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Abstract

This study characterizes the household's choice of investment fund as a multiple step procedure. Using two structural econometric models, I estimate potential investor characteristics that drive the decision process. While the first step includes choosing whether to invest in a fund or not, i.e. it models the extensive margin, the second step models the intensive margin, depending on the choice of the econometric model. In the first step, the probability of becoming a fund investor rises with the level of education, financial literacy and wealth, but falls with age and indebtedness. In the second step, the investment size increases with wealth and age but decreases with financial literacy. Further, I model the choice between different types of investment funds as extensions of the Random Utility Model (RUM) - representing full consideration - and the Limited Consideration Model. In this way, I am able to estimate and compare resulting models. I reject full consideration in favor of limited consideration behavior. Using a novel framework for investment fund choice, I estimate average monetary losses affected by limited consideration. In contrast to previous research that uses only the full consideration framework, I find that all households across the wealth distribution face significant losses. However, conditional on wealth, households with a lower level of education or financial literacy face larger losses. In addition, by combining results from multiple steps of the investment decision, I calculate the elasticity of marginal utility of investing in variables such as financial literacy.

JEL codes: D83, G11, G23, G41, G53

Keywords: Investment fund choice, Limited consideration, Financial literacy

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1 Introduction

Existing studies model the way households manage their financial assets by building a standard portfolio optimization problem. The usual assumption of those models is the symmetry in household information and the decision-making process across various household characteristics. Empirical findings suggest that returns to financial wealth exhibit significant persistence, further amplifying wealth inequality (Fagereng et al., 2020). Currently, with the development of industry and access to information, households are able to compare the potential costs and benefits of choosing a specific financial asset. Given the disproportionality in stock owning throughout the wealth distribution, I do not assume that households choose the share of stock on their own. This paper focuses on the importance of choosing the right mixture of financial assets through financial intermediaries, resulting in mutual fund share choices implied by intermediary options. The narrative in banks is that they offer to navigate their clients' options towards growth. However, not all households fully consider their investment choices but rather invest passively (Chalmers and Reuter, 2012). For instance, they find that substantial amount of workers remain at the default fund choice when allocating their retirement savings.

In this study, to model investment in an investment fund, I use the Two-Step Heckman Model (Heckman, 1979). As the outcome, the resulting choice is represented as a function of the household's characteristics, including the degree of financial literacy, education, and wealth. As the result of the model, I obtain characteristics that affect the likelihood of the investment (selection equation), and characteristics that affect the size of the investment (outcome equation). The likelihood of an investment in the investment fund rises with the level of education, financial literacy and wealth, but falls

with age and indebtedness of the household. On the other hand, the size of the investment increases with age, and wealth and decreases with the level of financial literacy. Conditional on a decision to invest, and the size of the investment determined, I look at households' decisions over the specific type of investment fund. Types of investment funds differ in returns, volatility, and expenses as their portfolio shares vary. For example, stock market funds invest primarily in equity (implying high returns and high volatility) and the money market fund invests mainly in short-term government T-bills (which implies low returns and low volatility).

To evaluate households' choices, I compare two models, the Random Utility Model that represents households' full consideration behavior, and the Limited Consideration Model. Barseghyan et al. (2021b) is the first to define the econometric framework for the Limited Consideration Model defined by Manzini and Mariotti (2014). I build on Barseghyan et al. (2021b), and instead of lottery representation of the game (used in the insurance market), I implement a continuous random variable for the outcome (return) of the investment fund choice. This is the first study that explores limited consideration in investment fund choice. The Limited Consideration Model fits households' choice much better and the Vuong (1989) test rejects the Random Utility Model in favor of the Limited Consideration Model at all usual significance levels. This finding suggests that, possibly, taking all available options is too costly for households and they do not make optimal choices, i.e., achieve the first best allocation for investment.

Using the estimated model, I evaluate average monetary loss (as a consequence of choosing from a constrained choice set) for different groups and observe heterogeneous effects. Households that have completed only high school lose more than households with at least some college or higher education. Similarly, households with financial lit-

eracy[1] 0 lose more than those with financial literacy 1. Moreover, I calculate the average monetary loss for households grouped by financial literacy and education separately for low and high wealth groups. First, I find that, all households across the wealth distribution face statistically significant average monetary loss. This results is in contrast with results by Campbell (2006), who uses only the full consideration framework and finds that only a small fraction of households makes investment mistakes. However, Campbell (2006) examines aggregate household investments and I look specifically at investments in investment funds. Second, I find that households with a lower level of financial literacy face higher average monetary losses than households with a higher level. Furthermore, I find the same pattern for education. Finally, by combining results from two econometric models, I calculate the elasticity of marginal utility of investing in investment funds in financial literacy, wealth, and other household characteristics.

2 Related Literature

This study builds on the large body of literature that examines limited market access (Holmstrom and Tirole, 1997; Allen and Gale, 1994), heterogeneity in attention span, and thus, different information sets.

Even though attention allocation is introduced in choice modeling, only a few empirical studies can estimate differences in attention. This is because econometric models are not developed enough on this front. Attention parameters have been estimated using experiments only (Bartoš et al., 2016). This study adds to the stream of literature that concerns households' decision-making under risk with constrained choice

[1]Financial literacy is measured by the standard three questions proposed by Lusardi and Mitchell (2014) covering inflation, interest rates, and riskiness. The list of questions is in section A of the appendix.

sets. Jung et al. (2019) and Caplin et al. (2019) connect rational inattention with the limited consideration literature. They model limited attention in choice by showing that the rational inattention model implies the formation of consideration sets. Thus, only a subset of the available alternatives will be considered for choice. Manzini and Mariotti (2014) model a boundedly rational agent who suffers from limited attention. The agent in their study considers each feasible alternative with a given (unobservable) probability, the attention parameter, and then chooses the alternative that maximizes a preference relation within the set of considered alternatives. Barseghyan et al. (2021b) build on Manzini and Mariotti (2014) and develop a discrete choice model with unobserved heterogeneity in consideration sets and standard risk aversion. Coughlin (2019) uses a framework developed in Barseghyan et al. (2021b) and explores limited consideration in the medical insurance setting. Other studies that explore preference and discrete choice model estimation over unobserved choice sets include Barseghyan et al. (2021a), Crawford et al. (2021), and Aguiar and Kashaev (2021). However, my study is the first that employs limited consideration in investment fund choice. Moreover, Barseghyan et al. (2021b) consider a simple lottery while I model expected utility with normally distributed returns, and Coughlin (2019) does not model households' preferences dependent on observable characteristics.

The econometric part of this study exploits the Two-Step Heckman Model (Heckman, 1979) applicable to many fields. In addition, I address concerns from Kline and Walters (2019). I use the Two-Step Heckman Model to explore household decisions on whether to invest or not and on the size of the investment. Further, I add to the household finance stream of literature. Campbell (2006) offers an overview of the field of household finance, and investigates households' portfolio structure on a more general level. Moreover, my conclusions from the Heckman Model are in line with his (i.e.,

less educated households participate less). Similarly, Calvet et al. (2009a) and Calvet et al. (2009b) find that financially sophisticated households, with greater income, wealth, and education, are more likely to enter the market. However, I take a different approach to the analysis of households' investment decisions by analyzing their investment in investment funds. Chalmers and Reuter (2012) investigate recommendations of advisors on retirement portfolio choice. Their results support their claim that the portfolio choices of broker clients reflect the recommendations of their brokers. Given these findings, it may be that assignment between households and experts should be based on their risk aversion. In this way, intermediaries take a role in the financial market, as their preference reflects one of the households. Further, Calvet et al. (2007) investigate the efficiency of household investment decisions and find that financially sophisticated households invest more efficiently and more aggressively. Mani et al. (2013) explore poverty and cognitive functions and find that poor people often behave in less capable ways. Calvet and Sodini (2014) and Brunnermeier and Nagel (2008) investigate how households' portfolio allocations change in response to wealth fluctuations and heterogeneity of preferences towards risk. Agarwal and Mazumder (2013) measure dependence of financial mistakes dependent on cognitive ability. Fagereng et al. (2020) show that returns to wealth are heterogeneous and persistent. In contrast to Calvet et al. (2007, 2009a,b), and Calvet and Sodini (2014), I concentrate my analysis only on investment funds and use SCF, whereas they use Swedish regulatory data. Campbell (2006) uses SCF, but does not account for financial literacy or different types of investment funds.

Lastly, I add to the literature that explores the heterogeneity of preferences and investment fund choice. Gennaioli et al. (2015) model matching of households to experts based on trust. Moreover, the authors claim that trust in financial intermediaries

reduces the perception of the riskiness of a proposed investment. Kacperczyk et al. (2016) explore rational inattention of mutual fund managers and I study the behavior of households that invest in mutual funds. Andersen et al. (2020) estimate the probability of active mortgage refinancing, and link it to households' attention allocation to financial well-being. Goeree (2008) explores the estimation consequences of using a full-information model when only limited information is available in the PC industry. More related is Calvet et al. (2021), who explore and document heterogeneity of household preferences and Sirri and Tufano (1998) who find that fees and costly search have a dominant impact on equity flows in mutual funds. Grinblatt et al. (2016) connect IQ and fees with mutual fund choice and Lusardi and Mitchell (2014) stress the importance of financial literacy and define a set of questions that are included in the Survey of Consumer Finances. I use the number of correctly answered questions as an objective measure of financial literacy.

3 Structural Econometric Model of Investment Decision

In this study, I use the Survey of Consumer Finances (SCF) for data about households. This dataset offers an extensive list of information about financial and personal household characteristics that include financial literacy, home and stocks ownership, education, age, and occupation. Most importantly for this study, the dataset contains information on which type of investment funds households invest in and how much money they have invested. Furthermore, each participant answers questions about finance, which enables the conductors of the SCF to create an objective measure of financial literacy for each participant of the survey. Table (1) presents an overview of

some household characteristics.

The object of interest is the probability of a choice (1) dependent on household i, with an expert that has type j, conditional on household's characteristics where, in this example, experts have the following types: risk averse (RA), risk neutral (RN), and risk loving (RL). More specifically, the object of interest is

$$p_i(s_i = j|z_i; \theta_i; \phi), \quad j \in \{RA, RN, RL\}, \tag{1}$$

where s is the household's expert choice, z are characteristics and θ_i is the household's specific, and ϕ is the general parameter vector. Further, for experts, I use data on investment funds. Therefore, choosing between different types of investment funds could be a natural choice for types of experts. As the choice of fund could be related to a potential financial expert that deals with bureaucracy, I use the terms fund and expert interchangeably.

I separate the analysis of this choice into two parts. In the first part, I use the Two-Step Heckman Model to examine what affects household decisions on whether to invest or not and which characteristics determine the value invested. In the second part, I concentrate more specifically on the outcome of the investment, i.e., what determines which investment fund the household chooses.

3.1 Two-Step Heckman Model and the LATE estimator

The proposed model is the Two-Step Heckman Model. Further, as outcomes express the household's preferences, they cannot be observed in the data. Correspondingly, outcomes in this empirical model are latent variables. The outcome of each choice $ij \in M = I \times J$ (I is the set of all households and J is the set of the household decision

- to invest or not) is given by the outcome equation

$$V_{ij}^{*} = W_{ij}'\alpha + \eta_{ij}, \tag{2}$$

where $W_{ij} \in \mathbb{R}^k$ is a vector of observed characteristics for a household $i \in I$, and parameter vector α needs to be estimated. The error term η_{ij} contains characteristics that are unobservable in the data. However, conditional on the decision to invest, I use the observable size of the investment as the measure of the valuation of the choice. To be specific, I use the natural logarithm of the size of investment so that marginal effects could be presented in percentage points as usual in the literature. The household i decides to invest if the value of the decision to invest is higher than the value of the decision to not invest.

The second part of the model is the selection equation

$$Y_{ij}^{*} = X_{ij}'\beta + \varepsilon_{ij}, \tag{3}$$

where X are observable characteristics in the data, ε is the error that again contains unobservable characteristics from the data, and Y^{*} is a latent variable. Since this is a discrete choice model, parameters are only identified up to a scale. This is natural (Sørensen, 2007) because selection equation represents preferences. Correspondingly, to normalize the scale, I set the variance of the error ε to 1. Following standard probit specification, the observable outcome from the data is

$$INV_{ij} = \mathbf{1}_{(Y_{ij}>0)}, \tag{4}$$

which is equal to one if household $i \in I$ invested in an investment fund. Moreover,

INV_{ij} is equal to one if Y_{ij} is greater than zero. Lastly, to finish the specification of the model, I impose the following distribution for errors:

$$\begin{pmatrix} \varepsilon_{ij} \\ \eta_{ij} \end{pmatrix} \sim \mathcal{N} \begin{pmatrix} 1 & \rho\sigma \\ \rho\sigma & \sigma^2 \end{pmatrix}. \tag{5}$$

All together, the selection equation is given with:

$$INV_{ij} = \mathbb{1}_{\{Y^*_{ij} \geq 0\}} = \begin{cases} 1, & \text{if } Y^*_{ij} \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

and the outcome equation with:

$$V_{ij} = \begin{cases} V^*_{ij}, & \text{if } Y^*_{ij} \geq 0 \\ 0, & \text{otherwise} \end{cases}.$$

Table 2 presents the estimation results. Inverse Mills Ratio is significant in Table 2 and correlation ρ is negative. Thus, I need to account for the bias in the outcome equation. Adjusted marginal effects are in Tables 3 and 4.

Kline and Walters (2019) address the issue of structural econometric methods that are often criticized for being sensitive to functional form assumptions. They study parametric estimators of the local average treatment effect (LATE). Moreover, they derive conditions under which LATE estimates are algebraically equivalent to the instrumental variables (IV) estimator. I manually check and confirm that my model and the data satisfy these conditions. Consequently, the results presented in this section are equivalent to LATE estimates and robust. For this reason, the results in this section

do not undergo the sensitivity critique of the Heckman (1979) estimator.

3.1.1 Selection Equation Estimation Results

The first column in Table 3 contains calculated marginal effects for the selection equation. The results are presented in percentage points. Furthermore, selection equation marginal effects are presented in Figures 1, 2a, 2b, 3, and 4.

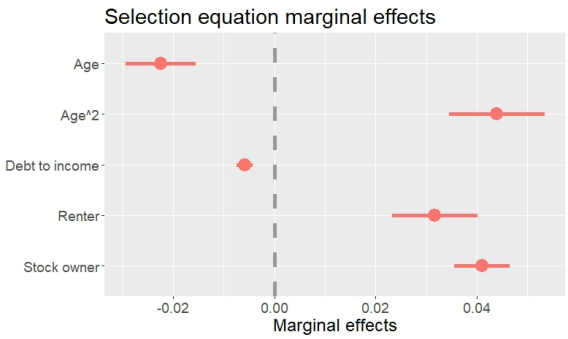
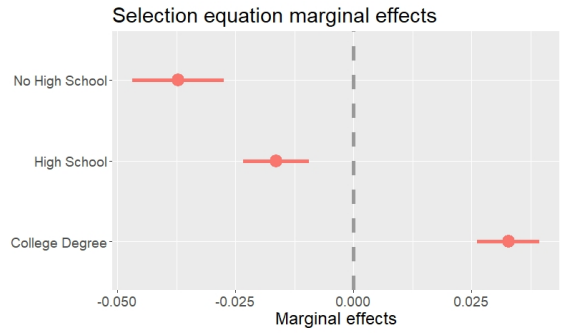


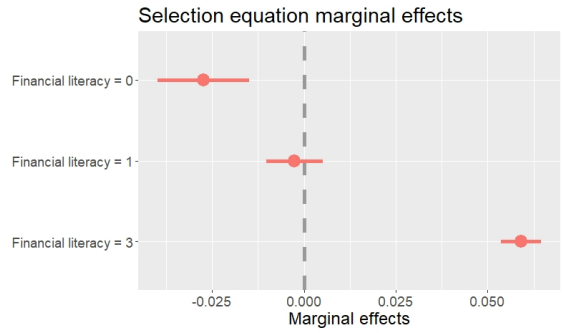
Figure 1: Selection equation marginal effects for age, debt to income ratio, houseownership and stockownership status. Marginal effects are reported with 95% confidence intervals.

Figure 1 shows that with the increase in age, households are 2% less likely to invest in an investment fund; however, this effect is diminishing. Moreover, renters and stock owners are more likely to invest, while more indebted households are less likely to invest. Calvet et al. (2007) and Calvet and Sodini (2014) find negative effects of age and indebtedness as well.

Figures 2a, and 2b contain marginal effects for education and financial literacy on the likelihood of the investment. Households with no high school relative to households with some college are 4% less likely to invest, while households with a college degree are 3% more likely to invest in investment funds. Similarly, households with financial literacy level 0 are 3% less likely to invest than households with financial literacy level equal



(a) Base category is "Some College".



(b) Base category is "Financial literacy = 2".

Figure 2: Selection equation marginal effects for education and financial literacy. Marginal effects are reported with 95% confidence intervals.

to 2. In contrast, households with a higher level of financial literacy than 2 are more likely to invest in investment funds. These results are in in line with the estimations of Calvet et al. (2007) and Calvet et al. (2009b) in which they find that households with low education and wealth are less likely to participate in the investment market.

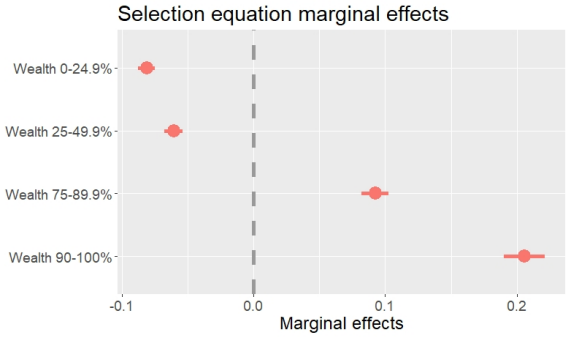


Figure 3: Selection equation marginal effects for wealth. Base category is "Wealth 50-74.9%". Marginal effects are reported with 95% confidence intervals.

Figure 3 shows that higher wealth implies higher likelihood of the investment and vice versa for lower levels. However, the magnitude of wealth is larger than the magnitude of previously mentioned effects. Households in the highest wealth quantile are 20% more likely to invest in investment funds than households in the middle wealth quantile. Conversely, households in the bottom wealth quantile are almost 10% less

likely to invest than households in middle wealth quantile. In addition, Figure 4 shows that households from managerial and professional occupations are more likely to invest than households from tech, sales or services positions. Finally, These results are in line with the results in the literature (Campbell, 2006; Calvet et al., 2007, 2009a,b; Calvet and Sodini, 2014) on asset market participation, i.e., more educated and wealthier households are more likely to participate.

Figure 4: Selection equation marginal effects for occupation. Base category is "Managerial/Professional". Marginal effects are reported with 95% confidence intervals.

3.1.2 Outcome Equation Estimation Results

Inverse Mills Ratio is significant which implies selection of the data. Thus, both estimated coefficients and marginal effects need to account for the bias. Further, marginal effects are calculated conditional on participation/investing in investment funds and presented in percentage points in Table 4. Moreover, Figures 5, 6a, 6b, and 7 contain a graphical representation of the outcome equation marginal effects.

In contrast to results from participation in investment estimations, the outcome equation marginal effects in Figure 5 imply that older people invest more. On the other hand, with the increase in debt to income ratio, households invest less in investment funds.

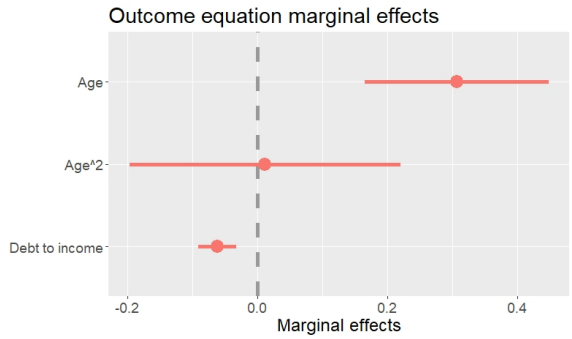


Figure 5: Outcome equation marginal effects for age, and debt to income ratio. Marginal effects are reported with 95% confidence intervals.

(a) Base category is "Some College". (b) Base category is "Financial literacy = 2".

Figure 6: Outcome equation marginal effects for education and financial literacy. Marginal effects are reported with 95% confidence intervals.

Figures 6a and 6b show education and financial literacy marginal effect on the size of the investment. Households with no high school degree invest almost 40% more in investment funds than households with some college. Conversely, households with a college degree invest around 15% less in investment funds than households with only some college. A similar effect holds for financial literacy. Households with a lower level of financial literacy than 2 invest less than households with a financial literacy level equal to 2, and vice versa. This result suggest that, possibly, households with less education and financial literacy do not diversify their investments. As noted by Campbell (2006), this could potentially be part of households that make mistakes. Moreover, Calvet

et al. (2007) find that more financially sophisticated households invest more efficiently. Conversely, households with a higher level of education and financial literacy invest more in other financial and non-financial assets (i.e., liquid savings and housing).

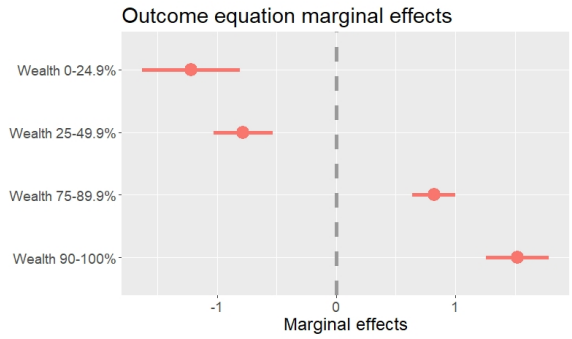


Figure 7: Outcome equation marginal effects for wealth. Base category is "Wealth 50-74.9%". Marginal effects are reported with 95% confidence intervals.

Finally, Figure 7 shows that the amount invested rises with the wealth of households. Again, as in the case in the likelihood of investment, the magnitude of the effect of wealth is the largest. The amount of the investment for households in the highest wealth quantile is more than double the amount invested by households from the middle wealth quantile. In contrast, the amount invested by households from the lowest wealth quantile is less than half the amount invested by households from the middle wealth quantile. These results are in line with Calvet et al. (2007), who find that wealthier households invest more.

4 Investment Fund Type Choice

The first part of the analysis was to examine what affects the decision of households to invest, and what affects the amount of the investment. In this part, conditional on the decision to invest, I explore what affects the choice between different types of

investment funds.

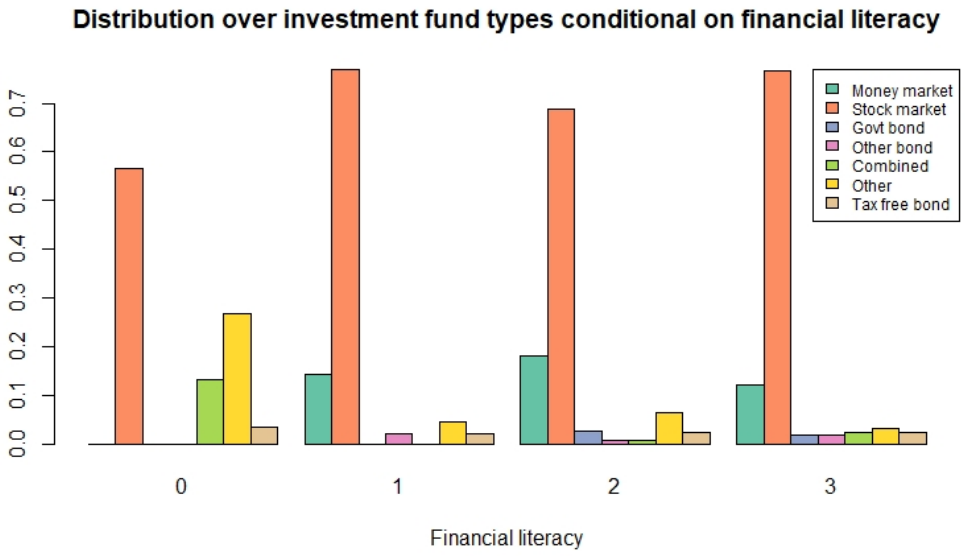


Figure 8: Distribution over investment fund types for different levels of financial literacy.

Figure 8 indicates that distribution over investment fund types is different for different levels of financial literacy. Moreover, even when all groups of financial literacy would be combined conditional on wealth, concentration in one specific type of investment fund (stock market investment fund) would be observable. On one hand, households with a lower level of financial literacy do not consider all available options. On the other hand, households with a higher level of financial literacy consider more available alternatives. Limited consideration theory analyzes situations in which some consideration sets are greater than others. In the next section, I set up and estimate the Limited Consideration Model and compare it to the Random Utility Model. To the best of my knowledge, this is the first study that explores limited consideration in investment fund choice.

4.1 Utility Specification

In my simplified model, agents (decision-makers) have CARA (constant absolute risk aversion) preferences defined with

$$u(c) = \begin{cases} \frac{1-\exp(-\nu c)}{\nu}, & \text{if } \nu \neq 0 \\ c, & \text{otherwise} \end{cases},$$

where ν is the parameter of the risk aversion. Further, in contrast to Barseghyan et al. (2021b), who assume a simple lottery that is sufficient to evaluate expected utility in the insurance market, I assume a continuous random variable. More specifically, I assume that given the size of investment W_i, agent i chooses an investment fund with returns $r_j \sim \mathcal{N}(\mu_j, \sigma_j^2)$, and expense ratio ξ_j such that expected utility is maximized. The utility of choosing an investment fund, assuming heterogeneity in preferences $\nu_i \in [0, \bar{\nu}]$ is

$$u_i(r_j, \xi_j) = u_{ij} = \frac{1 - \exp(-\nu_i(W_i r_j(1-\xi_j)))}{\nu_i}.$$

Since returns are assumed to be normally distributed, for choice set $\mathcal{J}$ follows

$$\begin{aligned} \max_{j \in \mathcal{J}} \mathbb{E}[u_{ij}] &\Leftrightarrow \max_{j \in \mathcal{J}} \mathbb{E}[-\exp(-\nu_i(W_i r_j(1-\xi_j)))] \\ &\Leftrightarrow \min_{j \in \mathcal{J}} \mathbb{E}[\exp(-\nu_i(W_i r_j(1-\xi_j)))] \\ &\Leftrightarrow \min_{j \in \mathcal{J}} \exp(-\nu_i(W_i \mu_j(1-\xi_j)) + \frac{\nu_i^2}{2}\sigma_j^2 W_i^2(1-\xi_j)^2) \\ &\Leftrightarrow \max_{j \in \mathcal{J}} \mu_j - \frac{\nu_i}{2}\sigma_j^2 W_i(1-\xi_j). \end{aligned}$$

The final expression allows for easier and faster evaluations of the objects of the model. In estimations, I use Vanguard's corresponding fund types data to approximate returns,

volatility, and expense ratios.

4.2 Limited Consideration Model

Building on Barseghyan et al. (2021b) and Manzini and Mariotti (2014), I model agents who have limited consideration. In contrast to the standard assumptions, i.e., that agents choose the best alternative among all available, agents in my model evaluate options from individual consideration set $J_i \subseteq \mathcal{J}$. Moreover, denoting $y_{ij} = 1$ if agent i prefers option j among other options within his consideration set J_i, the probability of the choice is (leaving out conditioning notation):

$$\mathbb{P}(y_{ij} = 1) = \sum_{J \subseteq \mathcal{J}: j \in J} \mathbb{P}(J_i = J)\mathbb{P}(\mathbb{E}[u_{ij}] > \mathbb{E}[u_{ik}], \quad \forall k \in J). \tag{6}$$

Investment fund j appears in the agent's consideration set with probability φ_j, independently of other alternatives. Moreover, I assume that consideration probabilities of investment funds are homogeneous across agents who face the same feasible choice set. However, Barseghyan et al. (2021b) offer more general consideration probabilities that could be modeled as functions of the agent's characteristics. Thus, the probability of any consideration set $J_i = J \subseteq \mathcal{J}$ in terms of the individual consideration probabilities is given with

$$\mathbb{P}(J_i = J) = \prod_{j \in J} \varphi_j \prod_{j \notin J} (1 - \varphi_j). \tag{7}$$

Following Barseghyan et al. (2021b), I assume $\varphi_j > 0$ to omit never-considered alternatives from the choice problem. The option for which $\varphi_j = 0$, is never considered or compared to other alternatives and as such, does not affect the choice problem. Combining equations (6) and (7) results in the following equation for the probability of

$y_{ij} = 1$:

$$\mathbb{P}(y_{ij} = 1) = \sum_{J \subseteq \mathcal{J}: j \in J} \prod_{j \in J} \varphi_j \prod_{j \notin J} (1 - \varphi_j) \mathbb{P}(\mathbb{E}[u_{ij}] > \mathbb{E}[u_{ik}], \quad \forall k \in J). \tag{8}$$

Use of equation (8) to evaluate the probability of a choice y_{ij}, requires enumeration of all possible consideration sets which would be computationally unfeasible. However, an approximation is unnecessary, because of the following model feature. Since equation (6) does not include an error term, the expected utility can be ranked for a fixed parameter of the risk aversion

$$\mathbb{E}[u_{i1}] < \cdots < \mathbb{E}[u_{ij}] < \mathbb{E}[u_{i|\mathcal{J}|}],$$

where $|\mathcal{J}|$ denotes cardinal number of set $\mathcal{J}$. Therefore, if $y_{ij} = 1$, it means that options ranked higher than j cannot be in the consideration set. Thus, for fixed $\nu_i = \nu$, for all alternatives $k \in J$ that are preferred over chosen alternative j, $\mathbb{P}(\mathbb{E}[u_{ij}] > \mathbb{E}[u_{ik}]) = 1$ and for all $k \notin J$ $\mathbb{P}(\mathbb{E}[u_{ij}] > \mathbb{E}[u_{ik}]) = 0$. All together, denoting

$$\mathcal{B}_\nu(y_j = 1, x) = \{k : \mathbb{E}[u_k|\nu, x] > \mathbb{E}[u_j|\nu, x]\}$$

in combination with the previous derivation yields the following form of the conditional probability

$$\mathbb{P}(y_j = 1|\nu, x) = \varphi_j \prod_{k \in \mathcal{B}_\nu(y_j = 1, x)} (1 - \varphi_k),$$

and probability conditional on observable characteristics of investment fund j :

$$\mathbb{P}(y_j = 1|x) = \int \mathbb{P}(y_j = 1|\nu, x) dF. \tag{9}$$

4.2.1 Maximum Likelihood Estimation

Similar to Barseghyan et al. (2021b) and Coughlin (2019), I assume Beta distribution for the parameter of the risk aversion. More specifically, I assume for each agent i,

$$\log \frac{\beta_{1i}}{\beta_2} = \mathbf{X}_i \gamma, \tag{10}$$

where $\mathbf{X}_i$ is an observable vector of agent's i characteristics and γ is an unknown vector of coefficients to be estimated. Parameters β_{1i} and β_2 are the parameters of the Beta distribution, where β_{1i} is household-specific and β_2 is common across agents. Moreover, the preference coefficients are random draws from a distribution with an expected value that is a function of the observable characteristics given with the following equation

$$\mathbb{E}[\nu_i] = \frac{\beta_{1i}}{\beta_{1i} + \beta_2} \bar{\nu} = \frac{\exp(\mathbf{X}_i \gamma)}{1 + \exp(\mathbf{X}_i \gamma)} \bar{\nu}. \tag{11}$$

Further, using the fact that given $\{\varphi_j\}_{j \in \mathcal{J}}$, $\prod_{k \in \mathcal{B}_\nu(y_j=1,x)}(1-\varphi_k)$ is a piecewise constant, equation (9) can be written in the following form:

$$\mathbb{P}(y_j|x) = \varphi_j \sum_{h=0}^{D-1} \left((F(\nu_{h+1}) - F(\nu_h)) \prod_{k \in \mathcal{B}_{\nu_h}(y_j=1,x)} (1 - \varphi_k) \right) \tag{12}$$

where ν_h terms are the sequentially ordered breakpoints augmented by the integration endpoints $\nu_0 = 0$ and $\nu_D = \bar{\nu}$, and $F(\cdot)$ is a CDF of the Beta distribution. Furthermore, I estimate equation (12) through a Riemann integral approximation. In the estimation, I model preferences to be dependent on wealth (Ameriks et al., 2003), education and financial literacy (Sutter et al., 2020; Mudzingiri, 2021). Results of the estimation are given in section B of the appendix in Table 5. In addition, appendix B

contains estimation results for the simpler version of the Limited Consideration Model in which parameters of the Beta distribution are free; they do not depend on observable characteristics of agents. For both models, estimation results are reported with 95% bootstraped confidence intervals for $B = 1000$ replications.

4.3 Random Utility Model

To evaluate the Limited Consideration Model from the previous section, I compare it with full consideration random utility model (RUM) with additively separable unobserved heterogeneity (e.g., Mixed Logit). Using standard derivations (McFadden and Train, 2000) and the assumption that the utility error iid Type 1 Extreme Value distributed, the probability of choosing alternative j, conditional on risk aversion parameter ν, is given with

$$\mathbb{P}(y_j|x,\nu) = \frac{\exp(V_j(x,\nu))}{\sum_k \exp(V_k(x,\nu))}, \forall j \in \mathcal{J}.$$

where $V_j(x,\nu) = \mathbb{E}[u_j|x,\nu] + \varepsilon_j$. Again, the parameter of the risk aversion follows Beta distribution such that parameters satisfy equations (10) and (11). Finally, integrating over the parameter of the risk aversion yields the final expression for the choice probability of option j

$$\mathbb{P}(y_j|x) = \int \mathbb{P}(y_j|x,\nu)dF,$$

where $F(\cdot)$ is the CDF of the Beta distribution. Similar to the estimation of the Limited Consideration Model, I use a Riemann integral approximation to estimate parameters via Maximum Likelihood. Results of the estimation are given in section B of the appendix in Table 6. Estimation results are presented with 95% bootstrapped confidence intervals for $B = 1000$ replications.

4.4 Comparison Between Models

Barseghyan et al. (2021b) show that the Limited Consideration Model and the Mixed Logit generate several contrasting implications. On the one hand, the Mixed Logit generally implies that each alternative has a positive probability of being chosen and satisfies a generalized dominance property. On the other hand, the Limited Consideration Model can generate zero shares (consideration probabilities of some choices are set to zero) and does not necessarily abide by generalized dominance. Moreover, the Mixed Logit Model's choice probabilities depend on the cardinal ranking, while the Limited Consideration Model probabilities depend on ordinal expected utility rankings.

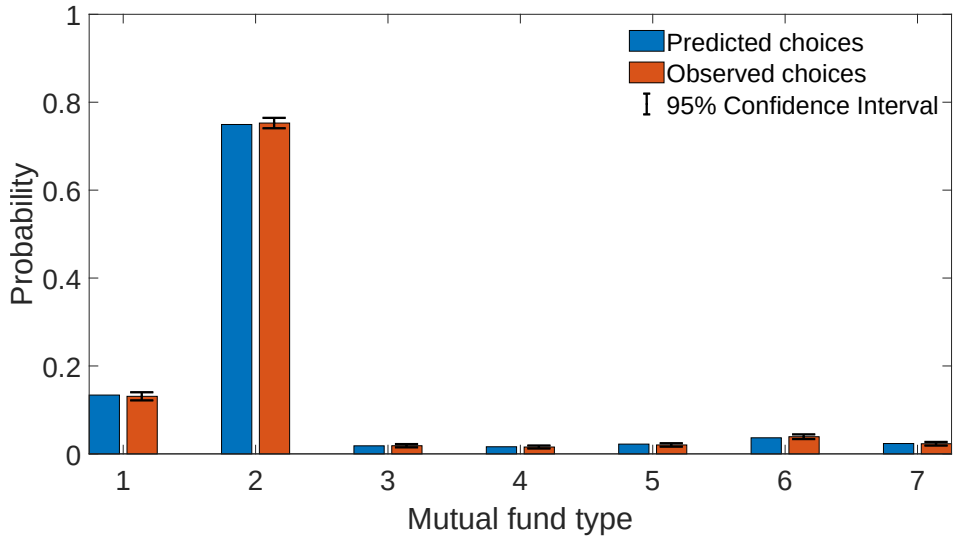


Figure 9: Predicted choices for the Limited Consideration Model and observed choices with 95% confidence intervals. Investment fund types are: money market, stock market, government bond, other bond (i.e., corporate bond), combined, other (i.e., hedge or growth), and tax free bond.

Figure 9 presents predicted probabilities from the Limited Consideration Model and compares them to observed choices. The predicted probabilities fit well the choices for all types of investment funds. All predictions are inside confidence intervals. In contrast, Figure 10 contains a comparison between predicted choices from the Random

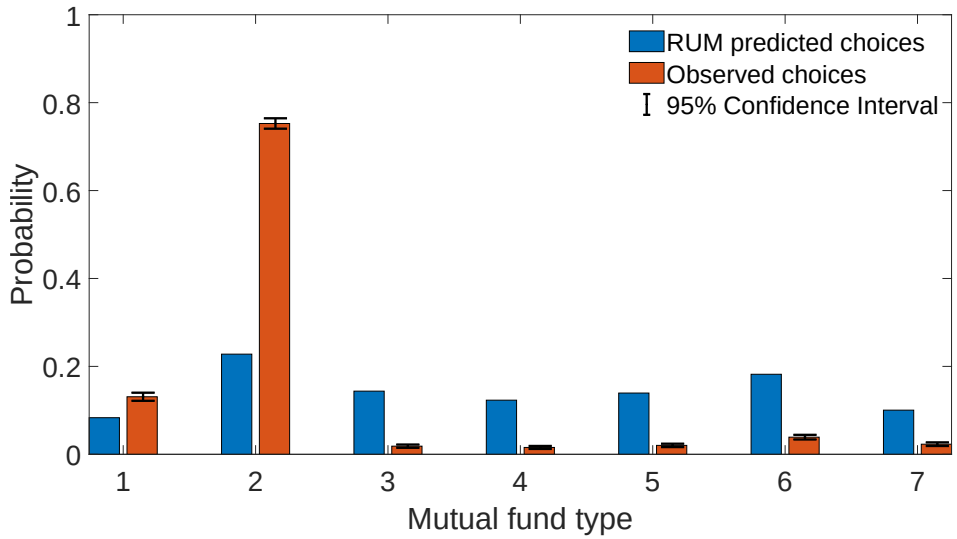
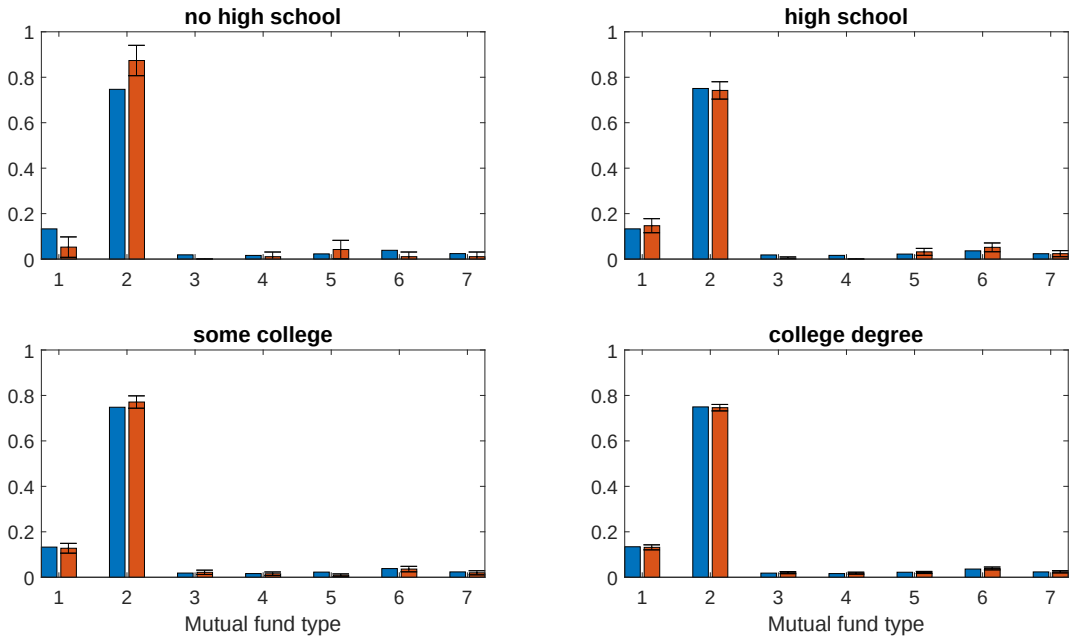


Figure 10: Predicted choices for the Random Utility Model and observed choices with 95% confidence intervals. Investment fund types are: money market, stock market, government bond, other bond (i.e., corporate bond), combined, other (i.e., hedge or growth), and tax free bond.

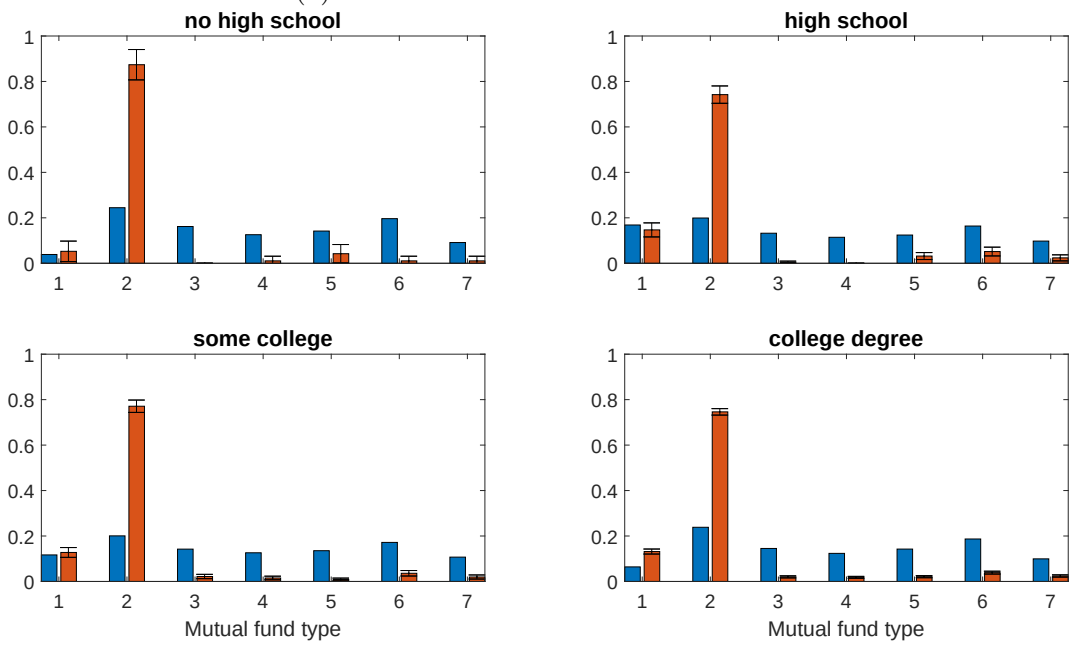
Utility Model and observed choices. Predictions from the Random Utility Model for each choice are out of 95% confidence intervals. The model that represents how rational agents would choose investment funds fits the data poorly. Moreover, the value of Vuong (1989) test statistics is 53.4949. The comparison of the test statistics with critical values of the Normal distribution implies that the test rejects the Random Utility Model in favor of the Limited Consideration Model at all usual significance levels. This result implies that agents are not behaving rationally when making decisions at risk.

4.4.1 Conditional Probabilities Comparison

Figure (11a) compares predicted choices to observed choices for the Limited Consideration Model conditional on the education level of households, and Figure (11b) presents the same for the Random Utility Model. Resulting predictions for the Limited Consideration Model from Figure (11a) imply that the model successfully fits conditional

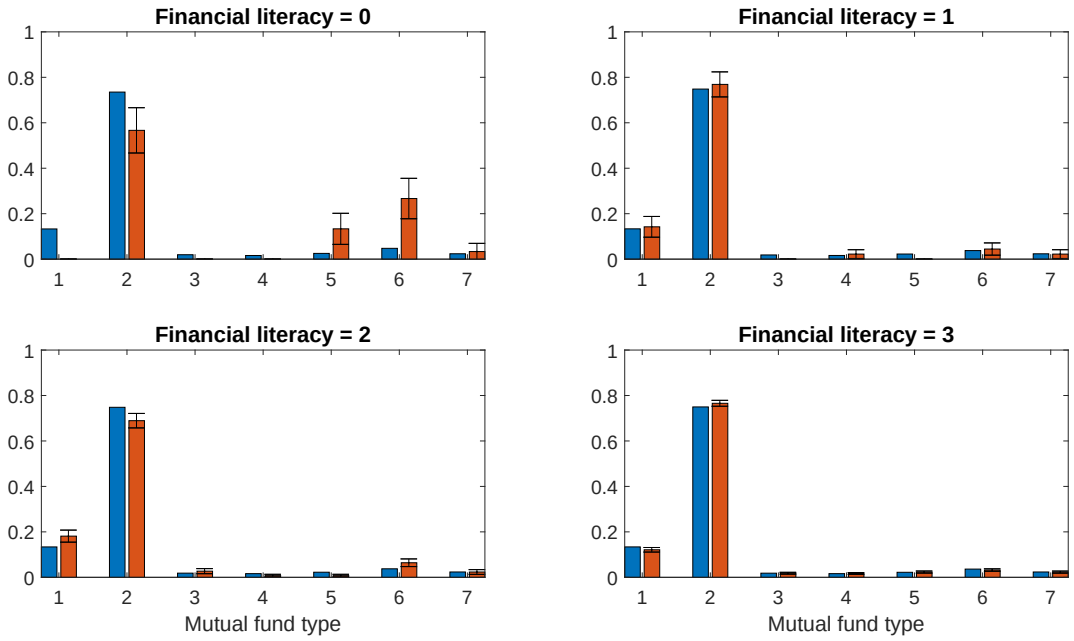


(a) The Limited Consideration Model.

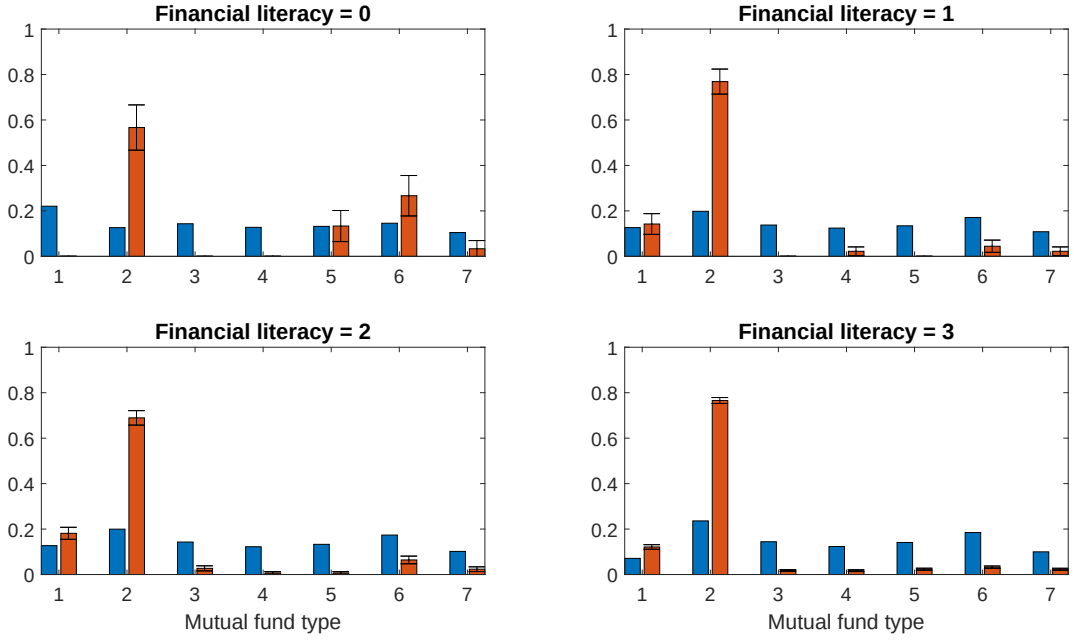


(b) The Random Utility Model.

Figure 11: Distribution of choices for the Limited Consideration Model and for the Random Utility Model conditional on the level of education compared to observed choices.



(a) The Limited Consideration Model.



(b) The Random Utility Model.

Figure 12: Distribution of choices for the Limited Consideration Model and for the Random Utility Model conditional on the level of financial literacy compared to observed choices.

distribution as well. Only predictions for the first two types, Money market and Stock market investment funds, are not inside confidence intervals for households without high school completed. All the other predictions are inside confidence intervals for all levels of education. In contrast, results from Figure (11b) show that the Random Utility Model fails to capture the conditional distribution of choices of investment fund for all levels of education. Thus, there is a similar conclusion as in unconditional predictions; the Limited Consideration Model outperforms the Random Utility Model.

A similar conclusion follows from Figure 12, where observed choices are compared to predicted choices for two models conditional on the level of financial literacy. On one hand, the Random Utility Model fails to match the conditional distribution of choices observed in the data. On the other hand, the Limited Consideration Model matches the conditional distribution of investment fund choices observed in the data well. The only exception is the distribution of choices for the lowest level of financial literacy, where for some choices, predictions are outside of confidence intervals. However, even though some predictions for the lowest level of financial literacy are outside confidence intervals, the shape of predictions is correct.

4.5 Results from the Limited Consideration Model

Results from the previous section imply that the Limited Consideration Model successfully matches both conditional and unconditional distribution of observed choices of investment funds. In addition, the Vuong (1989) test rejects the Random Utility Model in favor of the Limited Consideration Model on all usual significance levels. Thus, I can conclude that agents do not behave rationally when choosing investment funds, but that they make actions from a constrained-limited set of actions. Table 5 in section B of the Appendix contains the result of the estimation. Estimated risk aversion is in

line with the results in the literature (Barseghyan et al., 2021b; Coughlin, 2019; Rabin, 2013). Similar to their findings, Figure 15 shows only a small shift in the estimated average distribution of the risk aversion due to the use of equations 10 and 11. Further, resulting values for observable characteristics imply a significant impact of levels 2 and 3 financial literacy relative to financial literacy 0. Moreover, stock ownership and a college degree relative to no high school have a significant effect. However, due to the high level of nonlinearity in the model, the signs and size of estimated coefficients are not interpretable. Nevertheless, I can analyze the average and percentage monetary losses due to not achieving the first-best allocation under full consideration.

The model does not allow me to disentangle the underlining mechanism that prevents agents from achieving the first-best allocation. However, Figure 8 suggests that with a higher level of financial literacy, agents do expand consideration sets as they choose options that are not chosen for lower levels.

In this section, I analyze the implications and results of the Limited Consideration Model. More specifically, I attempt to measure the effect of agents' limited consideration by calculating monetary losses for groups of agents according to their level of education, financial literacy, and net worth. To do so, similarly to Barseghyan et al. (2021b), I calculate how much households lose in returns when they make choices made under limited consideration compared to choices made under full consideration. In other words, for each household, I calculate the certainty equivalent of the households' investment fund choice under full and limited consideration. Because I assume CARA utility, the certainty equivalent of the choice is defined with

$$ce_j = -\frac{1}{\nu}\log(1 - \nu\mathbb{E}[u_j]).$$

Further, I take the difference between two certainty equivalent values and average across the whole sample.I also calculate percentage loss by dividing the difference by the amount invested by the household. Table 7 shows average losses in measured $\$10,000$ and average percentage losses for each group. Results from the first column imply that, on average, households lose around $\$2,727$ because of limited consideration. Moreover, households with only a high school education or less lose more than the average. The third column shows that, in percentages, households with only high school education lose more than those with at least some college education. Further, households with a level of financial literacy equal to 1 lose more than those with one level more. Finally, households from the lowest quantile of the wealth distribution, on average, have a higher percentage loss than households from all higher quantiles of the wealth distribution. These results are in line with results from Campbell (2006), i.e., that poorer and less financially sophisticated households make poorer financial decisions. However, evidence in Campbell (2006) suggests that many households invest effectively and a minority make significant mistakes, whereas I find that all groups of households face significant monetary losses.

To further access the effect of limited consideration on education and financial literacy, I conduct the following estimation. I calculate average monetary loss for low and high education/financial literacy levels for both wealthy and poor households. The results are presented in Table 8.

Figures 13 and 14 contain average monetary losses by groups for education and financial literacy, respectively. Resulting losses imply that both a low education level and low financial literacy imply larger average monetary losses across the wealth distribution than a higher education and financial literacy level. Mani et al. (2013) find that poor people often behave in less capable ways. However, Table 8 shows (when

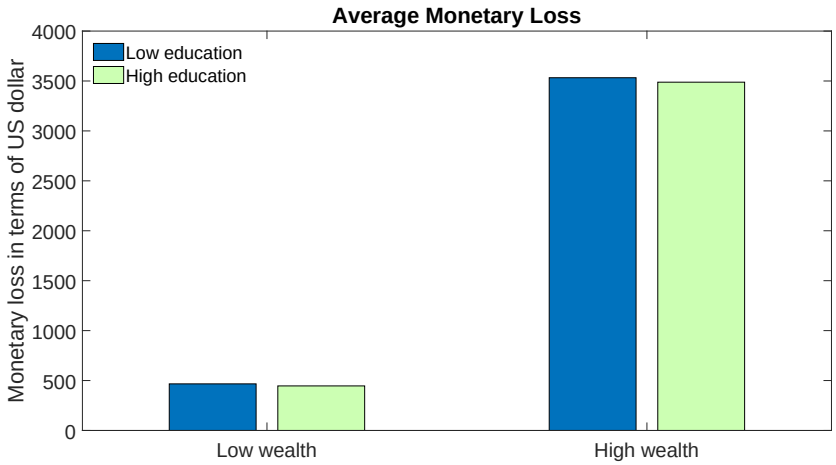


Figure 13: Average monetary loss for households' low and high level of education grouped by wealth category.

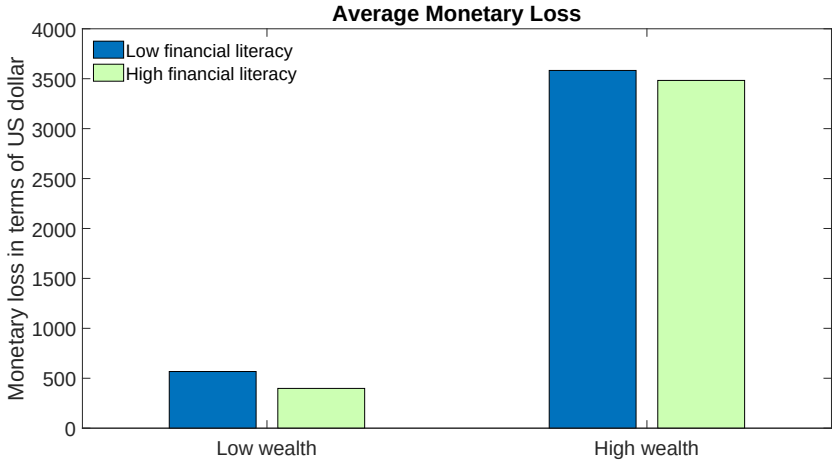


Figure 14: Average monetary loss for households' low and high level of financial literacy grouped by wealth category.

I examine the percentage loss - loss divided by the investment size) that, on average, wealthier households make larger losses since they invest more.

To summarize, even though I cannot specify the mechanism behind the limited consideration behavior of agents in their choice of investment fund, results from this section imply that agents for the lower level of education and financial literacy have higher losses on average than those with higher levels. This suggests that, potentially, lower levels of education and financial literacy imply higher costs of information acquisition that prevent the household from evaluating all alternatives in the choice set.

4.6 Source of Limited Consideration Heterogeneous Returns and Wealth Inequality

As mentioned before, this model does not specify the source of the limited consideration behavior of agents. However, (Caplin et al., 2019) show that, because it is too costly to consider all available options, rational inattentive agents take actions from constrained sets (they have limited consideration while making choices). Thus, potentially, households in this research with a lower level of education and financial literacy face higher attention costs and correspondingly larger monetary losses.

Another source of the limited consideration could be persuasion from the media or following advice from financial advisors. Mullainathan and Shleifer (2005) explore financial advertising in business magazines and its effect on investors. Gil-Bazo and Imbet (2020) show that asset managers use social media to persuade investors rather than to alleviate information asymmetries by either lowering search costs or disclosing privately observed information. As figure 8 shows, household choices are narrow and this could be a consequence of advertising the in media. Further, Mullainathan et al.

(2012) find that advisers fail to de-bias their clients and often reinforce biases that are in their interests. Moreover, they find that experts encourage returns-chasing behavior and push for actively managed funds that have higher fees, even if the household starts with a well-diversified, low-fee portfolio. Gennaioli et al. (2015) model households' choice of experts based on trust, and claim that trust in financial intermediaries reduces the perception of the riskiness of a proposed investment. Their finding is in line with the results from this paper, where household choices of investment funds are concentrated towards stock market investment funds (depicted in Figure 8), which imply a higher return but higher volatility at the same time.

Fagereng et al. (2020) show that for the same level of wealth and same preferences towards risk, households obtain heterogeneous returns to wealth. This could, potentially, be a consequence of different consideration sets and limited consideration. Let us now use insights from the previous section, i.e., limited consideration when an agent chooses an investment tool. Results from the previous section imply that for lower levels of education and financial literacy, agents face higher average monetary losses, which in turn imply a lower return.

4.7 Connecting Two Estimated Models

In this section, as an additional counterfactual exercise, I use estimated parameters from the Limited Consideration Model and reconstruct expected utility from investing in funds. In equation (3), latent variable Y^* represented unobserved utility from investing.

Now, using estimates from the Limited Consideration Model, I define

$$Y_i = \begin{cases} \mathbb{E}[u_i], & \text{if investment occurred,} \\ 0, & \text{otherwise.} \end{cases}$$

Regressors X of equation (3) remain the same. Results of the estimation are given in section B of the appendix in Table 9.

Estimation results in Table 9 are very similar to those from Table 2 (in sign, size, and significance levels). Households with higher financial literacy and education have higher expected utility from investing. Moreover, as in the estimation with the latent variable for utility from investing, utility increases for stock owners and renters. Finally, households' expected utility from investing in funds is higher for wealthier households and lower for more indebted households. Estimated coefficients for wealth and debt to income ratio appear in similar size and significance. However, some variables, such as age or lower level of education, show up insignificant or with the opposite sign but lower significance as well.

Using the results from Table 9, I am now able to calculate (semi) elasticity of marginal utility of investing in variables such as wealth and financial literacy. That is, I calculate the percentage change of the left-hand side variable corresponding to a change in the categorical variable of the right-hand side variable of the regression. I find that the change in expected utility of investing for college educated in comparison to households with some college is 33.5%. Similarly, the expected utility of investment increases is 40.9% higher for households with financial literacy equal to 3 than for those equal to 2. Household from the first and second wealth quintile have 21.3% and 41.4% lower expected utility of investment, respectively, than those from third wealth quintile

(50 − 74.9%). In contrast, households from the fourth wealth quantile have 108.9% higher expected utility of investment.

5 Conclusion

In this paper, I take a novel approach to modeling participation in the financial asset market. Instead of using a standard portfolio model, I consider investment fund choice as a two-step procedure. In the first step, households choose whether to invest in a fund or not. Subsequently, they choose the investment size and the type of fund, including money market and equity fund. Using the Two-Step Heckman Model, I evaluate the probability of households to become fund investors. Once households decide to invest, I estimate the effect of their characteristics on the investment size. I contribute to the current literature by examining only investments in investment funds, which capture investments via intermediaries. In this way, I can evaluate fund choice as a product choice offered by a household's bank or a financial advisor. Results on the likelihood of participation show that wealthier and financially literate households choose to invest in a fund. Once the investment is made, the size of the investment for the same level of wealth varies with other characteristics. That is, investment size decreases with education and financial literacy, potentially contributing to diversification.

To analyze specific fund choice, I take a novel approach and explore limited consideration (Barseghyan et al., 2021b) in the type of the investment fund choice. Consequently, I build on the lottery-based framework in Barseghyan et al. (2021b) by accounting for returns behavior, i.e., incorporating continuous random outcomes of a choice at hand. As a result of my estimates, I reject the full consideration behavior of households (RUM) in favor of limited consideration behavior. In contrast to previ-

ous literature, I show that households do not achieve first-best allocation because they consider only a constrained set of available investment options.

Given that the usual approach to investment choice in the literature is a full consideration setting, I evaluate the monetary losses accrued to limited consideration behavior. I find that, under limited consideration, all households make mistakes in their fund choice, which contradicts the findings within full consideration framework (Campbell [2006] finds that most households invest effectively and a minority makes mistakes). In another exercise, I find that, across the wealth distribution, households with a lower level of education or financial literacy face larger monetary losses than households with higher levels. Overall, this study highlights the importance of considering financial literacy and limited consideration in future research on the investment decision of households.

References

Agarwal, S. and Mazumder, B. (2013). Cognitive abilities and household financial decision making. *American Economic Journal: Applied Economics*, 5(1):193–207.

Aguiar, V. and Kashaev, N. (2021). Identification and estimation of discrete choice models with unobserved choice sets. *Available at SSRN 3869963*.

Allen, F. and Gale, D. (1994). Limited market participation and volatility of asset prices. *The American Economic Review*, pages 933–955.

Ameriks, J., Caplin, A., and Leahy, J. (2003). Wealth accumulation and the propensity to plan. *The Quarterly Journal of Economics*, 118(3):1007–1047.

Andersen, S., Campbell, J. Y., Nielsen, K. M., and Ramadorai, T. (2020). Sources of inaction in household finance: Evidence from the Danish mortgage market. *American Economic Review*, 110(10):3184–3230.

Barseghyan, L., Coughlin, M., Molinari, F., and Teitelbaum, J. C. (2021a). Heterogeneous choice sets and preferences. *Econometrica*, 89(5):2015–2048.

Barseghyan, L., Molinari, F., and Thirkettle, M. (2021b). Discrete choice under risk with limited consideration. *American Economic Review*, 111(6):1972–2006.

Bartoš, V., Bauer, M., Chytilová, J., and Matějka, F. (2016). Attention discrimination: Theory and field experiments with monitoring information acquisition. *American Economic Review*, 106(6):1437–75.

Brunnermeier, M. K. and Nagel, S. (2008). Do wealth fluctuations generate time-varying risk aversion? Micro-evidence on individuals. *American Economic Review*, 98(3):713–36.

Calvet, L. E., Campbell, J. Y., Gomes, F., and Sodini, P. (2021). The cross-section of household preferences. Working Paper 28788, National Bureau of Economic Research.

Calvet, L. E., Campbell, J. Y., and Sodini, P. (2007). Down or out: Assessing the welfare costs of household investment mistakes. *Journal of Political Economy*, 115(5):707–747.

Calvet, L. E., Campbell, J. Y., and Sodini, P. (2009a). Fight or flight? portfolio rebalancing by individual investors. *The Quarterly Journal of Economics*, 124(1):301–348.

Calvet, L. E., Campbell, J. Y., and Sodini, P. (2009b). Measuring the financial sophistication of households. *American Economic Review*, 99(2):393–98.

Calvet, L. E. and Sodini, P. (2014). Twin picks: Disentangling the determinants of risk-taking in household portfolios. *The Journal of Finance*, 69(2):867–906.

Campbell, J. Y. (2006). Household finance. *The Journal of Finance*, 61(4):1553–1604.

Caplin, A., Dean, M., and Leahy, J. (2019). Rational inattention, optimal consideration sets, and stochastic choice. *The Review of Economic Studies*, 86(3):1061–1094.

Chalmers, J. and Reuter, J. (2012). What is the impact of financial advisors on retirement portfolio choices and outcomes? *Available at SSRN 2078536*.

Coughlin, M. (2019). Insurance choice with non-monetary plan attributes: Limited consideration in medicare part d. Technical report, Cornell University Working Paper.

Crawford, G. S., Griffith, R., and Iaria, A. (2021). A survey of preference estimation with unobserved choice set heterogeneity. *Journal of Econometrics*, 222(1):4–43.

Fagereng, A., Guiso, L., Malacrino, D., and Pistaferri, L. (2020). Heterogeneity and persistence in returns to wealth. *Econometrica*, 88(1):115–170.

Gennaioli, N., Shleifer, A., and Vishny, R. (2015). Money doctors. *The Journal of Finance*, 70(1):91–114.

Gil-Bazo, J. and Imbet, J. F. (2020). Tweeting for money: Social media and mutual fund flows. *Available at SSRN 3719169*.

Goeree, M. S. (2008). Limited information and advertising in the us personal computer industry. *Econometrica*, 76(5):1017–1074.

Grinblatt, M., Ikäheimo, S., Keloharju, M., and Knüpfer, S. (2016). Iq and mutual fund choice. *Management Science*, 62(4):924–944.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica: Journal of the Econometric Society*, pages 153–161.

Holmstrom, B. and Tirole, J. (1997). Financial intermediation, loanable funds, and the real sector. *The Quarterly Journal of Economics*, 112(3):663–691.

Jung, J., Kim, J. H., Matějka, F., and Sims, C. A. (2019). Discrete actions in information-constrained decision problems. *The Review of Economic Studies*, 86(6):2643–2667.

Kacperczyk, M., Van Nieuwerburgh, S., and Veldkamp, L. (2016). A rational theory of mutual funds' attention allocation. *Econometrica*, 84(2):571–626.

Kline, P. and Walters, C. R. (2019). On heckits, late, and numerical equivalence. *Econometrica*, 87(2):677–696.

Lusardi, A. and Mitchell, O. S. (2014). The economic importance of financial literacy: Theory and evidence. *Journal of Economic Literature*, 52(1):5–44.

Mani, A., Mullainathan, S., Shafir, E., and Zhao, J. (2013). Poverty impedes cognitive function. *Science*, 341(6149):976–980.

Manzini, P. and Mariotti, M. (2014). Stochastic choice and consideration sets. *Econometrica*, 82(3):1153–1176.

McFadden, D. and Train, K. (2000). Mixed mnl models for discrete response. *Journal of Applied Econometrics*, 15(5):447–470.

Mudzingiri, C. (2021). The impact of financial literacy on risk seeking and patient attitudes of university students. *Development Southern Africa*, 38(5):845–861.

Mullainathan, S., Noeth, M., and Schoar, A. (2012). The market for financial advice: An audit study. Working Paper 17929, National Bureau of Economic Research.

Mullainathan, S. and Shleifer, A. (2005). Persuasion in finance. Working Paper 11838, National Bureau of Economic Research.

Rabin, M. (2013). Risk aversion and expected-utility theory: A calibration theorem. In *Handbook of the fundamentals of financial decision making: Part I*, pages 241–252. World Scientific.

Sirri, E. R. and Tufano, P. (1998). Costly search and mutual fund flows. *The Journal of Finance*, 53(5):1589–1622.

Sørensen, M. (2007). How smart is smart money? A two-sided matching model of venture capital. *The Journal of Finance*, 62(6):2725–2762.

Sutter, M., Weyland, M., Untertrifaller, A., and Froitzheim, M. (2020). Financial literacy, risk and time preferences – Results from a randomized educational intervention. Discussion Paper 13566, IZA.

Vuong, Q. H. (1989). Likelihood ratio tests for model selection and non-nested hypotheses. *Econometrica: Journal of the Econometric Society*, pages 307–333.

A Objective Measure of Financial Literacy and SCF

	Values					
Total sample	49377					
Education	no HS	HS	Some College	College Degree		
	5686	12086	13756	17849		
Age group	< 35	$55 - 64$	$35 - 44$	$65 - 74$	$45 - 54$	$>= 75$
	9312	9329	9811	9801	6950	4174
Occupation	Managerial/ Professional	Tech/Sales/ Services	Other	Not Working		
	15061	10598	8958	14760		
Income	$0 - 20\%$	$20 - 39.9\%$	$40 - 59.9\%$	$60 - 79.9\%$	$80 - 89.9\%$	$90 - 100\%$
	9678	9515	9563	10011	5586	5024
Wealth	$0 - 24.9\%$	$25 - 49.9\%$	$50 - 74.9\%$	$75 - 89.9\%$	$90 - 100\%$	
	12928	11566	11072	8860	4951	
Financial Literacy	0	1	2	3		
	2046	8287	17145	21899		
Home-Ownership Category	Owns Ranch/ Mobile Home/House /Condo/etc.	Otherwise				
	30061	19316				

Table 1: Descriptive statistics and overview of household data from SCF.

Questions asked in the Survey of Consumer Finances, proposed by Lusardi and Mitchell (2014) are:

- Suppose you had $100 in a savings account and the interest rate was 2 percent 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; exactly $102; less than $102; do not know; refuse to answer.]

- Imagine that the interest rate on your savings account was 1 percent per year and inflation was 2 percent per year. After 1 year, would you be able to buy: [more than, exactly the same as, or less than today with the money in this account; do not know; refuse to answer.]

- Do you think that the following statement is true or false? "Buying a single company stock usually provides a safer return than a stock mutual fund." [true; false; do not know; refuse to answer.]

B Estimation Results

Table 2: The estimatation results for the Two-Step Heckman Model estimated from the SCF.

	Selection Equation	Outcome Equation
	Dependent variable:	
	$\mathbb{1}_{\{Y_{ij}>0\}}$	$\log(invsize)$
Year	-0.089^{***}	-0.164^{***}
	(0.018)	(0.044)
Age	-0.168^{***}	0.307^{***}
	(0.027)	(0.072)
Age^2	0.328^{***}	0.012
	(0.036)	(0.107)
No High School	-0.350^{***}	0.435^{**}
	(0.054)	(0.173)
High School	-0.138^{***}	-0.021
	(0.030)	(0.088)
College Degree	0.230^{***}	-0.149^{**}
	(0.024)	(0.066)
Financial Literacy = 0	-0.314^{***}	0.730^{**}
	(0.086)	(0.285)
Financial Literacy = 1	-0.025	-0.045
	(0.038)	(0.114)
Financial Literacy = 3	0.442^{***}	-0.271^{***}
	(0.022)	(0.084)
Tech/Sales/Services	-0.124^{***}	
	(0.027)	
Other	-0.225^{***}	
	(0.034)	
Not Working	0.003	
	(0.027)	
Owns Stocks	0.306^{***}	
	(0.021)	
Renter	0.227^{***}	
	(0.030)	
Wealth $0-24.9\%$	-1.070^{***}	-1.219^{***}
	(0.048)	(0.210)
Wealth $25-49.9\%$	-0.586^{***}	-0.781^{***}
	(0.035)	(0.127)
Wealth $75-89.9\%$	0.470^{***}	0.821^{***}
	(0.025)	(0.093)
Wealth $90-100\%$	0.872^{***}	1.521^{***}
	(0.028)	(0.136)
Debt to Income Ratio	-0.044^{***}	-0.061^{***}
	(0.006)	(0.015)
Constant	-1.696^{***}	11.345^{***}
	(0.036)	(0.345)
Observations	49,377	5,125
R^2		0.338
Adjusted R^2		0.336
ρ		-0.402
Inverse Mills Ratio		-0.637^{***} (0.165)

Note: *p<0.1; **p<0.05; ***p<0.01

Base category for education is "Some College", for financial literacy is "Financial Literacy = 2," for wealth is "Wealth $50-74.9\%$", and for occupation is "Proffesional/Managerial"

Table 3: Marginal effects for the selection equation of the model.

	estimate	std.error	z-statistic	p-value	conf.low	conf.high
Age^2	0.04391	0.00481	9.12	0.000	0.03447	0.05334
Age	−0.02247	0.00355	−6.33	0.000	−0.02943	−0.01552
Debt to Income Ratio	−0.00583	0.00081	−7.17	0.000	−0.00742	−0.00424
No High School	−0.03710	0.00494	−7.51	0.000	−0.04677	−0.02742
High School	−0.01633	0.00356	−4.59	0.000	−0.02329	−0.00936
College Degree	0.03279	0.00334	9.81	0.000	0.02624	0.03933
Financial literacy = 0	−0.02740	0.00634	−4.32	0.000	−0.03983	−0.01497
Financial literacy = 1	−0.00261	0.00392	−0.67	0.505	−0.01029	0.00507
Financial literacy = 3	0.05906	0.00289	20.96	0.000	0.05354	0.06458
Renter	0.03169	0.00432	7.33	0.000	0.02322	0.04016
Stock owner	0.04096	0.00279	14.66	0.000	0.03548	0.04643
Wealth 0 − 24.9%	−0.08132	0.00329	−24.71	0.000	−0.08777	−0.07487
Wealth 25 − 49.9%	−0.06080	0.00359	−16.95	0.000	−0.06783	−0.05376
Wealth 75 − 89.9%	0.09234	0.00516	17.88	0.000	0.08222	0.10246
Wealth 90 − 100%	0.20576	0.00797	25.82	0.000	0.19014	0.22138
Tech/Sales/Services	−0.01650	0.00357	−4.62	0.000	−0.02351	−0.00950
Other	-0.02861	0.00413	−6.93	0.000	−0.03670	−0.02052
Not Working	0.00038	0.00385	0.10	0.92200	−0.00717	0.00792
Observations	49,377					

Note: *p<0.1; **p<0.05; ***p<0.01
Base category for education is "Some College", for financial literacy is "Financial Literacy = 2," and for wealth is "Wealth 50 − 74.9%".

Table 4: Marginal effects for the outcome equation of the model.

	estimate	std.error	z-statistic	p-value	conf.low	conf.high
Age^2	0.01183	0.10651	0.11	0.912	−0.19692	0.22058
Age	0.30661	0.07228	4.24	0.000	0.16494	0.44827
Debt to Income Ratio	−0.06116	0.01493	−4.10	0.000	−0.09041	−0.03190
No High School	0.43528	0.17261	2.52	0.012	0.09698	0.77358
High School	−0.02135	0.08847	−0.24	0.809	−0.19475	0.15205
College Degree	−0.14925	0.06560	−2.28	0.023	−0.27782	−0.02069
Financial literacy = 0	0.73032	0.28549	2.56	0.011	0.17076	1.28988
Financial literacy = 1	−0.04530	0.11437	−0.40	0.692	−0.26945	0.17886
Financial literacy = 3	−0.27094	0.08374	−3.24	0.001	−0.43508	−0.10680
Wealth 0 − 24.9%	−1.21865	0.20957	−5.81	0.000	−1.62940	−0.80789
Wealth 25 − 49.9%	−0.78148	0.12718	−6.14	0.000	−1.03076	−0.53221
Wealth 75 − 89.9%	0.82095	0.09296	8.83	0.000	0.63874	1.00315
Wealth 90 − 100%	1.52092	0.13565	11.21	0.000	1.25506	1.78678
Observations	5,125					

Note: *p<0.1; **p<0.05; ***p<0.01
Base category for education is "Some College", for financial literacy is "Financial Literacy = 2," and for wealth is "Wealth 50 − 74.9%".

B.1 Investment Fund Type Choice - Estimation Results

Table 5: MLE results for the Limited Consideration Model (LCM): Investment Fund Choice

		LCM		**LCM with Observables**
Average β_{1i}	8.29	[2.86, 12.3]	4.70	[0.0000, 8.51]
β_2	18.3	[16.9, 21.0]	11.2	[6.52, 11.3]
Mean of ν	0.0094	[0.0058, 0.013]	0.0058	[0.0020, 0.010]
SD of ν	0.0026	[0.0025, 0.0029]	0.0025	[0.0022, 0.0045]
Intercept	-	-	−2.57	[-2.73, -1.83]
Age	-	-	−0.027	[-0.366, 0.026]
Age^2	-	-	0.0008	[-0.0002, 0.068]
Have Stocks	-	-	0.932	[0.889, 1.77]
Debt to income	-	-	−0.209	[-0.399, 0.021]
Year	-	-	−0.212	[-0.551, -0.106]
High School	-	-	−0.202	[-0.393, 0.114]
Some College	-	-	−0.0085	[-0.052, 0.260]
College Degree	-	-	−0.928	[-1.74, -0.883]
Wealth 25 - 49.9%	-	-	0.015	[-0.013, 0.096]
Wealth 50 - 74.9%	-	-	−0.0079	[-0.087, 0.022]
Wealth 75 - 89.9%	-	-	−0.016	[-0.140, 0.043]
Wealth 90 - 100%	-	-	−0.047	[-0.185, 0.022]
Financial Literacy = 1	-	-	0.0006	[-0.030, 0.038]
Financial Literacy = 2	-	-	−0.434	[-0.806, -0.243]
Financial Literacy = 3	-	-	0.424	[0.247, 0.792]
Money Market	0.501	[0.468, 0.530]	0.501	[0.469, 0.530]
Stock Market	0.753	[0.744, 0.761]	0.753	[0.744, 0.761]
Govt Bond	0.0039	[0.0003, 0.0070]	0.0039	[0.0003, 0.0070]
Other Bond	0.0000	[0.0000, 0.0000]	0.0000	[0.0000, 0.0000]
Combined	0.0094	[0.0056, 0.013]	0.0094	[0.0057, 0.013]
Other	0.030	[0.025, 0.035]	0.030	[0.025, 0.035]
Tax Free Bond	0.029	[0.016, 0.041]	0.029	[0.016, 0.041]

Table contains MLE results and 95% bootstrapped confidence intervals (in brackets) for $B = 1000$ repetitions.

Table 6: MLE results for the Mixed Logit: Investment Fund Choice

	Mixed Logit	
Average β_{1i}	1079.8	[123.5, 1807.4]
β_2	113.2	[112.0, 127.9]
Mean of ν	0.011	[0.0092, 0.014]
SD of ν	0.0005	[0.0004, 0.0005]
Intercept	−17.4	[-33.4, -15.7]
Age	0.660	[0.587, 1.24]
Age^2	−0.0064	[-0.011, -0.0056]
Have Stocks	−1.54	[-4.27, -1.22]
Debt to income	−1.85	[-2.02, -1.76]
Year	1.49	[1.11, 2.00]
High School	−1.77	[-2.45, -1.62]
Some College	−1.55	[-2.10, -1.25]
College Degree	1.85	[1.75, 4.10]
Wealth 25 - 49.9%	−0.113	[-0.169, 0.418]
Wealth 50 - 74.9%	−0.512	[-1.17, 0.198]
Wealth 75 - 89.9%	−1.37	[-2.21, -0.953]
Wealth 90 - 100%	1.36	[0.963, 2.16]
Financial Literacy = 1	−1.28	[-1.67, -0.833]
Financial Literacy = 2	−1.43	[-2.84, -1.07]
Financial Literacy = 3	1.60	[1.36, 2.07]
Sigma	0.768	[0.704, 0.827]

Table contains MLE results and 95% bootstrapped confidence intervals (in brackets) for $B = 1000$ repetitions.

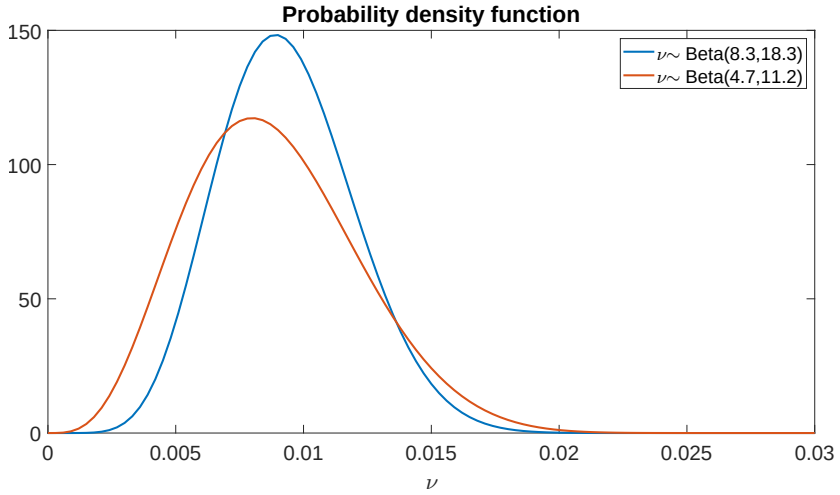


Figure 15: Shift in the estimated average distribution of the risk aversion parameter.

Table 7: Average monetary and percentage loss by group.

	Average Monetary Loss		Average Percentage Loss
All	−0.2727	[-0.4235, -0.2144]	−1.5688
No High School	−0.4430	[-0.6834, -0.3229]	−1.4849
High School	−0.2744	[-0.4202, -0.2111]	−1.5825
Some College	−0.2034	[-0.3131, -0.1664]	−1.5153
College Degree	−0.2856	[-0.4450, -0.2250]	−1.5826
Financial Literacy = 0	−0.1566	[-0.2209, -0.1188]	−1.1861
Financial Literacy = 1	−0.1520	[-0.2362, -0.1168]	−1.5379
Financial Literacy = 2	−0.2616	[-0.3963, -0.2072]	−1.5352
Financial Literacy = 3	−0.2825	[-0.4408, -0.2229]	−1.5800
Wealth 0 - 24.9%	−0.0128	[-0.0201, -0.0096]	−1.6931
Wealth 25 - 49.9%	−0.0210	[-0.0327, -0.0161]	−1.5145
Wealth 50 - 74.9%	−0.0591	[-0.0905, -0.0464]	−1.5447
Wealth 75 - 89.9%	−0.1887	[-0.2930, -0.1471]	−1.5596
Wealth 90 - 100%	−0.5032	[-0.7835, -0.4002]	−1.5893

The average monetary loss is calculated and reported in $\$10,000$.

Table 8: Average Monetary Loss by Group

	Average Monetary Loss		Average Percentage Loss
Low Financial Literacy & Low Wealth	−0.0568	[-0.0855, -0.0452]	−1.5210
High Financial Literacy & Low Wealth	−0.0398	[-0.0620, -0.0316]	−1.5660
Low Financial Literacy & High Wealth	−0.3583	[-0.5474, -0.2834]	−1.5293
High Financial Literacy & High Wealth	−0.3483	[-0.5435, -0.2753]	−1.5838
Low Education & Low Wealth	−0.0467	[-0.0706, -0.0380]	−1.5206
High Education & Low Wealth	−0.0446	[-0.0695, -0.0353]	−1.5732
Low Education & High Wealth	−0.3533	[-0.5446, -0.2714]	−1.5444
High Education & High Wealth	−0.3488	[-0.5439, -0.2772]	−1.5851
All	−0.2727	[-0.4235, -0.2144]	−1.5688

The average monetary loss is calculated and reported in $\$10,000$.

Table 9: The estimation results for expected utility estimated from the Limited Consideration Model.

	Dependent variable:
	$\mathbb{E}[u_i]$
Year	0.069^{***}
	(0.007)
Age	-0.006
	(0.009)
Age^2	0.037^{***}
	(0.012)
No High School	0.030^{**}
	(0.012)
High School	0.014
	(0.009)
College Degree	0.045^{***}
	(0.009)
Financial Literacy = 0	-0.012
	(0.017)
Financial Literacy = 1	-0.003
	(0.010)
Financial Literacy = 3	0.055^{***}
	(0.008)
Tech/Sales/Services	0.019^{*}
	(0.010)
Other	0.0003
	(0.011)
Not Working	0.051^{***}
	(0.010)
Owns Stocks	0.070^{***}
	(0.010)
Rents	0.059^{***}
	(0.010)
Wealth $0 - 24.9\%$	-0.056^{***}
	(0.012)
Wealth $24 - 49.9\%$	-0.029^{***}
	(0.010)
Wealth $75 - 89.9\%$	0.147^{***}
	(0.011)
Wealth $90 - 100\%$	0.879^{***}
	(0.013)
Debt to Income Ratio	-0.006^{***}
	(0.001)
Constant	-0.092^{***}
	(0.012)
Observations	49,371
R^2	0.138
Adjusted R^2	0.138
Residual Std. Error	0.721 (df = 49351)
F Statistic	415.887^{***} (df = 19; 49351)
Note:	*p<0.1; **p<0.05; ***p<0.01
Base category for education is "Some College", for financial literacy is "Financial Literacy = 2, for wealth is "Wealth $50 - 74.9\%$", and for occupation is "Professional/Managerial"	

Abstrakt

Tato studie zkoumá rozhodování domácností při volbě investičního fondu jako proceduru o dvou krocích. S využitím dvou strukturálních ekonometrických modelů odhaduji charakteristiky potenciálního investora, které stojí za rozhodnutím investovat. V prvním kroku se investor rozhoduje, zda investovat do fondu nebo ne. Model v druhém kroku popisuje velikost investice. Pravděpodobnost rozhodnutí investovat do fondu v prvním kroku rozhodovacího procesu roste s úrovní vzdělání, finanční gramotností a bohatstvím jednotlivce, ale klesá s věkem a zadlužením. V druhém kroku procesu pak výše investice roste s bohatstvím a věkem, ale klesá s finanční gramotností. Dále popisuji volbu mezi různými typy investičních fondů s využitím modelu s náhodným užitkem, kde agent zvažuje všechny dostupné možnosti, a modelu, kdy agent při rozhodování bere v potaz pouze omezenou nabídku možností (dále model s omezenou volbou). Modely odhaduji a porovnávám. Při srovnání je model s náhodným užitkem zamítnut ve prospěch modelu s omezenou volbou. S využitím nového rámce pro volbu investičního fondu odhaduji průměrné peněžní ztráty způsobené tím, že nejsou brány v potaz všechny možnosti. Ve srovnání s existující literaturou, kde agent zvažuje všechny možnosti, zjišťuji, že všechny domácnosti napříč rozdělením bohatství čelí významným ztrátám. Podmíněno bohatstvím, domácnosti s nižší úrovní vzdělání nebo finanční gramotností čelí vyšším ztrátám. Kombinováním výsledků z obou kroků investičního rozhodování navíc vypočítávám elasticitu mezního užitku vynaložení úsilí na zlepšení relevantních charakteristik, například finanční gramotnost.

Klíčová slova: volba investičního fondu, omezená volba, finanční gramotnost

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