more for investment in equities than in bonds, consistent with the fact that lower risk assets like bonds can serve as a hedge during a downturn.

Using a number of different empirical approaches, including OLS, interacting our main variables, and 2SLS instrumental variables, we find new evidence that, in addition to the role of financial literacy, investor self-confidence separately increases the probability of holding equities, consistent with results on stock market participation in China (Xia et al., 2014; Chu et al., 2017), even when controlling for financial literacy and confidence in the economy. In additional analysis investigating the interaction of the two factors, we find evidence that the effect of confidence varies by level of financial literacy. In contrast to Allgood and Walstad (2016), in supplementary analysis using interaction terms for financial literacy and confidence, we do not find that overconfidence is associated with stock market participation. While it may seem that overconfident individuals in our setting do not engage in excessive risk taking, our results do not preclude the possibility that some overconfident individuals may engage in high-risk investment behaviors (like excessive trading or investing in even riskier assets like cryptocurrencies) that are not well observed in our data. Indeed, consumer access to risky instruments in the US have proliferated in recent years. Additional data will be necessary to address this possibility.

While these relationships hold even when controlling for a large set of socio-economic characteristics which are highly predictive of financial literacy and participation in markets for risky assets, the relationships are generally weaker for the intensive margins. Conditional on holding risky assets, higher financial literacy, but not confidence, is

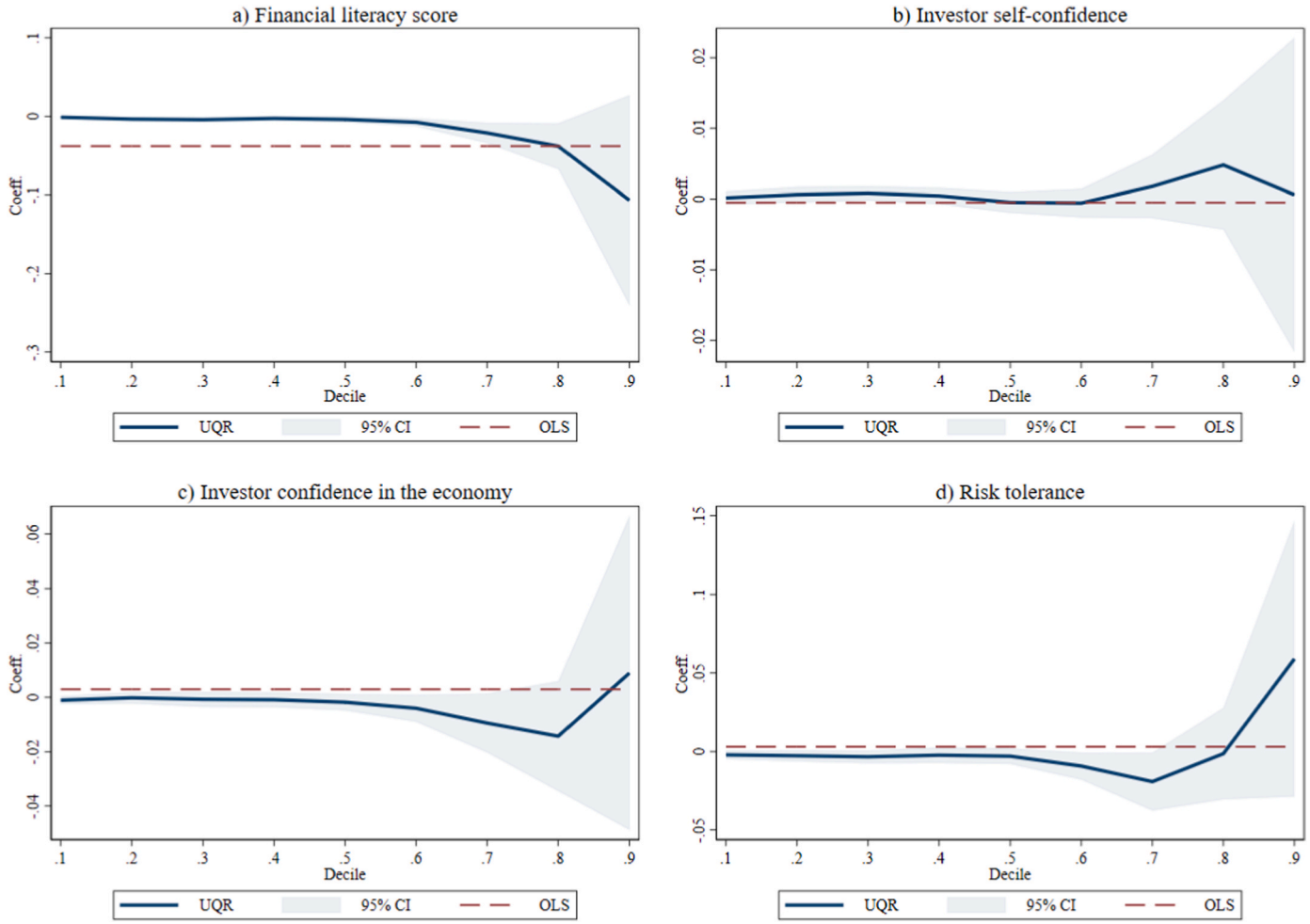

Fig. 8. Unconditional quantile regression estimates of determinants of share of total financial assets held in bonds (conditional on participation). Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped confidence intervals are based on 999 replicate weights. Quantile regressions are based on the same set of covariates and sample as in Table 3b.
Source: Survey of Consumer Finances 2019.

Table 4
OLS estimates of determinants of ownership of equities and bonds (both extensive and intensive margins, with interaction terms).

	Participation stage				Allocation stage			
	Equities		Bonds		Equities		Bonds	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial literacy score	0.069***	−0.025	0.016***	0.008	0.021**	0.055	−0.038***	−0.094*
	(0.007)	(0.023)	(0.003)	(0.014)	(0.008)	(0.035)	(0.013)	(0.050)
Investor self-confidence	0.006**	−0.014**	0.001	−0.006**	0.005*	0.007	−0.000	−0.045**
	(0.003)	(0.006)	(0.001)	(0.002)	(0.003)	(0.011)	(0.003)	(0.018)
Investor confidence in the economy	−0.011	−0.036*	−0.007	0.013	0.013**	0.045**	0.003	0.098**
	(0.008)	(0.018)	(0.004)	(0.009)	(0.005)	(0.023)	(0.008)	(0.043)
Fin. literacy × Investor self-confidence		0.010***		0.004***		−0.001		0.019**
		(0.002)		(0.001)		(0.004)		(0.007)
Fin. literacy × Investor confidence in the economy		0.011*		−0.009**		−0.013		−0.037**
		(0.007)		(0.004)		(0.009)		(0.015)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Joint test on interactions significance (p-value)		0.000		0.014		0.037		0.002
R squared	0.282	0.284	0.049	0.050	0.052	0.053	0.144	0.195
N	5776	5776	5776	5776	3630	3630	659	659

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Control variables are the same as in the main regressions. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.
Source: Survey of Consumer Finances 2019.

Table 5a
First-stage correlations of instrumental variables with endogenous regressors.

	Participation stage (Equities & Bonds)		Allocation stage (Equities)		Allocation stage (Bonds)	
	FL	Conf.	FL	Conf.	FL	Conf.
Mother's college education	0.113***	0.058	0.106***	0.037	0.129**	0.177
	(0.026)	(0.065)	(0.030)	(0.073)	(0.063)	(0.169)
Father's college education	0.099***	−0.196**	0.094***	−0.186**	0.079	−0.400**
	(0.027)	(0.075)	(0.031)	(0.071)	(0.078)	(0.166)
Using consulting documents	0.056***	0.057**	0.053***	0.003	0.067***	0.007
	(0.009)	(0.023)	(0.009)	(0.026)	(0.020)	(0.061)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
R squared	0.221	0.122	0.193	0.106	0.252	0.129
N	5776	5776	3630	3630	659	659

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Control variables are the same as in the main regressions. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.
Source: Survey of Consumer Finances 2019.

Table 5b
OLS and 2SLS estimates of determinants of ownership of equities and bonds (both extensive and intensive margins).

	Participation stage				Allocation stage			
	Equities		Bonds		Equities		Bonds	
	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
Financial literacy score	0.069***		0.016***		0.021**		−0.038***	
	(0.007)		(0.003)		(0.008)		(0.013)	
Financial literacy score (predicted)		0.643***		0.167***		0.029		−0.155***
		(0.070)		(0.040)		(0.065)		(0.052)
Investor self-confidence	0.006**		0.001		0.005*		−0.000	
	(0.003)		(0.001)		(0.003)		(0.003)	
Investor self-confidence (predicted)		0.224*		0.013		−0.005		−0.035
		(0.112)		(0.038)		(0.098)		(0.054)
Investor confidence in the economy	−0.011	−0.014	−0.007	−0.000	0.013**	0.016	0.003	0.000
	(0.008)	(0.022)	(0.004)	(0.009)	(0.005)	(0.018)	(0.008)	(0.013)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R squared	0.282		0.049		0.052		0.084	
F of instruments for fin. literacy		22.084		22.084		14.989		3.969
F of instruments for investor confidence		3.436		3.436		1.661		1.383
Sargan Chi-2		3.899		0.325		0.622		0.189
P-value of Sargan Chi-2		0.133		0.614		0.521		0.696
P-value of exogeneity test		0.000		0.001		0.748		0.110
N	5776	5776	5776	5776	3630	3630	659	659

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Control variables are the same as in the main regressions. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.
Source: Survey of Consumer Finances 2019.

associated with higher portfolio shares in risky assets still rises with financial literacy. Interestingly, the allocation decision is, to a great extent, determined by future economic expectations, or how confident investors are regarding the future macroeconomic performance of their country. On the other hand, of all of our behavioral outcomes, investor confidence in the economy only appears to be relevant for the decision of how much wealth to allocate to stocks. This suggests that the two forms of confidence, one internal and one external, operate differently for financial decision-making.

Using unconditional quantile regressions, we find only modest heterogeneity in the effect of financial literacy on equity shares. Our null results for portfolio allocation to bonds obscures the fact that patterns differ for the top of the top of the holdings distribution, though with the limited sample of bond holders we cannot draw firm conclusions on these relationships.

In sum, financial literacy, confidence in own skills, and confidence in the economy appear to be meaningful determinants for investing in risky assets and bonds, with considerably weaker effects for the intensive margin decision. The extensive margin results confirm the recent findings of Bilias et al. (2017), who argue that structural changes in financial attitudes (including literacy and sophistication) of US households might be behind the growing stock-market participation. Yet, the overall level of household engagement in the market for risky assets is still far from what economic theory predicts. The COVID-19 pandemic and recession are illustrative examples of which a diversified portfolio, including risky assets, that could have buffered families against income losses from health or labor market shocks. At the same time, the pandemic may also change households' risk tolerance levels or their assessment of risk, which would then affect their investment behavior as well, holding financial literacy or confidence constant. Our results suggest that self-confidence could be a barrier to entering bond and equity markets but plays a lesser role in how much is invested in these assets. Furthermore, recent trends in the digitalization and decentralization of finance might lower barriers to participating in more complex financial products. Conventional channels of financial intermediation and advising are easily avoided, and therefore, individual financial knowledge and self-confidence becomes ever more important for financial well-being.

As such, our results on the determinants of portfolio diversification can help inform potential policy tools, perhaps through initiatives to promote investor confidence in own financial abilities hand-in-hand with increasing financial knowledge to better prepare individuals for the new challenges of household finance in a rapidly changing financial environment to foster stock-market participation. Both increase

portfolio diversification and, therefore, households' financial resilience.

Data availability

The authors do not have permission to share data, but the raw data may be requested from the Board of Governors of the Federal Reserve System.

Acknowledgements

We are very grateful to the editor (Prof. Sushanta Mallick) and three anonymous referees for constructive comments and suggestions. We would also like to thank Alyssa Schneebaum, Martin Šuster, the participants in the 6th Luxembourg Household Finance and Consumption Workshop, and National Bank of Slovakia Research Seminar for their useful suggestions and comments. Andrej Cupák acknowledges the financial support from the Ministry of Education, Science, Research and Sport of the Slovak Republic [VEGA 1/0221/21] and the Slovak Research and Development Agency [APVV-20-0359]. The analysis and conclusions set forth are those of the authors and do not indicate concurrence by other members of the research staff or members of the Board of Governors of Federal Reserve System, the Oesterreichische Nationalbank, the National Bank of Slovakia, or the Eurosystem. All remaining errors are our own.

Appendix A. Description of variables used in empirical analysis

Variable	Description
Dependent variables	
Holds equities	Dummy variable taking a value of 1 if household holds any equity of the following type: publicly traded stocks, stock mutual funds, combination funds, IRAs/Keoghs invested in stocks, other managed assets w/equity interest (e.g., annuities, trusts, MIAs), thrift-type retirement accounts invested in stocks, savings accounts classified as 529 (educational savings accounts)
Share of financial assets in equities	Share of the equity value in total financial assets (including pensions)
Holds bonds	Dummy variable taking a value of 1 if household holds any instruments of the following type: government saving bonds, corporate bonds, commercial paper, state or municipal non-saving bonds, foreign bonds and other non-saving bonds, debentures, mortgage-backed securities, negotiable certificates of deposit, treasury bills (T-bills), treasury certificates (T-certificates), treasury bonds (T-bonds), zero-coupon bonds, and similar instruments normally traded in financial markets
Share of financial assets in bonds	Share of bonds and other debt securities in total financial assets (including pensions)
Explanatory variables	
Financial literacy score	Number of correct answers to the three financial literacy questions; ranging from 0 to 3
Fin. literacy (risk)	Dummy variable taking a value of 1 if the knowledge question on "risk" is answered correctly
Fin. literacy (interest)	Dummy variable taking a value of 1 if the knowledge question on "interest rates" is answered correctly
Fin. literacy (inflation)	Dummy variable taking a value of 1 if the knowledge question on "inflation" is answered correctly
Investor self-confidence	Respondent's self-assessed level of knowledge about financial matters; ranging from 0 "very low" to 10 "very high"
Investor confidence in the economy	Respondent's confidence in overall performance of the US economy in 5 years' horizon as compared to today (2019); ranging from 1 "worse" to 3 "better"
Risk tolerance	Dummy variable taking a value of 1 if the respondent reports positive risk attitude
Net real estate wealth	Net real estate wealth defined as a total value of properties minus the corresponding liabilities
Privately-held businesses	Dummy variable taking a value of 1 if household owns or shares ownership in any privately-held businesses
Disposable household income	Total monetary and non-monetary household current income net of income taxes and social security contributions. We calculated the household disposable income by subtracting from the gross household income (collected in the SCF) the income taxes simulated with the TAXIM program provided by NBER (https://taxsim.nber.org/to-taxsim/scf27-32/)
Inheritance/gift received	Dummy variable taking a value of 1 if household had received an inheritance or a gift
Number of household members	Number of members in household
Presence of children under 18	Number of children in household aged below 18
Age	Age of the respondent in years
Female	Dummy variable taking a value of 1 if the respondent is female
Employed for wage	Dummy variable taking a value of 1 if the respondent is employed for wage or self-employed
Primary or no education	Dummy variable taking a value of 1 if the respondent has less than high school education
High school graduate	Dummy variable taking a value of 1 if the respondent has secondary education
College graduate	Dummy variable taking a value of 1 if the respondent has university education (bachelor, graduate, postgraduate)
White	Dummy variable taking a value of 1 if the respondent declares Caucasian ethnicity (including Middle-eastern/Arab whites)
Black	Dummy variable taking a value of 1 if the respondent declares African-American ethnicity
Hispanic	Dummy variable taking a value of 1 if the respondent declares Hispanic/Latin-American ethnicity
Other race/ethnicity	Dummy variable taking a value of 1 if the respondent declares other ethnicity (e.g., Chinese, Indian)
Married	Dummy variable taking a value of 1 if the respondent is married or having partner
Single	Dummy variable taking a value of 1 if the respondent is living in a single-member household
Divorced/separated	Dummy variable taking a value of 1 if the respondent is divorced or separated
Widowed	Dummy variable taking a value 1 if the respondent is widowed

Source: own processing.

Appendix B. Text of the financial literacy questions

1) Please tell me whether this statement is true or false. "Buying a single company's stock usually provides a safer return than a stock mutual fund."
   True
   False (correct answer)
   Do not know

Refuse to answer

2) Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?
   More than $102 (correct answer)
   Exactly $102
   Less than $102
   Do not know
   Refuse to answer
3) Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?
   More than today
   Exactly the same
   Less than today (correct answer)
   Do not know
   Refuse to answer

Appendix C. Unconditional quantile regression

To analyze the relationship between covariates and the share of risky assets in total financial assets beyond the mean (baseline model outlined in equation (2)), we employ the unconditional quantile regression (UQR) method. To do so, we use the concept of the recentered influence function similar to the standard regression technique, replacing the dependent variable with the recentered influence function of the statistics of interest (Firpo et al., 2009). For convenience we summarize the UQR framework from Firpo et al. (2009).

Let Y be the observed outcome variable of interest in the presence of a set of available covariates X. Y and X have a joint distribution $F_{YX}(.;.)$. The unconditional distribution of X can be defined as follows:

$$F_Y(y) = \int_{(Y|X)}^{F} (y|X=x) \times dF_X(x).$$

The UQR framework is developed by defining a recentered influence function (RIF), which is an extension to the concept of the influence function (IF). Influence functions are used in statistics to extract the effect/influence of adding or removing a particular observation on the value of statistics $v(F_Y)$. The standard IF can be written as:

$$IF(y; v(F)) = \lim_{\varepsilon \to 0} \frac{\left[v\left\{(1-\varepsilon)\cdot F + \varepsilon \cdot \delta_y\right\} - v(F)\right]}{\varepsilon}, 0 \le \varepsilon \le 1,$$

where F is the cumulative distribution function for Y, and δ_y represents the probability measure putting mass 1 at the value y. We obtain the RIF by adding the IF to the statistics of interest $v(F)$:

$$RIF(y; v, F_Y) = v(F) + IF(y; v, F_Y).$$

After substituting in the particular statistic of interest, regression quantile q_τ, it yields:

$$RIF(y; q_\tau) = q_\tau + IF(y; q_\tau).$$

In the case of quantiles, we can write the influence function as follows:

$$IF(y; q_\tau) = \frac{\tau - I[Y \le q_\tau]}{f_Y(q_\tau)},$$

where $f_Y(q_\tau)$ represents the probability density function of Y evaluated at quantile q_τ. $I[Y \le q_\tau]$ is an indicator variable taking a value of 1 if the outcome variable Y is smaller than q_τ and 0 otherwise.

Finally, the UQR estimator is defined as coefficient vector obtained from the following linear regression of the RIF on a set of explanatory variables:

$$RIF(Y, \tau) = X\beta^{UQR} + \varepsilon.$$

UQR produces coefficients corresponding to the impact on the τ-th quantile of the outcome variable Y, irrespective of the included set of explanatory variables, which makes the method an attractive tool, especially in the policy context analysis.

Appendix D. Analyzing multiple imputed data

A specific feature of many surveys (including the SCF) is that missing values in some of the variables due to responses of "Don't know" and "Refused" have been imputed and replaced m times (five in the case of SCF). This feature should be considered in an empirical analysis when obtaining statistical inferences. Estimations ignoring item-nonresponse can lead to substantial biases as well as efficiency loss due to the large number of covariates included in regressions (see Christelis et al., 2010). Therefore, we follow the rules suggested by Rubin (1987) and Little and Rubin (2002), and we use multiple-imputation techniques to obtain correct estimated coefficients along with the variance. Let β be our point estimate of an interest – that is mean and regression parameter. For each of the imputed datasets

m, we obtain an empirical estimate of β, denoted by $\widehat{\beta}_m$. The final average point estimate of β, given by $\overline{\beta}$, is computed as follows:

$$\overline{\beta} = \frac{1}{5}\sum_{m=1}^{5}\widehat{\beta}_m.$$

The final estimated $\overline{\beta}$ is associated with a variance having two components: $W = \frac{1}{5}\sum_{m=1}^{5}\widehat{V}_m$, which is a within imputation sampling variance, and the between imputations variance given by $B = \frac{1}{4}\sum_{m=1}^{5}(\widehat{\beta}_m - \overline{\beta})^2$. The total variance-covariance matrix, $\widehat{V}$, associated with $\overline{\beta}$ is given by:

$$\widehat{V} = W + (6/5)B.$$

Finally, to estimate W accounting for the complexity of the SCF sampling design, we implement a bootstrap procedure taking into account 999 replicate weights provided in the SCF.

Appendix E. OLS estimates of determinants of ownership of equities and bonds (alternative confidence measures)

	Equities				Bonds			
	Participation stage		Allocation stage		Participation stage		Allocation stage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Conf-High/FL-High (I)	0.133***	0.132***	0.048***	0.048***	0.044***	0.044***	−0.056***	−0.056***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.009)	(0.009)	(0.020)	(0.020)
Conf-High/FL-Low (II)	−0.026*	−0.025*	0.031	0.030	0.001	0.002	−0.051**	−0.052**
	(0.015)	(0.015)	(0.019)	(0.019)	(0.007)	(0.007)	(0.022)	(0.022)
Conf-Low/FL-High (III)	0.084***	0.083***	0.040**	0.041**	0.007	0.006	−0.063***	−0.062***
	(0.017)	(0.016)	(0.018)	(0.018)	(0.010)	(0.010)	(0.023)	(0.023)
Investor confidence in the economy		−0.008		0.014**		−0.007		0.006
		(0.008)		(0.006)		(0.004)		(0.008)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R squared	0.283	0.283	0.051	0.052	0.050	0.051	0.136	0.085
N	5776	5776	3630	3630	5776	5776	659	659

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Dummy variable for low confidence and low financial literacy is the reference category of the respective dummy variable set. Control variables are the same as in the main regressions. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.
Source: Survey of Consumer Finances 2019.

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Prílohy

A Endogenita finančnej gramotnosti z dôvodu chybovosti jej merania

Potenciálna endogenita finančnej gramotnosti sa zvažovala vo viacerých teoretických a empirických štúdiách (napr. Jappelli a Padula, 2013; Lusardi a Mitchell, 2014; Deuflhard a iní, 2019; Crossley a iní, 2021). Vo všeobecnosti môže byť endogenita finančnej gramotnosti spôsobená možnou reverznou kauzalitou medzi finančnou gramotnosťou a finančným správaním (t.j. získavaním finančnej gramotnosti prostredníctvom skúseností na finančných trhoch), vynechanými (nepozorovanými) faktormi, ktoré súčasne ovplyvňujú finančné správanie aj úroveň finančnej gramotnosti, ako aj chybou merania spojenou s meraním gramotnosti v dotazníkoch (viď Deuflhard a iní, 2019).

Empirický výskum ukazuje, že vplyv finančnej gramotnosti je pri štandardných OLS odhadoch skreslený v porovnaní s prístupom inštrumentálnych premenných, pričom výsledky sú skreslené smerom k nule (tzv. "attenuation bias"), čo naznačuje práve endogenitu finančnej gramotnosti z dôvodu chybovosti jej merania (viď Lusardi a Mitchell, 2014).

Dôsledky klasického problému chybovosti v meraní nezávislej premennej pre odhadnutý OLS efekt môžeme jednoducho popísať podľa Pischke (2007). Uvažujme o jednoduchom lineárnom regresnom modeli s jednou nezávislou premennou (finančnou gramotnosťou v našom prípade). Pre zjednodušenie budeme tiež predpokladať, že závislá aj vysvetľujúca premenná majú strednú hodnotu 0. Predpokladajme, že chceme odhadnúť populačný vzťah pomocou:

$$y = \beta x + \epsilon. \tag{A.1}$$

Nanešťastie, v empirických údajoch pozorujeme iba:

$$\tilde{x} = x + u \tag{A.2}$$

$$\tilde{y} = y + v, \tag{A.3}$$

čo znamená, že naše premenné sú merané s určitou dodatočnou chybou.

Chyba merania vysvetľujúcej premennej má strednú hodnotu 0, nie je korelovaná so skutočnými závislými a nezávislými premennými a s náhodným poruchovým členom rovnice. Taktiež budeme vychádzať z predpokladu, že $\sigma_v^2 = 0$, t.j. existuje len

chyba merania v nezávislej premennej x (finančnej gramotnosti v našom prípade). Tieto predpoklady definujú klasický model chýb v premenných.

Pri nahradení $\tilde{x} = x + u$ do $y = \beta x + \epsilon$ dostaneme nasledovný vzťah:

$$y = \beta(\tilde{x} - u) + \epsilon = y = \beta\tilde{x} + (\epsilon - \beta u). \tag{A.4}$$

Vidíme, že chyba merania v x sa stáva súčasťou náhodného poruchového člena v regresnej rovnici, čím vzniká skreslenie z dôvodu endogenity. Keďže $\tilde{x}$ a u sú pozitívne korelované, môžeme vidieť, že OLS odhad povedie k zápornému skresleniu v $\hat{\beta}$, ak je skutočné β pozitívne a k pozitívnemu skresleniu, ak je záporné.

Na posúdenie veľkosti skreslenia zvažujeme OLS odhad pre regresný koeficient β:

$$\hat{\beta} = \frac{cov(\tilde{x}, y)}{var(\tilde{x})} = \frac{cov(x + y, \beta x + \epsilon)}{var(x + u)} \tag{A.5}$$

a

$$\text{plim}\hat{\beta} = \frac{\beta\sigma_x^2}{\sigma_x^2 + \sigma_u^2} = \lambda\beta \tag{A.6}$$

kde

$$\lambda \equiv \frac{\sigma_x^2}{\sigma_x^2 + \sigma_u^2} \tag{A.7}$$

Táto veličina sa označuje ako spoľahlivosť alebo pomer signálu k celkovej odchýlke. Keďže $0 < \lambda < 1$, koeficient β bude skreslený smerom k 0. Toto skreslenie sa preto nazýva skreslenie zoslabenia ("attenuation") a v tomto prípade je λ faktorom zoslabenia.

Veľkosť skreslenia môžeme kvantifikovať ako:

$$\text{plim}\hat{\beta} - \beta = \lambda\beta - \beta = -(1 - \lambda)\beta = -\frac{\sigma_u^2}{\sigma_x^2 + \sigma_u^2}\beta, \tag{A.8}$$

čo opäť poukazuje na skutočnosť, že skreslenie závisí od znamienka a veľkosti β.

B Vyhlásenie o autorskom príspevku (CRediT)

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