

Financial Literacy and Perceived Economic Outcomes

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Abstract

We explore the relationship between financial literacy and self-reported economic outcomes using survey data from the United States. Our dataset includes a large number of covariates from the National Financial Capability Study, widely used by literacy researchers, and we use a new econometric technique developed by [Hahn et al. \(2018\)](#), designed specifically for causal inference from observational data, to test whether changes in financial literacy infer positive changes in self-perceived economic outcomes. We find a negative treatment parameter on financial literacy contrary to the presumption in many empirical studies involving financial literacy, and consistent with the recent work of [Netemeyer et al. \(2018\)](#). We conclude with a discussion of heterogeneity of the treatment effect and investigate financial literacy's effect on household income, gender and education level sub-populations. In general, we do not find the effect of more financial literacy is to raise perceived economic outcomes.

Keywords: Financial Literacy, Economic Outcomes, Regularization, Causal inference

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1. Introduction

Is financial literacy associated with a household achieving a higher economic outcome? There is a natural presumption that basic literacy is good and gradations of increasing financial literacy are better. Interest and education in financial literacy in the United States has become widespread and institutionalized by the Federal Reserve System and the Consumer Finance Protection Bureau.¹ Books on personal finance, investing, and wealth creation have become as ubiquitous as books on health and weight loss.

A presumption underlying an investment in financial knowledge is that a household will have a better chance at optimizing their living standard if they are financially adept. Specialized knowledge appears to be important while just being well-educated does not enable competence about personal finance. [Mitchell and Lusardi \(2015\)](#) found that increased education and financial literacy are positively correlated, yet they find less than 50% of college-educated students can successfully answer three key financial literacy questions and less than 64% of students with a post-graduate education can answer all three questions correctly. Perhaps “interventionist” activity is needed. [Campbell \(2016\)](#) argued that important questions about financial regulations surrounding household finance are ripe for the attention of economists because there is not much known about how consumer financial regulatory costs would be offset by its benefits.

There is a large body of research summarized by [Hastings et al. \(2013\)](#) and [Lusardi and Mitchell \(2014\)](#) that trace many of the key questions around a more financially literate populace to education choices, the timing of education delivery during an individual’s life-cycle, public policy prescriptions, and regulatory intervention. What is less well understood is whether being personally financially literate is causally related to economic outcomes?² [Hastings et al. \(2013\)](#) expressed the importance of causal assessments between literacy and economic outcomes to financial education policy-making. To paraphrase, “is it financial literacy that leads to better

¹As an example of financial education sources the CFPB has a [consumer tool tab](#) and the U.S Treasury department has compiled a [list](#). [The Chicago FED](#) lists educational offerings of banks in the system.

²Over the past twenty years, social scientists have been exploring “financial well-being” and how this attitudinal construct fits within an individual’s determination of their overall well-being. [Netemeyer et al. \(2018\)](#) review this literature which, in the spirit of predicting an outcome, is parallel to this paper. For overall well-being researchers, the authors offer a new way to define financial well-being and find it to be a significant predictor of overall well-being.

economic outcomes, do certain economic behaviors lead to more financial literacy, or do factors such as general intelligence and an interest in financial matters contribute to both higher levels of financial literacy and better financial outcomes?”³

In this paper, we heed the call of other economists to strengthen our understanding of the causal connection between financial literacy and financial outcomes through a treatment effect estimation procedure applied to publicly available data commonly used by literacy researchers.⁴ We begin by isolating economic outcomes from behaviors utilizing the data generated from FINRA’s complete 2015 & 2018 National Financial Capability Survey studies. We identify three survey questions that reveal actual respondent self-perceived economic outcomes. Further, we categorize a number of good and bad financial practice behaviors and include numerous other respondent and household factors that are plausibly related to economic outcomes, including a financial literacy treatment variable. In this study we are interested in a primary question:

Is there a causal relationship between the level of an individual’s financial literacy and their perception of their current economic condition?

There are two important aspects of this question to address. First, the question investigated is answered with an assessment taken on a household financial measure nearer to the accumulation of a household’s past financial decisions, current financial resources, and future prospects (expected human capital, an inheritance, bequest planning and so forth). This is in contrast to many financial literacy studies that attempt to look at a specific financial activity that when viewed in isolation is likely to be conflated by other decisions within the household economy.

Second, there is significant confounding in the survey data since financial literacy is correlated with both a dependent variable measuring economic outcome and characteristics measured for each person in the survey. Also, the dimensions of any final sample from the NFCS study are characterized by a large number of covariates and a relatively limited number obser-

³See [Hastings et al. \(2013\)](#), pp. 358.

⁴As noted by [Lusardi and Mitchell \(2014\)](#), p. 34, “Though it is challenging to establish a causal link between financial literacy and economic behavior, both instrumental variables and experimental approaches suggest that financial literacy plays a role in influencing financial decision making, and the causality goes from knowledge to behavior.” Two noteworthy contributions along this path are [Calvet et al. \(2007\)](#) and [Agarwal et al. \(2009\)](#)

vations making more traditional estimation approaches problematic.⁵ To mitigate the effects of these statistical issues, we apply the work of [Hahn et al. \(2018\)](#) who call on recent research in treatment effect estimation and machine learning. We employ the authors’ data-driven approach to mitigate treatment effect estimation bias.⁶

After a review of the literature, the study proceeds by defining a new variable, a household’s perceived economic outcome, from information in the NFCS dataset. We use answers to three questions to construct an economic outcome index using principal component analysis, and we then estimate a model relating economic outcome to financial literacy and a large set of covariates using a regularized regression methodology.

Following a brief discussion of the control variables, we provide background on the estimation approach and report a treatment effect estimate that strongly supports a negative relationship between financial literacy and economic outcome. Our findings are based on the NFCS 2015 and 2018 surveys and control for all available covariates that potentially account for variation in our treatment and outcome variables.⁷ The estimation approach utilized in this paper permits controlling for all covariates, instead of more traditional empirical analyses where plausible (small) subsets of covariates are selected by the researcher and coefficient estimates are compared across model specifications. We advocate for an approach where all covariates are used ([Hahn et al., 2018, 2020](#)) since it mitigates treatment effect bias due to confounding. The contrast between the approach used here and traditional approaches that fit several “smaller” models based on sets of covariates is worth emphasizing. Hand-selecting small sets of covariates is implicitly biasing the treatment effect estimate and our approach avoids this empirical mistake. We conclude by introducing future work on understanding treatment effect heterogeneity. These results suggest that the effect of literacy on economic outcome becomes increasingly negative as household income increases.

⁵Indeed, most empirical questions surrounding financial literacy are characterized by these problems.

⁶These authors propose jointly modeling the treatment and response $Y, Z \mid X$ by first modeling the treatment variable as a function of covariates $Z \mid X$, and then modeling the response $Y \mid Z, X$. The first likelihood provides information on the propensity of being treated as a function of covariates, and the second utilizes this information to mitigate endogeneity when estimating the partial effect of Z on Y . Importantly, their procedure provides a way to “shrink-away” irrelevant covariates using Bayesian shrinkage priors.

⁷In Appendix A, we visually compare our NFCS sample to the entire survey universe to confirm the sample and universe are similar across several covariates.

1.1. Literature Review

It is well-documented that U.S. citizens have low levels of financial knowledge and make financial “mistakes.” [Calvet et al. \(2009\)](#) created an index of financial sophistication from mistakes related to under diversification, risky share turnover and the disposition effect and find that less sophistication is related to individuals with less wealth, smaller family size, less education and less financial experience.⁸ [Choi et al. \(2011\)](#) found that more than a third of employees do not take advantage of an employer match to a 401(k) plan when it is clearly to their benefit to do so.⁹ [Keys et al. \(2016\)](#) found that 20% of households do not refinance their mortgage even when it is to their benefit, and [Agarwal et al. \(2017\)](#) found the individuals who opt for points in their mortgages, a poor financial choice in their analysis, are less responsive to interest rate changes and preferred refinancing behavior.

To expand financial literacy, many states have implemented education reforms at the K-12 level. The intensity of state-mandated personal finance education varies by states and in 2020 twenty-four states require a personal finance course to be offered.¹⁰ There is a growing body of research on the relationship between state-mandated financial education and financial behavior using a variety of datasets. [Brown et al. \(2016\)](#) found a significant causal relationship between more financial education and better non-student debt repayment behavior among adults ages 19 to 29 using the Council on Economic Education’s “Survey of the States.”¹¹ Using NFCS data from 2012 and 2015 among respondents from 19 through 31, [Harvey \(2019\)](#) found financial education reduced the reliance on payday loans, but not other “alternative” financial services among survey respondents. [Urban et al. \(2018\)](#) explored financial education and credit scores among a sample of 18 through 21 year-olds using Georgia and Texas as financial education regimes and contrasting each regime with a synthetic control state using

⁸[Odean \(1998\)](#) defined the disposition effect as the tendency for investors who hold losers to hold them too long, and investors who own winners to have sold them too quickly.

⁹[Choi et al. \(2011\)](#) sample included employees who were older than 59.5 who were unconstrained by withdrawal penalties: they could have simply withdrew employer contributions but chose not to take advantage of it. Even among a subsequent experiment, the researchers find conclude that low financial literacy and poor choice about a matching contribution are positively related.

¹⁰See [Survey of the States, Council for Economic Education](#).

¹¹[Mangrum \(2019\)](#) explored student loan repayment behavior after college using university-level data from the College Scorecard database. Universities are populated with students from different states, therefore, different financial education experiences, and Mangrum found that “mandated students” improve financial student loan repayment percentages among first generation and low income borrowers.

data from the Consumer Credit Panel (CCP). The researchers found that financial education improved credit repayment behavior and credit scores, and that the amplification of the results were higher in Georgia where the mandated financial education requirement goes deeper in teacher training and student testing. [Stoddard and Urban \(2020\)](#) examined whether high school financial education influenced borrowing behavior of incoming freshmen at 4-year colleges using financial aid data from the National Postsecondary Aid Study (NPSAS) from 1999 through 2011. The time frame of the sample permitted the authors to compare college students from the same states before and after mandated financial education. The authors' found that while borrowing for college is slightly higher among those students with a financial education background, loan choices were toward lower cost subsidized loans rather than higher cost private loans, and credit card usage is lower.

There is another body of literature that suggests investments in financial education may not be helpful in solving the problem of poor financial choices. [Willis \(2008\)](#) confronted the idea that financial education is inherently a good idea by taking the view that a “financial regulation-through-education policy model” imposes costs on those aspiring to be financial literate that are significantly higher than the benefits from the financial literacy gained.¹² Policymakers who promote financial literacy as important intend, at least partly, to have the individual bear responsibility for the management of his or her financial future. Indeed, [Willis \(2011\)](#) asserted that financial regulation replaced by financial education is a “fundamental fallacy.”¹³ The individual would always be chasing the details of new product innovation and once the consumer shortens their information disadvantage, Willis argues that the industry would “outmaneuver” them¹⁴

[Lusardi et al. \(2017\)](#) explored the investment in financial knowledge in a dynamic life-cycle model and illustrate how those with lower educational levels and a lesser household life income path are rational to invest less in costly financial knowledge. The value in learning how and where to invest savings is not high among those with lower private saving levels and higher

¹²See [Willis \(2008\)](#), p. 204. Willis interprets policymakers' promotion of financial literacy as an ineffective substitute for financial regulation that places too high a burden on non-expert consumers.

¹³See [Willis \(2011\)](#) p. 429.

¹⁴[Willis \(2011\)](#) notes that empirical work to date is replete with evidence that “biases, heuristics, and other non-rational influences” circumvent good financial decision-making. In this study, we are unable to test a hypothesis related specifically to financial education because the 2015 NFCS study did not survey that question.

replacement rates funded by social security retirement benefits. One important implication from this work is that if financial knowledge acquisition can be less costly than wealth levels of all households will benefit.

Another path toward financial literacy is to rely at least partially on the literacy of others, e.g., advisors. [Calcagno and Monticone \(2015\)](#) started with a premise that those who are less financially literate may benefit from more personal finance advice or derive more value from a financial adviser. They construct a theoretical model that considers an adviser who has the ability to sell investments and is compensated by a proportional commission linked to the size of the investment. The adviser's customer may be asymmetrically informed about the attributes of prospective investments. Considering incentives, penalties and information costs, their model predicts that those who are better informed are more likely to invest in risky assets and utilize a financial adviser. Indeed, the authors use bank survey data from Italy to find empirically that utilization of financial advisers is higher among those who are already financially literate, and that financial literacy is positively related to the probability of investing in risky assets. Results consistent with the implications from [Lusardi et al. \(2017\)](#).¹⁵ In a different yet relevant study, [Balasubramanian and Brisker \(2016\)](#) used 2012 NFCS survey data and an instrumental variables approach to mostly corroborate Calcagno and Monticone's empirical results. Balasubramanian and Brisker defined advisers by their role with a survey participant (e.g., Investment adviser, Debt Counselor, Tax adviser and so forth) if such a relationship existed at all.¹⁶ The researchers found a positive relationship between working with an investment financial adviser and financial literacy, although they found a negative relationship for those who worked with a debt consolidation adviser.

The literature to date supports the conclusions that households err in their financial decision-making, more highly educated individuals are not inclined to be better at making financial decisions, and that investments in financial education can lead to changes in certain financial behaviors. More sophisticated individuals may be more inclined to hire financial

¹⁵[Almenberg and Dreber \(2015\)](#) linked financial literacy and investing in the stock market with the intent to explore how investing varies between men and women when financial literacy is controlled. The authors' measure financial literacy by identifying basic and advanced financial skills. While the authors find that men have higher probabilities of investing in the stock market, controlling for financial literacy skills reduces the probability differences between men and women substantially, and makes a "gender gap," inconsequential.

¹⁶53.4% of Balasubramanian and Brisker's sample used one of the defined advisers.

advisers, but is that a good idea, and do individuals of any sophistication level know there are differences in how advisers are paid and the incentives that drive their recommendations? There are good reasons for consideration of a third-party who can force guidance on consumers in the spirit of the arguments presented by [Campbell \(2016\)](#). Promoting higher levels of financial knowledge, however delivered, suggests that not enough is yet known about whether financial literacy can create good economic outcomes. Indeed, [Netemeyer et al. \(2018\)](#) found a negative correlation between financial literacy and perceived financial well-being using data from the Survey Sampling International online panel. While our primary interest is to offer evidence on whether financial literacy has a causal effect on an economic outcome, we have a secondary interest related to financial behaviors. That is, we want to know whether financial behaviors commonly thought as “good” or “bad” have the expected relationship with economic outcome. Evidence that literacy, behavior, or both are important to household wealth would have implications for education and policy choices and the allocation of resources to these activities.

2. The Study

What is an Economic Outcome? The NFCS survey provides reasonable proxies of economic outcomes based on answers given by respondents to survey questions placed throughout the questionnaire.¹⁷ We identified three questions used in both the 2015 and 2018 National Financial Capability Studies that are representations by respondents about their current financial circumstance.¹⁸ They are the following:

1. “Overall, thinking of your assets, debts and savings, how satisfied are you with your current personal financial condition?”
2. “In a typical month, how difficult is it for you to cover your expenses and pay all your bills?”
3. “How strongly do you agree or disagree with the following statement? - I have too much debt right now”

¹⁷Generally, the economic outcome for a household at any point in time is its economic net worth; that is, assets including household human capital less debt.

¹⁸Studies were conducted in 2009, 2012, 2015 and 2018. See <http://www.usfinancialcapability.org>.

Defining an economic outcome from survey data that does not contain financial metrics can, at first glance, pose a challenge. However, the NFCS survey questions listed above are asking respondents to reflect on their economic comfort which shifts the judgment about how an economic outcome might be defined by a researcher toward the judgment of the respondent. Answers to the three survey questions are ordinal, and we use a principal component analysis to aggregate answers to multiple questions with ordinal outcomes to create a single economic outcome measure.

The Data and Analysis. We start with the combined full data set from the 2015 and 2018 NFCS studies made available to us by FINRA.¹⁹ As is common in survey data, many observations contain variables with answers coded as missing. In addition to missing values, answers to certain questions contain the responses, “Don’t know” or “Prefer not to say.” In our dataset 38 of the 114 aggregate variables are missing responses. Analogous to other standard modeling approaches, we omit observations with these features as do all authors who use the NFCS data sets (see, for example, [Lusardi et al. \(2020\)](#)). Importantly, in our empirical approach we are not restricting the covariate space. In this manner, correct inferences can be made and generalizations can follow from the structure of the sample. Most importantly, this permits us to use as much covariate information as possible.²⁰ The largest set of complete data for which we are able to include a sufficiently rich subset of survey variables includes 4,694 observations and 33 continuous and categorical variables.²¹ These covariates are described in Table 3. After expanding out the categorical variables via one-hot encoding, our set of covariates numbers 532. Note that in the Appendix, we compare our sample with the original NFCS 2015 and 2018 survey along the chosen covariates which highlights the compatibility of our sample and provides guidance, based on covariate distributions, about the types of individuals to which applies our inference of literacy on economic outcome.

Dependent Variable. Our dependent variable of interest is an economic outcome index that is created from the responses to the economic outcome questions which are summarized in

¹⁹There are 27,564 and 27,091 observations from the surveys conducted in 2015 and 2018, respectively.

²⁰We will discuss in the empirical analysis below why this is important for inferring a more accurate causal effect estimate and how regularization provides a greater degree of confidence the estimate.

²¹The attributes of the final data set are available from the authors upon request.

Table 1. Questions 1,2, and 3 are measured on integer scales from 1 to 10, 1 to 3, and 1 to 7, respectively. The mean, minimum, and maximum values are displayed on the left in Table 1.

| | Q1 | Q2 | Q3 |
|------|------|------|------|
| mean | 6.61 | 2.51 | 4.21 |
| min | 1 | 1 | 1 |
| max | 10 | 3 | 7 |
| s.d. | 2.35 | 0.64 | 2.17 |

Table 1: (left) Responses to questions used to construct the economic outcome (dependent) variable: Summary statistics for quantitative variables across the NFCS sample of 4,694 observations. (right). Responses to questions used to construct the economic outcome (dependent) variable: Summary statistics for binary variables across the NFCS sample of 4,694 observations.

These three questions comprise our measures of economic outcomes for individuals in the sample. In Section 3, we discuss how we combine this information from multiple outcomes into a single, meaningful measure.

Financial Literacy Variable. The connection between economic outcomes and financial literacy is tested with a measure for financial literacy that is the total number of correct answers to six financial literacy questions included in the 2015 survey and reported in Table 2.²² The third column of Table 2 summarizes the percentage of correct answers for each of the six financial literacy questions across the sample. Relatively higher proportions of respondents were successful at answering correctly the savings account growth question (“Interest rate”) and the mortgage payment and mortgage interest paid (“Mortgage”) question. More than 60% of respondents did not understand the relationship between a bond’s value and market interest rates (“Bond price”), and about half of the respondents proved adept at questions related to inflation, the rule of 72 and risk. The six questions taken together across the final sample showed a mean number of correct answers equal to **3.86**.

²²The interest rate, inflation and risk questions were designed by Olivia Mitchell and Annamaria Lusardi. See Lusardi and Mitchell (2014). According to the 2015 NFCS national report, the Rule of 72 question was added as an additional interest rate question to “to test the concept of interest compounding in the context of debt.”

| Concept addressed | Question | % Correct |
|-------------------|---|-----------|
| Interest rate | 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? | 86% |
| Inflation | 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? | 68% |
| Bond price | If interest rates rise, what will typically happen to bond prices? | 35% |
| Rule of 72 | Suppose you owe \$1,000 on a loan and the interest rate you are charged is 20% per year compounded annually. If you didn't pay anything off, at this interest rate, how many years would it take for the amount you owe to double | 43% |
| Mortgage | 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less. Measurement Level: Nominal | 92% |
| Risk | Buying a single company's stock usually provides a safer return than a stock mutual fund. | 62% |

Table 2: Financial literacy assessment questions considered from the FINRA data set. Displayed are the financial concept addressed, question asked, and the percentage who answered correctly within our sample.

Additional Control Variables. Generally, descriptive statistics of the NFCS data have been reported by many researchers including the NFCS itself, and we follow accordingly for the data used in this paper.²³ For discussion, we segregate the controls into socio-economic factors and financial behaviors. The socio-economic factors are numerous and include information about the respondent's age, education, and marital status along with the other variables listed in Table 3.

We present the listing of variables associated with the survey questions and answers that are indicative of financial behaviors that we categorize as good practice (Panel A) and bad practice (Panel B). In Panel A we included the set of variables based on questions a positive answer to which would more clearly indicate that the respondent is more active in thinking about financial planning. Having emergency funds, a budget, long-term financial goals, an implemented savings plans and the pay down of a credit card bill are indicative of both planning and financial practice. By contrast, in Panel B of Table 3 a longer list of variables, positive answers to which are more indicative of financial stress. Many of these variables indicate higher debt loads, or consumption greater than current resources.

²³See <http://www.usfinancialcapability.org/results.php?region=US>.

| NFCS | Panel A Description: Good practice financial behaviors |
|----------|---|
| J5 | Do you have emergency funds that can cover 3 months of expenses? |
| J6 | Are you saving for your children's college education? |
| F2_1 | Over the past 12 months have you always paid your credit card in full? |
| C5 | Do you or your spouse regularly contribute to a thrift plan, 401(k) or IRA |
| | Panel B Description: Bad practice financial behaviors |
| B4 | Do you overdraw from your checking on occasion? |
| E15 | How many times have you been late with your mortgage payment? |
| E20 | Do you owe more on your home than it is worth? |
| F2.2 | Over the past 12 months have you carried a balance and were charged interest? |
| F2.3 | Over the past 12 months, in some months I paid the minimum payment only |
| F2.4 | Over the past 12 months, I incurred credit card late fee |
| F2.5 | Over the past 12 months, I was charged an over the limit fee for exceeding my credit line |
| F2.6 | Over the past 12 months, I used my card for a cash advance |
| G25_1 | In the past 5 years, how many times have you taken out an auto title loan? |
| G25_2 | In the past 5 years, how many times have you taken out a payday loan? |
| G25_4 | In the past 5 years, how many times have you used a pawn shop? |
| G25_5 | In the past 5 years, how many times have you used a rent-to-own store? |
| | Panel C Description: Other controls |
| A3 | Gender of respondent |
| log(A3A) | The log of the age of the respondent |
| A4A | Ethnicity subcategory |
| A5.2015 | Highest level of education |
| A7 | Living arrangement in the household |
| A7A | Marital status that includes a living with partner choice |
| A8 | Household's income |
| A9 | Best describes your current employment or work status |
| A10 | Best describes your spouse/partner work status |
| A11 | Children who are financially dependent |
| AM21 | Armed forces member? |
| G1 | Do you have an auto loan? |
| G20 | Do you have any unpaid medical bills? |
| J2 | When thinking of your financial investments, how willing are you to take risks? |
| J3 | Would you say your spending was less than, more than, or about equal to your income? |
| STATEQ | The state of the respondent |
| Time | Indicates whether the data set is 2015 or 2018 |

Table 3: This table presents the additional control variables that we consider in our empirical analysis. They are categorized as *(i)* good practice financial behaviors, *(ii)* bad practice financial behaviors, and *(iii)* other controls.

3. Empirical Analysis

3.1. Economic Index Construction

We construct a single economic outcome index for each observation combining the answers to the three questions summarized in Table 1 using a common dimension reduction technique. These three variables provide self-reported proxies for the economic health as well as perceived future economic health of the observations. Answers to these questions are certainly correlated.²⁴ Since there is overlapping information present in each variable, our first methodological step is to extract the relevant variation among the original three variables, and we use principal component analysis (PCA) to accomplish this dimension reduction task. Specifically, we construct our economic index by projecting the three original variables onto the first eigenvector from the PCA analysis. This provides a univariate variable which uses information from the three questions along the highest variance dimension of these economic outcome proxies.

Figure 1 displays boxplots corresponding to the economic health variables and the constructed economic outcome index. The economic outcome index is shown on each vertical axis and is scaled to have zero mean and unit variance. Positive values of the index correspond to favorable economic outcomes, and negative values correspond to unfavorable outcomes. Question 1 (Q1) deals with how satisfied the respondent is with their financial condition. Low levels of satisfaction given by answer on the far left of the x-axis are associated with (on average) negative values for the index. As satisfaction increases, the conditional expectation of the index (given by the black lines in the center of the boxplots) increases.

Q2 displays conditional distributions of the constructed economic outcome index related to the difficulty in covering monthly expenses and paying off bills on a three level scale. There are separations in the conditional distributions where the “Very difficult” respondents possess negative index values, while the “Not at all difficult” respondents have markedly higher, and on average positive, index values.

²⁴For example, a person who is not satisfied with her current personal financial condition (Question 1) is also likely to have difficulty paying bills every month (Question 2).

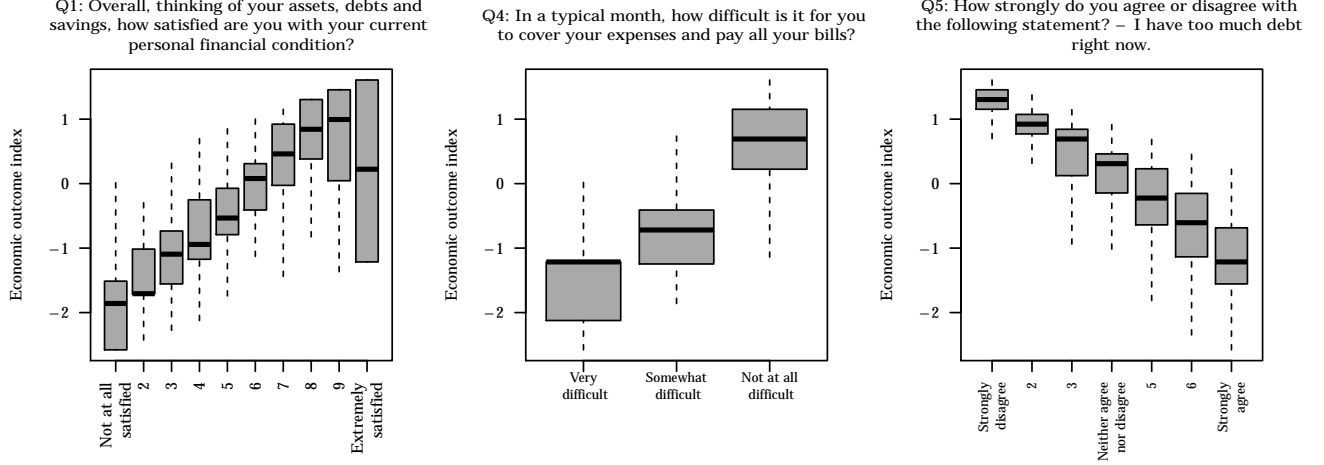


Figure 1: Values of the economic outcome index separated by answers to original financial outcome questions. Each subplot corresponds to a single question, and the individual boxplots display the distribution of the economic outcome index for the set of respondents that answered accordingly.

The final question measures agreement with the following statement: “I have too much debt right now.” There are 7 levels of agreement. As the levels go from “Strongly disagree” to “Strong agree,” we observe a monotonic trend from positive index values to negative index values – especially in expectation. On average, respondents who feel that their personal debt is high are those with negative economic outcomes. Taken together, the conditional distributions displayed in Figure 1 provide evidence that the economic index is measuring what we want: negative index values imply economic instability and financial distress and positive values imply economic stability.

3.2. The Estimation Approach

The establishment of an economic outcome index from the NFCS question set permits us to focus on the question of whether financial literacy has an effect on economic outcome. The problem is framed in terms of the following regression model for observation i :

$$Y_i = \alpha Z_i + X_i^t \beta + \nu_i, \quad (1)$$

where X_i is a vector of control variables, β is a vector of the control effects, Z_i is a continuous scalar treatment variable and α is a scalar regression coefficient. We assume the errors, ν_i , are normally distributed with zero mean and unknown variance. In our application, Z_i is a measure of financial literacy – the number of correct answers to the six questions outlined in Section 2. The dependent variable Y_i is the economic outcome index described in Section 3.1. The control variables (covariates) X_i are the 41 additional characteristics of the observations displayed in Table 3. For ease of interpretation, we scale Z_i and X_i to have zero mean and unit variance. This allows us to estimate Model 1 without an intercept.

α is the parameter of interest. Accurate estimation of α must be done by including the “right” controls, where the formal definition for “right” is:

$$\text{cov}(Z_i, \nu_i | X_i) = 0. \quad (2)$$

This condition ensures the desired counterfactual interpretation of α as the amount that economic outcome (Y) would change if literacy (Z) were increased by one unit.

For our analysis, we, like other researchers, quickly encounter the question: Which controls from the NFCS study should we select, and how does that selection impact the estimation of α ? Omitted variable biases are generally well known. Traditionally, one selects multiple sets of plausible control variables. “Plausibility” for inclusion in the model may be based on economic theory, anecdotal observation, or past empirical findings, but the lack of rigor in this approach is well known (Leamer, 1978, 1983). To resolve these problems and to capture the causal inference, we utilize the approach outlined in Hahn et al. (2018) in which the large set of potential controls in the NFCS data set can be informed from statistical regularization. Put simply, this approach allows the analyst to include *every* measured control variable, instead of hand selecting a subset. The latter will lead to unknown biasing of the causal effect, while the former guarantees that any bias is mitigated.

Regularized Regression for Treatment Effect Estimation. Our desire to use predictive methods for causal inference stems from the need to “predict” an economic outcome in a “counterfactual world.” In our data set, we have a fixed set of individuals with varying levels of financial literacy and tied to each individual is a measured level of financial literacy. However,

we would like to ask the question: How would an individual’s outcome change if her literacy increased? This question exposes the main challenge of causal inference. We are “missing data” since we are unable to observe the counterfactual outcome of an individual with a different literacy level (Imbens and Rubin, 2015). We utilize a two equation variant of Model 1 coupled with a useful reparameterization.²⁵ To do this, we couple Model 1 with a model for financial literacy (Z) conditional upon the covariates:

$$\begin{aligned} \text{Selection Eq.: } Z &= X\gamma + \epsilon, & \epsilon &\sim N(0, \sigma_\epsilon^2), \\ \text{Response Eq.: } Y &= \alpha Z + X\beta + \nu, & \nu &\sim N(0, \sigma_\nu^2). \end{aligned} \tag{3}$$

The first model attempts to predict literacy using observed characteristics of the observations. Importantly, the residual error σ_ϵ^2 will gauge the degree of confounding – how well the characteristics of the observations describe the resulting financial literacy.

Jointly estimating the model for $Z \mid X$ and $Y \mid Z, X$ can lead to better inferences about α . The intuition follows in two steps. First, learn about which X ’s “matter” for Z from the selection equation. Second, use that information to properly “control” for those X ’s in the response equation. In both steps, statistical regularization via Bayesian priors is used to determine the meaningful X ’s. In our estimation approach, there is no need to select a subset of characteristics in X to control for in the selection and response equations *a priori*. Instead, all available covariates are included in our model, and the estimation procedure automatically determines which are relevant.

Several recent papers focus on estimating the causal effect α using state-of-the-art Bayesian modeling (Hahn et al., 2018, 2020). This research discusses how to deploy statistical regularization (through Bayesian shrinkage priors) to allow for the inclusion of all covariates in the selection and response equations in Model 3 and accurately estimate the causal effect. In this paper, we employ a two-step approach described in Hahn et al. (2020) using Model 3. First,

²⁵Several recent studies develop methods for inferring causal effects using machine learning techniques. Chernozhukov et al. (2016) propose a double machine learning approach. Hill (2011) provide an early method using Bayesian Additive Regression Trees. Taddy et al. (2016) and Hahn et al. (2020) develop more recent Bayesian approaches for experimental and observational data, respectively. Wager and Athey (2018) provide theoretical guarantees for an approach based on random forests, but Hahn et al. (2020) point out the challenges with their method in practice. Little guidance is given for controlling the level of statistical regularization of the random forests, and these practical issues are manifest for any ML method used for causal inference.

we obtain an prediction of literacy \hat{Z} from the selection equation. Second, we augment the covariates in the response equation to include this prediction, $\tilde{X} = [\hat{Z} X]$, and estimate the causal effect α .²⁶

3.3. Findings

The regularization approach in this paper informs the process of identifying appropriate controls from the total number of controls ($p = 532$) across the final dataset with 4,694 observations. Included in the model is the set of variables in Table 3 plus several interactions terms. The interaction terms include $\log(\text{Age})$, gender, and time, each interacted with all other variables displayed in Table 3. We report the top line estimate of the causal effect α in Table 4. Our analysis finds that not only is the effect of financial literacy on economic outcome negative, but also that this effect is strongly significant since the posterior credible interval does not include zero. At first glance, the result is surprising because financial institutions, policy-makers, educators and personal finance writers assert that financial literacy is as important as the ability to read and write; competence is required for economic satisfaction. Saving, little debt and an understanding of how to invest are prescriptions for how to be financially independent or financially happy. These views are corroborated by academic studies which hypothesize financial literacy to be related to a certain financial behavior that is a single component in a more complicated household financial picture. Beyond mitigating statistical bias, what is different about this research is that economic outcome, like Netemeyer et al. (2018)’s “perceived financial well-being measure,” is broader than financial behavior dependent variables normally used in financial literacy correlation studies.

The regularized estimate confirms that higher levels of financial literacy are related to lower

²⁶Hahn et al. (2018) discussed how naive regularization of γ and β in Model 3 will lead to significant bias in the estimate of α – a phenomena called regularization-induced confounding (RIC). To avoid this, we follow an approach outlined in Hahn et al. (2020) to control for a prediction of literacy as a function of the covariates. First, we estimate literacy \hat{Z} from the selection equation in Model 3 with a shrinkage prior placed on the coefficient vector γ . Second, we control for this prediction \hat{Z} in the response equation and only regularize the coefficients β , leaving unregularized α and the coefficient on \hat{Z} . The shrinkage priors used are closely related to the horseshoe priors of Carvalho et al. (2010) and estimation is undertaken using a variant of the elliptical slice sampler developed in Hahn et al. (2019) and implemented in the R package `bayeslm`. 100,000 MCMC draws from the posterior distribution are generated after 10,000 draws are generated as burn-in. 95% intervals for the model estimates are computed as the empirical quantiles of this posterior distribution.

levels of economic outcomes controlling for all of the covariates in Table 3 and their interaction terms.

| | α estimate | 2.5% | 97.5% | interval length |
|------------------------|-------------------|--------|--------|-----------------|
| Regularized regression | -0.052 | -0.076 | -0.028 | 0.048 |

Table 4: 95% credible interval ($p = 532$, $n = 4,694$)

The implication of finding no measurable economic benefit to financial literacy raises questions about any expenditures on policy measures such as mandated financial education, and raises doubts about the value of any future governmental policies that might dictate a required level of financial competence. The results in this paper indicate that being financially literate is not a requirement for broader economic happiness.

What if anything might be said about financial practice behaviors and economic outcome? To address this question, we use the posterior distributions of the coefficients on the covariates. Table 5 reports inferences from the estimations focusing on good and bad practice financial behaviors as well as other covariates with significant effects (Panel C). We define a coefficient as significant positively or negatively if at least 80% of its posterior mass is above or below zero, respectively.

Among good practice behaviors such as setting aside funds for emergencies, saving for a child’s college education, paying off credit card debt in full and regular contributions to a retirement plan, none show a significant relationship with the perceived economic outcome of the household. Part of the explanation for these findings likely lies in the fact that the economic outcome index is based on household perception and judgment around satisfaction with their personal financial condition, the ability to pay off their bills, and their interpretation of what it means to have too much debt. The good practice behaviors in Panel A may not necessarily be important to a household in a broader context. A household that holds funds explicitly for emergencies may or may not perceive economic happiness because such savings behavior takes money off the table that could otherwise be used for discretionary spending. For similar reasons, a regular contribution to a retirement plan may be less important to the perceived current economic condition of a household and the implication that it is a good financial behavior assumes that work life, longevity and indeed retirement are similarly

preferred across the population. Two of the bad practice behaviors and three other covariates are significant. Occasionally overdrawing the household checking account is related to a lower economic outcome and negative home equity is related to a lower economic outcome. Armed Services participation is also related to a lower outcome. Households without an auto loan have higher perceived economic outcomes as do households with no unpaid medical bills.

3.4. Discussion and Extension

The primary conclusion that being more financially literate is causally related to less perceived economic happiness suggests a need to more thoroughly understand this inference. A key follow up question asks: which specific sub-populations are driving this negative effect? This question amounts to investigating the heterogeneity of the effect of literacy on outcome. A nonlinear extension of Model 3 developed in the recent paper [Hahn et al. \(2020\)](#) allows us to estimate these *individual treatment effects* (ITEs), i.e., what is the effect of literacy on outcome for every individual in our sample? The result is an estimate $\alpha(x)$ for an observation with covariates x instead of the average treatment effect α .

Individual treatment effects estimates are displayed in Figure 2.²⁷ The histogram contains 4,694 values which represent the effect of literacy on economic outcome for each individual in the sample. Note that even under this different (nonlinear) model specification, the majority of ITEs are negative, indicating that increasing literacy decreases economic outcome for the majority of individuals in the sample. This finding is in line with the average treatment effect estimate in Section 3.3. The spread of the ITE distribution also suggests there is heterogeneity in the effect: the effect of literacy on economic outcome differs across individuals. There are two modes of the ITE distribution; one exists around the linear estimate, -0.05, and the other exists around 0. This implies there are individuals for which literacy does not materially affect economic outcome and others for which it negatively affects economic outcome. Are there traits that distinguish membership in either group? We focus on three variables: household

²⁷We use the R package Bayesian causal forests – `bcf` – to fit the nonlinear model which gives estimates of the individual treatment effects. The current model is built for a binary treatment variable, so we use our existing literacy variable and create a binary version by dividing at the median literacy value. Thus, all sample observations with measured literacy larger (smaller) than the median will be labeled as a 1 (0) in the new binary literacy variable. The quantile at which we divide literacy does not affect the overall heterogeneity results described.

income, gender and education.²⁸

Figure 3 displays the plot of the ITE distribution for financial literacy by household income, NFCS variable A8. The horizontal axis displays the categories of household income, with a value of 1 indicating an income lower than \$15,000 and sequentially higher horizontal axis values related to sequentially higher income amount categories. Category 8 denotes a household income greater than \$150,000. The vertical axis displays the ITE distribution for each income category: the black dot is the median ITE, the black line is the 90% interval, and the gray area is the inner quartile range of the distribution.

Among the lowest income groups there is no meaningful effect of financial literacy on economic outcome, and that among highest income groups (A8 values from 6 to 8), the effect of literacy on economic outcome monotonically moves to higher negative values. The implication is important for it offers caution about whether resources used to enhance financial literacy offer the benefit of perceived economic comfort. Lower income individuals, whether more financially literate or not, may be able to cover their debt obligations and be satisfied with their level of debt and personal financial condition. Similarly, high income individuals who are financially literate can be dissatisfied with their current economic state and more financial education will not change this perception. While higher incomes and more wealth are preferred generally, our findings make clear that higher levels of financial literacy are not important to an individual's satisfaction with their economic outcome across the household income ranges. We may not yet completely understand why higher income, financially literate individuals have less satisfaction with their economic outcome than their less literate counterparts, but we know that more financial literacy is not causing a higher economic outcome.

In addition to income levels, we explored gender and education. Figures 4 and 5 show the medians and distributions of individual treatments for gender and education level, respectively. As is apparent in Figure 4, there is no immediate difference between the effect of literacy on economic outcome by gender. Ranges of the literacy parameter within a gender category are similar for both gender categories. Any role that gender might play in how financial literacy impacts economic outcome is *de minimis*. Differences in education level offer a similar conclu-

²⁸There are, of course, many traits of potential interest limited only in number by the variables in the underlying dataset.

sion. The median difference between holders of graduate degrees and those respondents who are less educated exist, however the distributions of the estimated literacy parameter among individuals within a specific educational classification range widely, thus across educational classifications there is much overlap indicating that differences are statistically implausible.

While heterogeneity of the financial literacy treatment exists for certain individual characteristics, the more nuanced findings of ITEs still support the general conclusion that more financial literacy offers little measurable economic benefit. Different levels of income, gender and education level do not reveal alternative statistical inferences for the literacy treatment and the NFCS data. Other characteristics within the NFCS datasets may be of interest to literacy researchers, and the modeling approach illustrated in this paper charts out an interesting path for future work.

4. Conclusion

Although there is a general consensus that financial literacy is important to households, this paper addresses the question of whether financial literacy is causally related to the perceived economic outcomes of individuals. The negative treatment effect does not support the notion that more financial literacy is necessary to achieve a higher level of perceived economic happiness. This finding helps to inform policymakers about required financial educational initiatives such as expanded K-12 education. If the intent of mandated financial literacy education is to raise a household's future economic outcome, then the result of such expenditures is not promising. Resources may be better spent on other initiatives to achieve such a goal. Lastly, the findings in this new paper are attributed to a relatively new statistical technique that will help future financial literacy researchers to mitigate bias in their studies while drawing well-grounded causal inferences.

| NFCS | Panel A: Good practice financial behaviors | Inference |
|-------|--|--|
| J5 | Do you have emergency funds that can cover 3 months of expenses? | insignificant |
| J6 | Are you saving for your child’s college education? | insignificant |
| F2_1 | Over the past 12 months have you always paid your credit card in full? | insignificant |
| C5 | Do you or your spouse regularly contribute to a thrift plan, 401(k) or IRA | insignificant |
| NFCS | Panel B: Bad practice financial behaviors | Inference |
| B4 | Do you overdraw from your checking on occasion? | not overdrawing related to higher economic outcome |
| B30 | How often do you use a reloadable prepaid debit card | insignificant |
| E15 | How many times have you been late with your mortgage payment? | insignificant |
| E20 | Do you owe more on your home than it is worth? | positive equity related to higher economic outcome |
| F2_2 | Over the past 12 months have you carried a balance and were charged interest? | insignificant |
| F2_3 | Over the past 12 months, in some months I paid the minimum payment only | insignificant |
| F2_4 | Over the past 12 months, I incurred credit card late fee | insignificant |
| F2_5 | Over the past 12 months, I was charged an over the limit fee for exceeding my credit line | insignificant |
| F2_6 | Over the past 12 months, I used my card for a cash advance | insignificant |
| G25.1 | In the past 5 years, how many times have you taken out an auto title loan? | insignificant |
| G25.2 | In the past 5 years, how many times have you taken out a payday loan? | insignificant |
| G25.4 | In the past 5 years, how many times have you used a pawn shop? | insignificant |
| G25.5 | In the past 5 years, how many times have you used a rent-to-own store? | insignificant |
| NFCS | Panel C: Other (significant) covariates | Inference |
| AM21 | Have you ever been a member of the U.S. Armed Services, either in the active or reserve component? | Never been a member related to higher economic outcome |
| G1 | Does your household currently have an auto loan? | Not having an auto loan related to higher economic outcome |
| G20 | Do you currently have any unpaid bills from a health care or medical service provider (e.g., a hospital, a doctor’s office, or a testing lab) that are past due? | No unpaid medical bills related to higher economic outcome |

Table 5: Inferences from Bayesian linear model with a large set of controls. We define significant positive or negative coefficients as those having 80% posterior mass above or below zero, respectively.

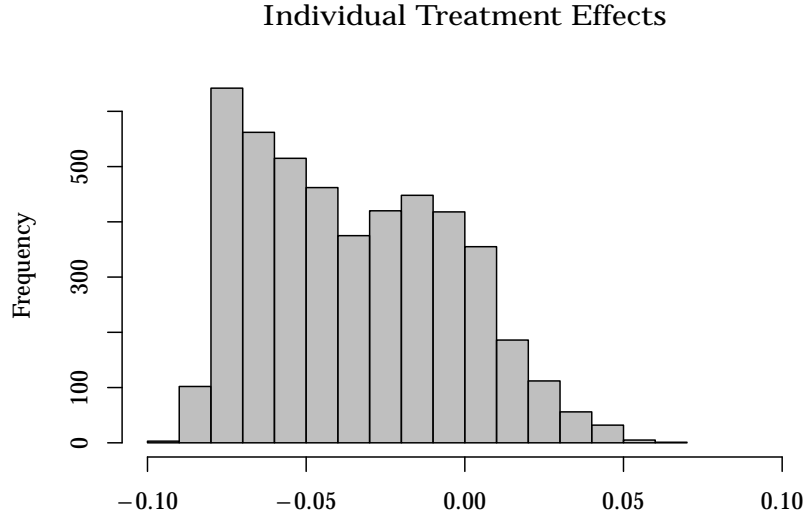


Figure 2: The distribution across observations of the estimated individual treatment effects (ITEs). Specifically, each ITE represents the effect of literacy on economic outcome uniquely for each observation in the sample (since $N = 4,694$, there are 4,694 values in the above histogram). Similar to the linear treatment effect estimate, the ITEs are collected around negative values, although there are some greater than zero. The spread of this distribution suggests that there is heterogeneity in the effect of literacy on economic outcome.

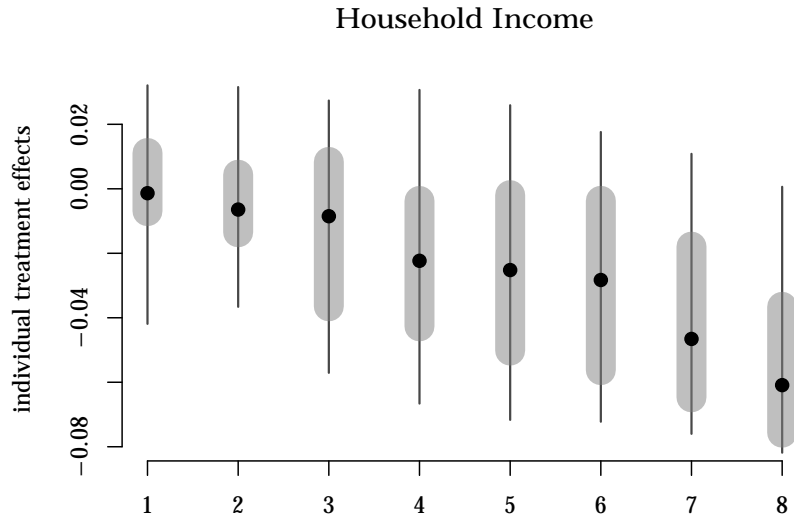


Figure 3: Individual treatment effect distributions categorized by the A8 variable, which measures the approximate household annual income. The value “1” denotes less than \$15,000, and the value “8” denotes greater than \$150,000. The numbers in between are annual incomes of increasing amounts. The black dot denotes the median ITE value within each income category, the black line is the 90% interval of the distribution, and the gray area is the inner quartile range of the distribution.

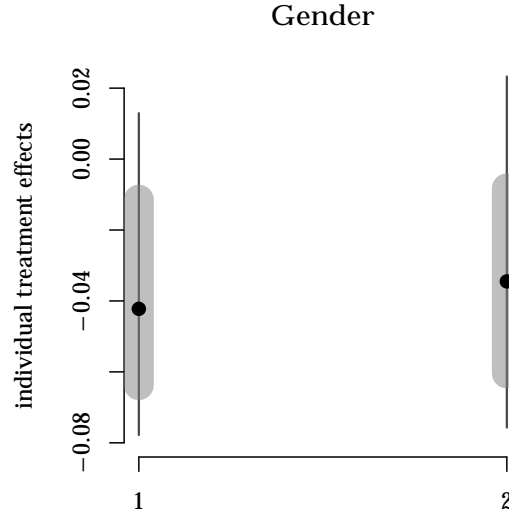


Figure 4: Individual treatment effect distributions for the A3 variable where gender is defined by the value “1” for male and “2” for female.

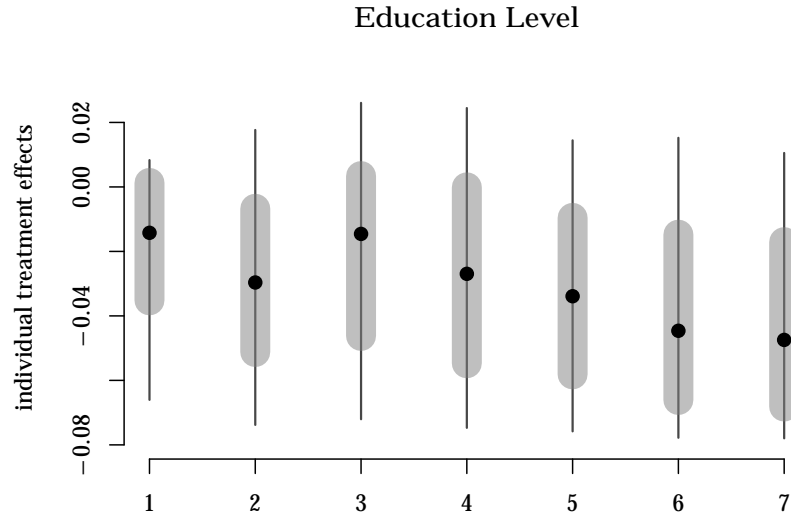


Figure 5: Individual treatment effect distributions for the A5_2015 variable with categories by education level. The value “1” denotes Did not complete high school, “2” denotes High school graduate - regular high school diploma, “3” denotes High school graduate - GED or alternative credential, “4” denotes Some college, no degree, “5” denotes Associate’s degree, “6” denotes Bachelor’s degree, and “7” denotes Post graduate degree.

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A. Appendix: Sample and entire survey comparison

We compare our sample ($n = 4,694$) to the entire survey data set. Figure 6 shows the distributions of observations across the covariates used in the analysis for the sample (light gray) and the entire survey data set (black). There is reasonable balance between the sample and entire survey data set, suggesting our data sub-setting is not drastically affecting the kinds of observations we use for inference. Pertinent summary statistics of our sample are as follows: respondent age varies from 18 to 86 with an average of 42.6 and a median age of 42. 46% of respondents are female. There is variability in general educational achievement and a skew towards higher educational levels: 10.7% graduated high school with either a diploma or GED, 20.6% completed some college without attaining a degree, 11% and 34% attained associate's and bachelor's degrees, respectively, and 23% possessed a post-graduate degree. Variability in household annual income is represented: 7.8% of observations make less than \$50,000, 18.2% make less than \$75,000, and 74% make greater than \$75,000.

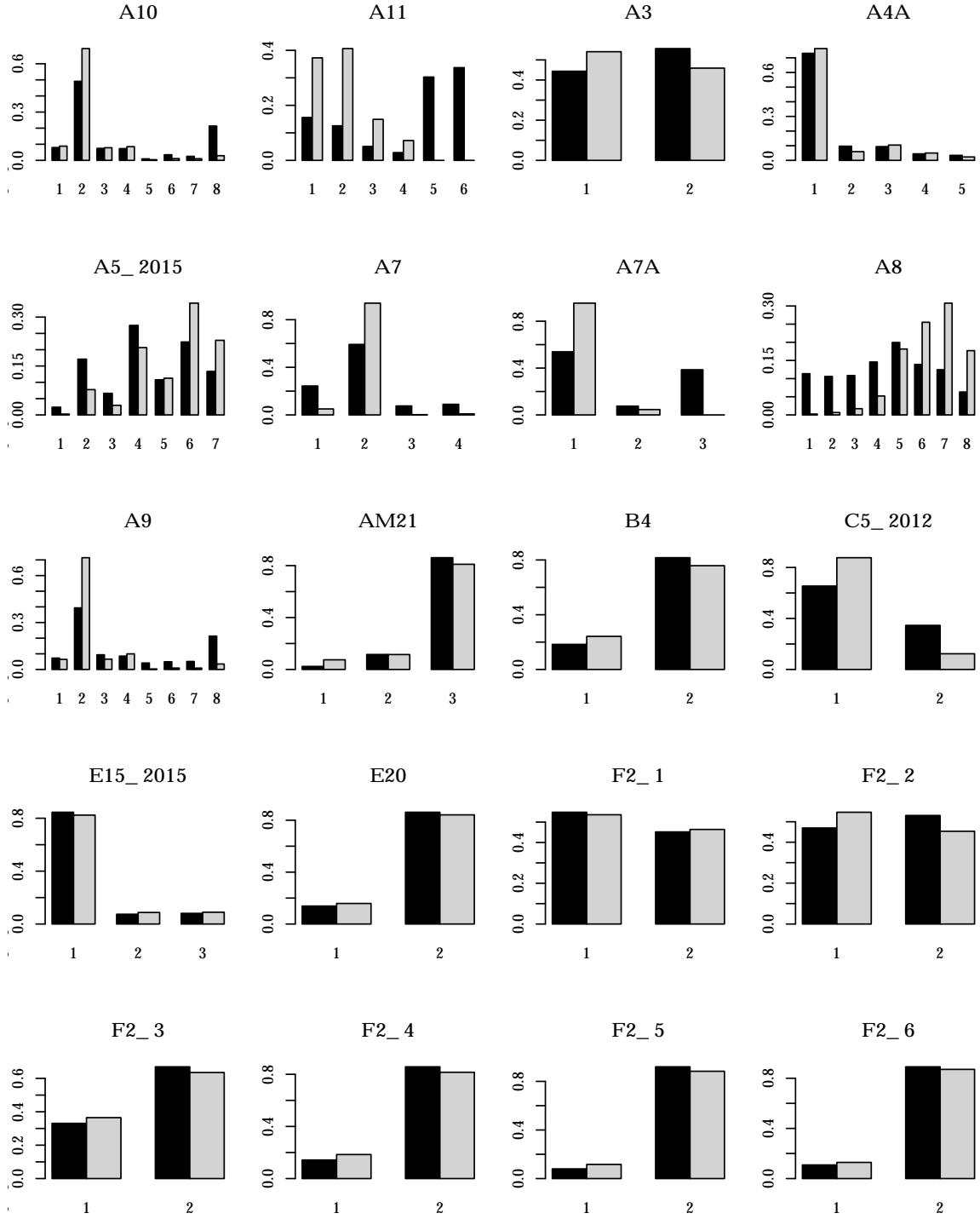


Figure 6: Comparison of sample (light gray) and entire survey data sets across the large set of covariates used for the analysis (first panel).

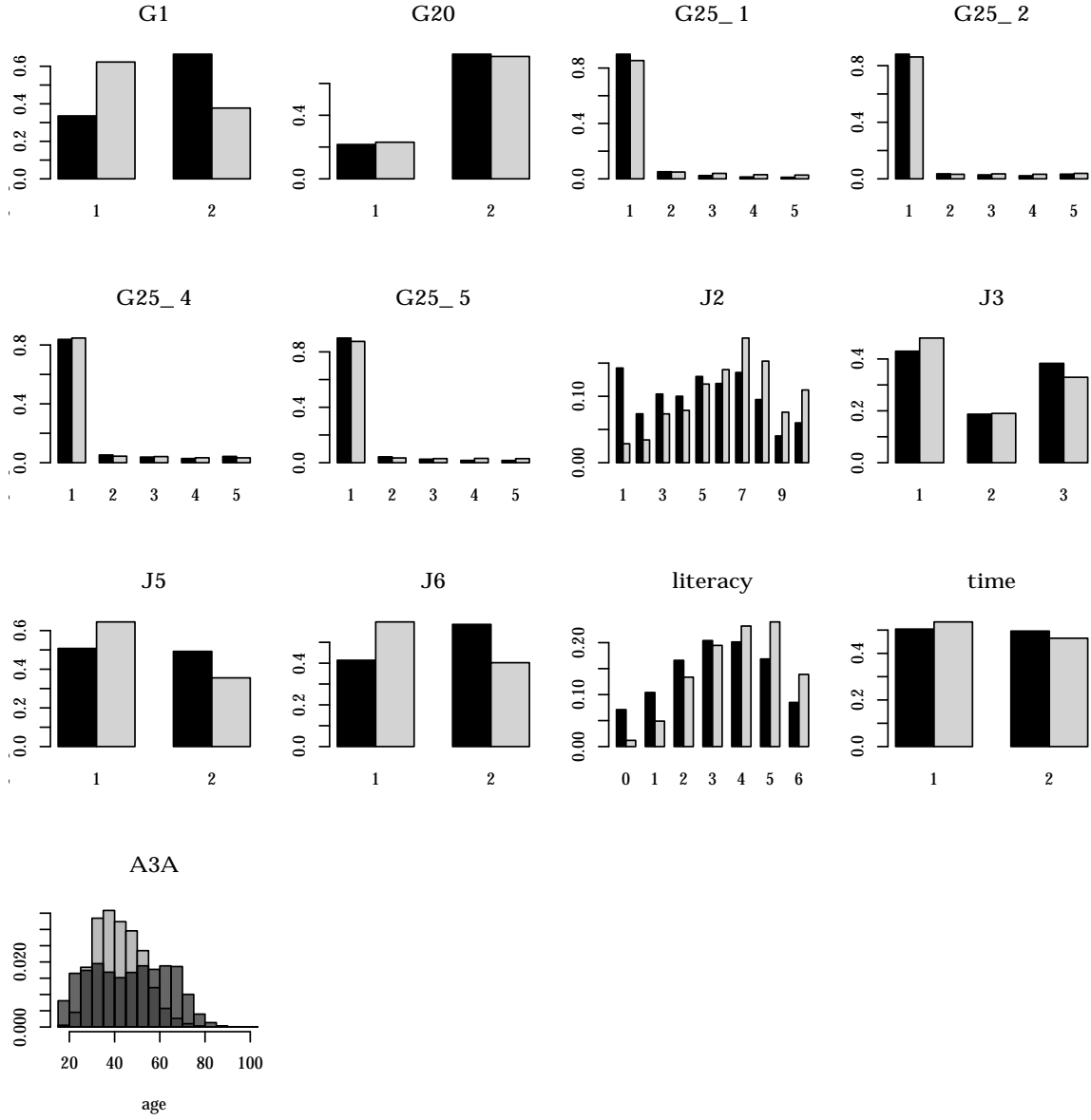


Figure 7: Comparison of sample (light gray) and entire survey data sets across the large set of covariates used for the analysis (second panel).