

Essays on Behavioral Household Finance

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Abstract

This thesis touches on the intersections between household finance and development economics, using primary and secondary data from the fieldwork in Bangladesh. It consists of three self-contained papers that seek to advance the emerging literature that evaluate different dimensions of household financial decision.

The first paper is a field experiment that provides financial interventions with the aim of improving financial literacy and financial well-being among women in rural area in Bangladesh. We conduct a Randomized Controlled Trial (RCT) among women in 180 villages in rural Bangladesh to compare the efficacy of teaching a standard financial curriculum with maintaining a financial diary. We find that keeping a financial diary to track spending was largely as effective as financial education in improving financial test scores and downstream financial behavior. Using incentivized experiments, we also show that participants who maintained a financial diary exhibited significantly higher household bargaining power. Overall, the findings suggest that maintaining a financial diary can be a cost effective alternative to financial education in improving the financial wellbeing of women in developing contexts.

The second paper is a lab-in-the-field experiment among non-professional traders in Dhaka Stock Market. Our results show that the trading behaviour of household are consistent with myopic loss aversion (MLA) - a higher level of feedback lowers the willingness to invest in the stock market, possibly leads to the under-diversification tendency documented in household finance survey. We combine the experimental results with a unique dataset on daily transactions and portfolio positions over two years to examine the relationship between traders' investment decisions under controlled experimental settings and their real-life investment decisions in stock markets. We show that experimental behaviors may predict but do not fully capture the essential realworld trading analogs of non-professional traders in emerging markets in developing countries.

The last paper takes advantage of an existing microfinance program in Bangladesh. Bangladesh has passed through a crucial phase of fertility transition and microfinance expansion. The country has experienced considerable decline in fertility in recent past decades. We examine how access to microfinance has affected the fertility using one of the largest panel datasets ever conducted among microfinance households in Bangladesh. We find that access to microfinance is associated with having fewer children after joining the program. We also find that declines in recent fertility are likely attributable to increased awareness of contraception use among women (but not their partners) participating in microfinance programs.

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Chapter 1

Introduction

The rise in the market share of household assets and the increasingly active role of households in the financial sector has attracted interest from both academics and policymakers. Yet, despite the central role of household finance in the functioning of the financial system, and the rapidly evolving research on this topic, several gaps in our understanding remain (Gomes, Haliassos and Ramadorai (forthcoming)). First, the main focus of behavioral household finance is on modelling household decisions, preferences and constraints using standard rational optimization models in macroeconomics and price determination in the asset market. Second, the current empirical body of household finance literature relies heavily on evidence from developed countries. Households in emerging markets may face a unique set of risks and constraints and circumstances that may affect their financial behavior and wellbeing. Thirdly, the scarcity of quality datasets documenting real behavior of household poses a significant challenge to documenting household decisions in the market. The lack of a counterfactual is also a threat to impact evaluation of economic policies on household finance.

My dissertation adds to the modern field of household finance by providing rigorous evidence-based research that seeks to analyze and improve households financial lives and welfare. It addresses the representative disparity of household finance literature by investigating some of the factors affecting individual and household financial decisions in a developing country context. Lastly, primary data collected in combination with administrative and natural occurring investment transaction data provides a unique opportunity to over come data constraint hurdles.

The thesis consist of three papers that together focus on under-explored themes that have recently emerged from the household finance literature. The first paper addresses which type of policy interventions can assist in removing the barriers that households often face in the financial market. The second paper documents how behavioral bias may change household willingness to participate in the financial market. The third paper studies how household finance can have a spillover effect on other wellbeing outcomes.

The first paper investigates and compares the impact of financial education and financial diary interventions on several dimensions of women's financial literacy and wellbeing in rural areas in Bangladesh. Financial literacy is the most fundamental requirement for households to make informed financial decisions - an intervention that improves financial literacy has the potential to shape household financial outcomes. Many women in developing countries have primary responsibility for daily decisions about household expenditure, while their husbands work outside the home.

Investment in financial education has long been advocated as an important way to improve the financial wellbeing of women, including their bargaining power within the home, but it can also be relatively expensive to administer. The design and costefficiency of financial interventions are significant practical concerns for policymakers, especially in developing countries due to the constraints on resources. Maintaining a financial diary potentially represents a less-intensive, simplified, alternative to financial education in improving female financial wellbeing. We find that keeping a financial diary to track spending was largely as effective as financial education in improving financial test scores and downstream financial behavior. Using incentivized experiments, we also show that participants who maintained a financial diary exhibited significantly higher household bargaining power. Overall, the findings suggest that maintaining a financial diary can be a cost-effective alternative to financial education in improving the financial wellbeing of women in developing contexts. We also utilized a lab-in-thefield experiment to measure female bargaining power - a dimension of empowerment that is not directly observable in self-reported surveys. Using incentivized investment decisions, we also show that participants who maintained a financial diary exhibited

significantly higher household bargaining power. Overall, the findings suggest that maintaining a financial diary can be a cost-effective alternative to financial education in improving the financial wellbeing of women in developing contexts.

In the second paper, the focus turns to how behavioral bias may affect household asset allocation and investment portfolios. Household finance research generally emphasizes the lack of portfolio diversification. Using experimental variation in lab-in-the-field setting, we explore how higher feedback frequency decreases the willingness to invest in the stock market. The project uses a sample of 343 non-professional traders and investors from eight stock brokerages on the Dhaka Stock Exchange. We study their investment behavior under both a controlled experimental setting and real life trading platform. Our results show that a higher level of information feedback frequency decreases willingness to invest in the stock market, which is potentially why household portfolios are often under-diversified. High frequency of market news may also subsequently affect the capital accumulation and stability of the stock market. The novelty of our study is that we combine the experimental results with a unique dataset on daily transactions and portfolio positions over two years to examine the relationship between traders' investment decisions in the experiment and their real-life investment decisions in stock markets. We show that experimental behaviors may predict, but do not fully capture, the essential real-world trading analogues of non-professional traders in emerging markets in developing countries.

The third paper studies show an improvement in household finance may affect change in behavior and welfare that goes beyond financial wellbeing. The paper seeks to explore the impact of an existing microfinance program on the fertility choice of their beneficiaries in Bangladesh. Microfinance is one of the approaches targeting poverty alleviation focusing on women as their main beneficiaries. Microfinance programs are believed to facilitate poverty alleviation by helping households to overcome financial and social barriers to the formal credit system. According to Becker, Murphy and Tamura (1990) fertility should respond positively to an increase in household income or wealth. In the third paper, we find that access to microfinance is associated with reductions in fertility.

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Chapter 2

Financial Diaries and Women's Money Management Behavior: Evidence from a Randomized Controlled Trial Increasing women's access to economic resources and opportunities including financial services, skills development and employment outside the home is central to increasing female empowerment. Studies show that women have lower financial knowledge than men, which is typically measured by their understanding of financial concepts and risks (Lusardi and Mitchell (2008)). In rural areas in developing countries, many women are not only poor, but they often have little knowledge of, and little capacity to manage, their household finances (Cull, Demirguc-Kunt and Morduch (2012)). Improving their knowledge of, and understanding about, household income and expenditure is important for facilitating financial empowerment and increasing their bargaining power within the home.

There are a number of studies which examine the effectiveness of traditional financial education as a vehicle to improve financial inclusion in developing countries. However, the effects of financial education programs on the various dimensions of financial literacy and downstream behavior remain inconclusive (Fernandes, Lynch and Netemeyer (2014); Kaiser, Lusardi, Menkhoff and Urban (2020))). Financial education programs are also expensive to offer. This issue is particularly important at a time when many development agencies, which have invested in improving the financial wellbeing of the rural poor, are facing increasing competing demands on their budget. We know virtually nothing about the efficacy of alternative interventions to traditional financial education in improving female financial wellbeing. In this paper, we study the effectiveness of maintaining a financial diary, which potentially represents a simplified, more cost-effective alternative to traditional financial education, in improving the financial wellbeing of the rural poor.¹

We conduct a randomized controlled trial (RCT) in order to compare the effectiveness of teaching a standard financial curriculum with maintaining a financial diary on improving overall financial wellbeing. Participants were 2215 young women aged 18 to 40

¹For the same impact on financial literacy, the cost of financial education in our program is estimated to be ten times the cost of maintaining a financial diary.

from 150 villages in rural Bangladesh. We measure financial wellbeing by financial literacy, downstream financial behavior and female empowerment. To measure the latter we employ both traditional survey measures and a lab-in-the-field experiment measure of bargaining power within the household. Our lab-in-the field experiment is based on a simple sequential move game between a pair of two players, which is designed to measure the female player's willingness to overrule the financial decision of either her spouse or a random male from her village (Ashraf (2009)). We also examine several channels through which each intervention might have improved financial wellbeing.

Huston (2010) suggests that financial literacy has two components. The first is awareness of basic financial concepts, measured by financial test scores or a financial literacy index. The second is having the confidence to apply that knowledge, measured by financial self-efficacy. Our results suggest that the financial education and financial diary treatments both improved awareness of financial concepts. Specifically participants in both the financial education and financial diary treatments experienced about a 0.3 SD improvement in the financial literacy index. Overall, participants in the the financial diary treatment performed as well as those in the financial education treatment for most of the topics that constitute the financial literacy index. Both treatments increased awareness of budgeting, risk and simple interest rates. Participants in the financial education treatment outperformed those in the financial diary treatment with respect to awareness of inflation. We also find that financial education improves financial self-efficacy, but the financial diary treatment has no significant effect on financial self-efficacy.

The financial diary treatment had similar effects on downstream financial behavior as the financial education treatment, where downstream financial behavior is measured by unbiased weighted indices of savings, debt and use of formal financial services. The financial education and financial diary treatments improved participants' saving index by 0.15 SD and 0.17 SD respectively. The effects on the debt index were also similar. Financial education improved the debt index by 0.14 SD, while the corresponding effect for the financial diary treatment was 0.17 SD. Neither treatment, however, increased awareness of formal financial services.

Our findings for the effect of the two treatments on female empowerment differ between the survey and lab-in-the field measures. We find that financial education improves female empowerment when female empowerment is defined in terms of self-reported joint decision making between the participant and her husband. The financial diary treatment, though, has no effect on self-reported female empowerment measures. In our lab-in the field experiment, however, we find that the financial diary treatment increases female empowerment, while the effects of financial education are not statistically different from the control. Specifically, when given a choice, 42% of women in the financial diary treatment overruled their male partner's decision, compared to only 20% in the control group and around 25% of women in the financial education group. The magnitude of the amount by which participants in the financial diary treatment overruled the other player were also much larger. The results were similar for women in the financial diary treatment, irrespective of whether the other player was her spouse or a stranger. Our results suggest that social desirability bias might be an important factor to consider in eliciting financial behavior, especially among those participants who directly received the training.²

Studies which seek to improve financial literacy have focused on examining financial training programs (see Lusardi (2008), Lusardi and Mitchell (2011)). Existing studies that have examined alternatives to traditional financial education have mainly involved either altering the curriculum (Drexler, Fischer and Schoar (2014)), the teaching method (Kaiser and Menkhoff (2017)) or adding personalized elements (Carpena, Cole, Shapiro and Zia (2015)) within the context of financial education.³ This paper

 $^{^{2}}$ We tried to minimize the bias by engaging a separate team of enumerators for the endline survey and experiment. See more details in sections 4.3.1 and 4.3.2.

³Drexler et al. (2014) experimented with two distinct training programs for micro-entrepreneurs and found that a much simplified, rule-of-thumb intervention significantly improved performance

is the first to use a large-scale RCT to measure the effectiveness of maintaining a financial diary in improving financial behavior and decision making and to compare the effectiveness of maintaining a financial diary with a financial training program.

Economists have proposed maintaining diaries as a measurement instrument to capture households' financial decision making and livelihoods through high-frequency data on income and expenditure (see Collins, Morduch, Rutherford and Ruthven (2009) and Morduch and Schneider (2017)). Large-scale projects have been carried out by major Non-Government Organizations (NGOs), such as CGAP and BRAC (Anderson and Ahmed (2015)), seeking insights into how the poor manage their money. A rapidly growing literature seeks to document the financial lives of poor people. These studies seek to draw implications about the need for financial tools based on their diaries entries. Nevertheless, we lack evidence on whether maintaining a diary alters financial attitudes and behavior. We contribute to the growing literature that seeks to document the financial lives of poor people by being the first to show that maintaining diaries can induce improvements in financial behavior and, in many respects, be as effective as the more expensive financial education alternative.

We also contribute to the literature on the efficacy of traditional financial education programs in improving financial wellbeing of the rural poor, for which existing evidence has been mixed. Fernandes et al. (2014) conduct a meta-analysis of 168 papers covering 201 financial literacy studies, including 85 impact interventions, finding that financial education can only explain 0.1% of the change in financial behavior and that the effect is even smaller for low-income groups. However, a more recent study by Kaiser and Menkhoff (2017) synthesizes empirical findings from 124 impact evaluation studies. Those authors find that financial education does improve financial literacy and speculate that their results reflect that their meta-analysis contains a bigger sample of large-scale RCTs. Our findings are consistent with this more recent meta-analysis outcomes, compared to a standard training program, which had no measurable impact.

and suggest that traditional financial education programs can be effective in improving financial literacy and other dimensions of financial wellbeing.

We add to the recent limited literature on the channels through which financial interventions can improve financial wellbeing (Kaiser and Menkhoff (2017)). We employ the traditional causal approach using mediation analysis (see Baron and Kenny (1986) and MacKinnon, Fairchild and Fritz (2007)) to examine the direct and indirect effect of the treatments on participants' revealed preferences, behavior, test scores and intra-household bargaining (see, for example, Ashraf, Karlan and Yin (2006) and Abbink, Islam and Nguyen (2020)) via numeracy, time preferences and risk preferences. We find two important channels- numeracy and time preferences- through which the interventions influence financial outcomes.

Overall, our results are important because they not only show that traditional financial education can be effective, but they show that maintaining a financial diary can be a simple, cost-effective alternative to traditional financial education in improving financial wellbeing. This is incredibly important when NGOs and policy-makers are looking at alternative ways to improve the economic and financial wellbeing of vulnerable populations.

2.1 Experimental design and data

The study took place in rural areas in two south-western districts, Khulna and Satkhira, in Bangladesh. We randomly selected 150 villages from five sub-districts in these two districts for the purpose of the intervention.⁴ We assigned 50 villages to the control group and 50 villages to each to the two treatment groups at random. The randomization was conducted at the village level with each village either being assigned to

⁴See Appendix 2.C for the power calculation used in the pre-analysis plan.

the control group or to receive the financial education or financial diary interventions (see Figure 2.1). Married women who were aged 18 to 40 randomly selected from each of these villages were offered to participate in the study. The final sample consisted of 2248 female participants from the 150 villages who were surveyed at baseline, with 15-22 participants from each village.⁵

The lower panel of Figure 2.1 illustrates the geographical distribution of the control and treated villages (Tala, Dumuria, Assasuni, and Paikgachha Upazila) in Khulna and Satkira. Given the considerable distance between each control village and its nearest treatment village,⁶ spillovers between participants in the treatment and control groups seem unlikely. At baseline, all participants completed a survey containing questions intended to elicit basic demographic and financial information. They also completed a test to measure ex-ante numeracy, financial literacy and risk preferences. The financial education and financial diary interventions were introduced following the survey. Approximately 12 months after the baseline survey, we conducted follow-up tests and administered surveys to participants in the control group and each of the two treatment groups to measure the post-treatment effect of each intervention on their savings behavior and level of financial literacy. Details of the timeline can be found in Appendix 2.A.

⁵We exclude relatively atypical households, i.e., polygamous households, households in which there were divorcees and multiple family households, in order to ensure homogeneity within, and between, treatment arms. Women from atypical households, if eligible, still filled in the surveys and received the interventions. We only exclude these observations in the final analysis to prevent our results being driven by extreme outliers. The results do not change qualitatively if we utilize the full sample.

⁶The road conditions in Khulna and Satkira were poor at the time of treatment, making it difficult for participants to commute long distances on a regular basis.



Figure 2.1: Randomization Process and Treatment distribution map

2.1.1 Overview of the intervention

Financial diary/household budgeting

This treatment group received financial diary/ household budgeting training. Participants self-recorded household daily income and expenditure over a 28-week period. The majority of financial diary interventions use regular (biweekly or monthly) visits to interview households on income and expenditure over the period. We, instead, had participants maintain a daily record to get a more accurate and detailed picture of household spending behavior. Having participants self-record their own daily transactions also has the advantage that they can learn to improve their money management skills and understand their family's financial situation better; thereby, potentially improving their confidence in their own financial ability.

Following the randomization process, research assistants visited each household to brief participants about how to maintain a financial diary and respond to any questions participants had. Given the sensitivity of household financial matters, we ensured that all discussion took place in the presence of the participant's family members, including her husband and in-laws. The financial diary consisted of two main columns representing cash inflows (income/borrowing) and outflows (expenditure/lending). The cash inflow of the budget tracked all separate income sources, dividing them into five main categories: agricultural production, loans, casual income, savings withdrawals and self-employment. The expenses were divided into five categories: groceries, clothing, education, production and services. To maintain an ongoing and regular relationship with the participants, our field workers re-visited households every two weeks to collect, and cross-verify, the diary entries, as well as answer questions on, and provide guidance about, how to use the diary to record daily cash inflows and outflows.

One of the most important tasks during each of the fortnightly visits was to under-

stand any discrepancies between the household's inflow and outflow of income. If expenses exceeded income by a significant amount, the field worker followed up to understand how the extra expenditure was being financed.⁷ Overall, the gap between income and expenditure was below 10% over the course of the intervention. A critical factor pertaining to the recruitment for this treatment was to secure the willingness of the participant to maintain the financial diary throughout the 28-week period. To encourage participants to do so, in addition to providing monetary compensation for their time, we offered each household the opportunity to participate in a lottery round with a chance to win some prize if their diary was properly maintained. During each visit, our field worker reminded them about the upcoming lottery.⁸

Financial education

We invited all eligible women in a randomly selected village to take part in a short course that was designed to improve their basic financial knowledge. The curriculum for the course was adapted from the Global Financial Education Program (Microfinance Opportunities, Freedom from Hunger). We employed standardized topics that have been adopted by a number of researchers (see Brown, Grigsby, Van Der Klaauw, Wen and Zafar (2016)). Specifically, the program consisted of six modules; namely, budgeting, savings, debt, informal and formal financial services, dealing with financial emergencies and saving for old age.

The training was conducted in the local language and the course content was modified to suit regional specific characteristics and culture. The training was administered by local trainers from Khulna University and other NGOs in the same district with experience of conducting similar training. Each session entailed one lecture and group discussions with graphical illustrations and field exercises, the curriculum can be found

⁷As a rule of thumb, the field staff followed up with the household when the discrepancy in their weekly income and expenditure was above 20%.

⁸The lottery payment was proportionate to the average household expense per month.

in Appendix ??. The training commenced at 10:00 AM and concluded at 3:00 PM once a week for six consecutive weeks.⁹

2.1.2 Data description

Attrition and take-up rate

The attrition between baseline and endline surveys was 7.14% for the full sample, with some variation across treatment arms. Due to new households being formed within the cluster over the same period because of, for example, marriage or relocation/migration, there were 120 new participants in the endline survey.¹⁰ There were also some non-compliant participants, defined as treated participants who did not complete all modules of the course or did not maintain the diary for the whole period. The final take-up rate - conditional on finishing their endline survey - for each treatment is illustrated in the lower panel in Table 2.1. The take-up rate varies by experimental condition: approximately 76.52 percent of the financial education group took part in all the training sessions. By comparison, 79.82 percent of those who participated in the financial diary treatment maintained their diaries throughout the whole period. Every participant who completed the endline survey had at least partial compliance.

In some instances, relatively low response rates for specific outcome variables may create the potential for outliers to drive the results. Where outliers are suspected across such variables, we conduct the following unreported robustness checks: (1) drop outliers or (2) truncate the data where there is little to no expected loss in statistical power. The potential effects of attrition were identified by using a dummy variable to

⁹We provided snacks and lunch and hard copies of the materials. Each participant received compensation for their time.

¹⁰These participants were not listed in our sample pool from the census survey and were not present during the baseline survey. Regardless, we still accepted them into the program, as long as they were eligible. Almost all of the added participants were recently married and relocated to the village. However, the results do not change whether they are included in the analysis or not.

identify participants who withdrew or become unreachable throughout the evaluation. The attrition group was analyzed against baseline data to examine selection bias due to attrition. To test for balance on attrition during the endline survey, we regressed an attrition indicator on each of the treatment variables - there appears to be no significant correlation between treatment groups and attrition rate.

		Panel A - Sample Distribution ^a					
	Round		Treatment Arms				
		Control	Financial Education	Financial Diary			
Surveys	Baseline	698	798	802	2298		
		30.37%	34.73%	34.90%			
	Endline	660	741	748	2149		
		30.71%	34.48%	34.81%			
	Panel B - Attrition and Participation Rate ^b						
Attrition		38	57	54			
		5.44%	7.14%	6.73%			
Participation		N/A	567	593			
			76.52%	79.28%			

Table 2.1: Sample Distribution, Response Rate and Take up Rate

Notes:

This table provides the sample distribution and response/attrition rate by treatments. The fully reproducible randomization was done using Stata. Randomization was first used to select 150 villages from the list of 1000 villages. Then, the selected 150 villages were randomly assigned into either control, financial education or financial diary groups (first stage randomization). Two of the clusters (villages) were non-compliant during the initial field activities. These villages were removed and replaced with two villages with similar characteristics.

^a Panel A provides the final distribution of the sample during baseline and post-treatment surveys.
^b Panel B shows the attrition rate between baseline and endline survey, and the final take-up rate of the interventions. The take-up rate is defined as the participant having finished all the sessions within the assigned treatment.

Baseline balance

Causal inference on the effect of financial interventions on intended outcomes rests on ensuring that the assignment of clusters to the treatment conditions is random. Table 2.2 displays descriptive statistics and balance checks for the 2248 participants at baseline for treatment and control groups. As shown in Panel B, participants' socioeconomic characteristics were balanced across the control group and financial education and financial diary treatments. The differences across treatment arms are not statistically significant. The control group has a slightly lower income than the treatment group, but the differences are not significant. Participants in the financial diary treatment have slightly higher loan repayment expenses, which are significant at 10% using the conventional t-test, but are not significant based on a randomization inference test.¹¹

The average household size among participants is four to five members, with each household having one to two children. Less than 20% of participants have a job outside of a home business and approximately 44% were saving money. By design, none of the participants was illiterate and the majority could perform basic calculations. While approximately 80% of the participants possessed at least some forms of resources (such as jewelry and savings), only 6% were landowners. Across all the intervention arms, only 11% had an income-earning job, leading to a low level of annual income. Approximately half of the sample were members of local NGOs or MFIs; however, only 19% of the participants had a savings account. The distribution of financial product ownership reflects the Bangladesh context: informal savings and loans, together with NGOs, remain dominant despite the increasing penetration of formal credit institutions. Banking options in the rural areas of Khulna and Satkhira districts are particularly limited and large commercial financial institutions are only located in the city centers.

¹¹We also regress the baseline variables (demographics and financial tests) on each of the treatment indicator variables. In addition, since some of the pre-intervention variables are likely to be correlated with each other, we conduct joint tests to see whether groups of variables predict assignment to each of the treatment groups. None of the analysis suggests an imbalance at baseline. The results are available on request.

	Panel A - Descriptive Statistics						Panel B - Balance Check		
T7 (11 0	Contr	ol (C)	Educati	on (FE)	Diary	(FD)	p-va	alue (Differe	ence) ^b
Variable ^a	Mean	SD	Mean	SD	Mean	SD	FE v.s C	FD v.s C	FE v.s FD
Household size	4.64	1.23	4.63	1.20	4.60	1.11	0.85	0.55	0.69
Number of sons	0.86	0.79	0.80	0.70	0.89	0.73	0.15	0.49	0.02
Number of daughters	0.95	0.83	0.92	0.83	0.86	0.79	0.47	0.05	0.25
Income-earning job	0.13	0.34	0.12	0.33	0.10	0.29	0.82	0.14	0.22
Income earned last year	4870.44	7118.39	5539.07	8980.78	5332.16	7560.71	0.20	0.36	0.70
Land owner	0.06	0.23	0.07	0.26	0.06	0.24	0.26	0.65	0.49
Other resources	0.80	0.40	0.81	0.39	0.76	0.42	0.76	0.20	0.10
Active bank account	0.17	0.38	0.22	0.41	0.21	0.40	0.1	0.14	0.85
MFI members	0.51	0.50	0.49	0.50	0.47	0.50	0.49	0.30	0.64
Currently saving money	0.76	0.25	0.78	0.25	0.77	0.25	0.44	0.67	0.72
Monthly saving	1655.75	3354.27	1741.18	4144.62	1957.77	4447.93	0.82	0.44	0.63
Expense: food	5056.11	2850.75	5103.50	2560.02	5006.68	2898.15	0.78	0.80	0.61
Expense: shelter	42.04	223.75	30.40	177.30	31.06	212.87	0.64	0.65	0.96
Expense: bills	371.01	262.37	404.36	343.58	372.63	298.87	0.24	0.95	0.29
Expense: loan repayment	882.20	1639.67	1028.60	2814.36	1154.13	3109.87	0.33	0.09	0.50
Financial test scores	5.71	1.33	5.73	1.61	5.72	1.42	0.89	0.94	0.95
Numeracy test scores	5.80	2.42	5.76	2.22	6.11	2.11	0.88	0.31	0.15
Observations				4	2149				

Table 2.2: Summary Statistics and Randomization- Balance Test at Baseline

Notes: This table provides descriptive statistics across the three intervention arms at baseline. Panel A presents the statistics for the control group (C) and treatment groups (FE) and (FD) respectively. Panel B provides the p-value from a test for whether the financial education treatment coefficient is different than zero, the financial diary treatment coefficient is different than zero and the difference between these ^a Definition of variables are given in the Appendix.

2.2 Outcomes measurement and estimation strategy

Financial literacy and financial wellbeing includes several dimensions that are often overlooked in the literature. For example, the majority of research uses book knowledge and numeracy tests to measure financial literacy, but these may not fully capture downstream financial behavior and level of financial inclusion of participants. There is no universally accepted meaning of financial literacy. We follow the definition proposed by Huston (2010). Financial literacy is conceptualized as having two aspects - financial knowledge (the understanding of financial topics) and application (the ability and confidence to apply the knowledge to financial activities).

2.2.1 Financial literacy - financial test score and financial selfefficacy

The financial knowledge questions are composed of three parts. The first set of questions seek to assess basic financial literacy, similar to those used in Lusardi and Mitchell (2008). These questions cover three main topics (i) understanding of compound interest rates, (ii) understanding of inflation; and (iii) understanding of risk diversification. We also include questions on general awareness of practices associated with positive financial behavior: (iv) understanding of income-generated loans; (v) understanding of budgeting; (vi) understanding of simple interest rates;¹² and (viii) understanding of formal financial institutions (formal saving methods). For each of the questions, we re-code the answer to one if the answer is correct, and 0 otherwise.

The second component of the Huston (2010) definition of financial literacy is having the context-specific confidence to apply the acquired knowledge. Women are generally

¹²The widely-used three questions proposed by Lusardi and Mitchell (2011) only include the compound interest rate. However, considering our participants' educational background and the context of a developing country, we include both types of interest rates.

believed to be less confident in their financial capacity than men, and the difference is especially large in developing countries (Lusardi and Mitchell (2008)). We examine if the interventions improve financial confidence of participants using the financial self-efficacy scale (FSES), developed and validated by Lown (2011). We replicated six statements from Lown (2011), measuring participants' self-confidence in their own capabilities with respect to saving and debt management.¹³ Participants were asked to respond to the FSES statements on a 4-point Likert-type scale: 'exactly true', 'moderately true', 'hardly true' or 'not true at all'. The exact wording of the six statements are:

- (Item 1) It is hard to stick to my spending when unexpected expenses arise.
- (Item 2) It is challenging to make progress towards my financial goals.
- (Item 3) When unexpected expenses occur, I usually have to use credit.
- (Item 4) When faced with a financial challenge, I have a hard time figuring out a solution.
- (Item 5) I lack confidence in my ability to manage my finances.
- (Item 6) I worry about running out of money in retirement.

Downstream financial behavior

While there is a strong correlation between financial literacy and prudent financial decisions (Xu and Zia (2012)), an improvement in financial literacy may not result in positive financial behaviors due to other factors having an impact on financial

¹³We test if participants were confident in their answers in the knowledge test. They were informed that each question only has one correct answer and is worth one point each and that we deduct half a point for every wrong answer. Thus, participants have the incentive to answer "I do not know" rather than attempt to select the answer randomly. However, we find no significant pattern among women who choose not to answer.
behavior. Similarly, financial interventions, with or without directly affecting the level of literacy, may lead to positive behavioural change. Therefore, we also examine the program impact on downstream financial behavior, which we measure using three domains:

- Savings index which consists of the following items: whether the participant has any type of savings (including a savings account or cash at home); the amount of the household's monthly savings; whether she is a regular saver, whether she has a deposit account; and whether she has expressly saved some money for old age.
- **Debt** which consists of the following items: whether the participant plans to borrow from a money lender in the future; the sources of her most recent loan, and her monthly loan repayment as a percentage of household expenditure.
- Exposure to **Financial Institutions**, which consists of the following items: whether the participant has a bank account, if she had ever been to a bank; and if she knew the location of her local bank.

Bargaining power - survey-based and experiment measures

Financial interventions have the potential to promote the economic empowerment of women in developing countries. Bargaining power is central to the link between female empowerment and economic wellbeing. However, bargaining power is not directly measurable, and the existing literature often relies on self-reported participation in household decisions as a proxy (Doss (2013)). An alternative is to use experimental games to understand female autonomy in intra-household decisions. We employ both measures of female empowerment. **Surveys:** The dominant definition of bargaining power is exercising control over resources (see Kabeer (1999)). We asked participants who was the main decision-maker when deciding on: major household purchases, food, livestock and children's education. Possible responses were "yourself", "your husband," or a "joint decision between you and your husband". The answers for these questions were used to construct a household decision making power index (HDMI). We define autonomy in two ways. First, similar to the approach used in Ashraf, Karlan and Yin (2010), we define having autonomy in decision making as the participant either being the sole decision-maker or having joint decision-making authority over household spending (HDMI2). Peterman, Schwab, Roy, Hidrobo and Gilligan (2015) find that including joint decisions in the HDMI may result in substantially different conclusions about female empowerment than just focusing on sole decision making by women. Thus, alternatively, we define autonomy as the participant being the sole decision-maker in relation to household spending (HDMI1).

Experimental game: Experimental measures have advantages over survey measures in our context. Experimental games likely provide a more reliable estimate of bargaining power since responses to surveys often vary across different cultural contexts (see Banerjee, Duflo, Goldberg, Karlan, Osei, Parienté, Shapiro, Thuysbaert and Udry (2015)). Hypothetical survey questions carry no real incentives for women to reflect their true preferences. In the cultural context of developing countries, existing dis-empowerment may make it particularly challenging to collect data about women's opinions, and desires. Experiment neutrality in the lab setting allows one to control certain factors that can affect intra-household interactions, making it possible to get meaningful insights that cannot be obtained from survey data. Experimental decision tasks also allow us to directly test the classic bargaining power concept - when women choose their own preferences, even when the man's preference is clearly stated (Dahl (1957)). Following the endline survey in December 2019, we invited a randomly selected subsample of our participants, along with their husbands, to participate in a household decision-making experiment. We randomly selected 62 out of the 150 villages to participate in our experiment, comprising 17 control villages, 22 villages from the financial education treatment and 24 villages from the financial diary treatment.

On average, there were eight couples (8x2=16 players) per session.¹⁴ Once the participants consented to participate in the experiment, the rules for the first task were explained. In this task, the participant received an endowment of 100 takas and had to decide how much to invest in a lottery. The investment could be any value between 0 and 100 takas. The invested amount is doubled with a probability of two-thirds and lost with a probability of one-third.¹⁵

After the participant recorded the amount that they wished to invest in the first task, the enumerator explained the second task. The second task entailed a sequential move game between a pair of two players. The pairing was either between spouses or between the female participant and a random man in the same session.¹⁶ The final payoff was split equally between each pair, and the endowment was increased to 200 takas, so that each individual had the same expected payoff as in Task 1. We randomly assigned the woman to the role of being either first or second mover. The first mover decided and recorded how much of the 200 takas that they would invest in the same risky lottery as in task 1. After being informed about the first mover's investment choice, the second mover had the option to either accept or overrule the decision. If the second mover

¹⁴The participants were similar in terms of demographic characteristics to the whole sample. The sample size varies between villages due to differences in village size and the availability and willingness of couples in villages from the two treatments to participate. The game takes the form of a risk elicitation task, first played as an individual one-off decision, then as a sequential move game between two players.

¹⁵The probabilities of winning and losing were demonstrated using a box of two white balls (denoting winning) and one blue ball (denoting losing).

¹⁶All participants were informed that a coin toss would determine whether the first or second task would be selected for the final payment. If the first task was chosen, each individual took a ball from the box to determine if their investment was doubled or lost. If the second task was chosen, then the second mover selected the ball.



Figure 2.2: Game Distribution

chose to overrule, he or she recorded a new amount to invest.

We use this experiment to test whether the financial intervention empowers the female participant to choose her investment level in preference to her male partner. To do so, we observe the female participant's behavior as second mover and test three hypotheses:

- Hypothesis 1 Participants in the treatment groups are more likely to overrule than participants in the control group.
- Hypothesis 2 Conditional on overruling, participants in the treatment groups are more likely to overrule their spouse than a random male.
- Hypothesis 3 Conditional on overruling, participants in the treatment group will choose their preferred investment, rather than compromising with their partner.

2.2.2 Estimation strategy

We estimate the intent-to-treat (ITT) effects of the interventions on three domains of financial wellbeing: financial literacy, downstream financial behavior and financial empowerment by comparing the treatment groups to the control group at the time of the follow-up (endline) survey. To avoid type-I-error inflation due to multiple hypothesis testing, we aggregate all the related outcomes into summary generalized least squares (GLS)-weighted indices of each outcome domain (see Anderson (2008)). A complete list and description of each outcome variable can be found in appendix 2.E and section 2.2. Following Anderson (2008), first, we re-code the variables, so that a positive sign on the coefficient indicates an improvement in wellbeing i.e., positive treatment effect. All individual outcomes y are demeaned and converted to the size of the effect by the control group standard deviation. The index, constructed by an efficient GLS estimator, weights outcomes using the inverse of their variance-covariance matrix. As noted in Anderson (2008) and Kling, Liebman and Katz (2007), the analysis using the summary index has three advantages over individual outcomes: (1) it is robust to over-testing because each index represents a single test, instead of multiple hypothesis testing; (2) it provides a statistical test for the overall effect of a program on the domain of outcomes; and (3) it is potentially more powerful than individual-level tests. The GLS weighting procedure assigns less weight to outcomes that are highly correlated with each other and a higher weight for uncorrelated outcomes that may contain new information.

Since the treatment and control groups are chosen at random and their characteristics are balanced at baseline, the ITT effect is estimated using the following equation:

$$y_{ij} = \alpha + \beta_1 F E_j + \beta_2 F D_j + \Gamma' X_{ij} + \varepsilon i j$$

where Y_{ij} denotes the outcome index for individual i in village/cluster j. FE_j and FD_j are dummy variables denoting if the participant lives in a village in the financial education or financial diary treatments, respectively. β_1 and β_2 capture the ITT effect of the two treatments. X_{ij} is the vector of controls, including household type, household size, age, participant education and household income. We also control for interviewer fixed effects.

We provide three main robustness checks to address the different null hypotheses that arise due to multiple treatment arms, through multiple outcome variables of interest and multiple sub-group analyses. In addition to computing the index, we use the adjusted p-value generated by randomization inference (see Young (2019)). The procedure follows a nonparametric permutation test, controlling for the family-wise error rate. We also confirm the result with another approach proposed by List, Shaikh and Xu (2019), which builds on Romano and Wolf (2005). Finally, we estimate the treatment effect as the treatment on treated by defining the treatment group as those who completed all the sessions or components of their assigned interventions. There does not appear to be any difference in the qualitative results across methods.

We estimate the intent-to-treat (ITT) effect on individual outcomes within each index with the following ANCOVA framework:

$$y_{ij(t)} = \alpha + \beta_1 F E_j + \beta_2 F D_j + \theta_1 y_{ij(t-1)} + \varepsilon i j(t)$$

in which:

- $y_{ij(t)}$ denotes the outcome variable for individual i in village/cluster j at the time of follow-up (t).
- $y_{ij(t-1)}$ controls for the lagged value of outcome variable at baseline.

For individual binary outcomes, we apply linear probability models. However, the qualitative results are not sensitive to using non-linear (logit) models for binary outcomes (the results employing a logit model are not reported, but are available on request).

2.3 Results

Table 2.3 presents the ITT effects for the financial education and financial diary treatments on financial literacy, downstream financial behavior and female empowerment.

2.3.1 Financial literacy

The results in Column (1) of Table 2.3 show that participants in the financial education and financial diary treatments experienced a 0.324 and 0.299 SD improvement in the financial literacy index, respectively. The effect size for financial education is consistent with previous studies that have examined the effect of financial education on financial knowledge using rigorous RCT designs (effect size of 0.209) and other designs (effect size of 0.394).¹⁷

Table 2.4 shows the results for each of the financial topics that constitute the financial literacy index; namely, the three items in the Lusardi and Mitchell (2011) three-part questionnaire - compound interest rates (compound), inflation and risk - as well as simple interest rates (simple), loan repayment strategy (loan), budget management (budget) and methods of saving (saving). On the whole, participants in the the financial diary treatment performed as well as those in the financial education treatment for most topics. Both treatments increased individual awareness on risk diversification by approximately 0.3 SD, awareness of budgeting by slightly over 0.2 SD and awareness of simple interest rates by 0.18-0.19 SD. The one item on which participants in the financial education treatment is knowledge of inflation. Neither treatment increased awareness of compound interest rates, loan repayment strategy or methods of savings, relative to the control group.

The most challenging topic for participants was compound interest rates. About 40% of

¹⁷The range of treatment effects of RCT and other designs are reported in a meta-analysis by Kaiser and Menkhoff (2017).

	Literacy				Behaviou	Bargaining Power		
	(1) Full ^a	(2) Standard ^b	$(3) \\ FSES^{c}$	$(4) \\ Saving^d$	(5) Debt ^f	(6) Institution ^f	(7) HDMI1 ^g	(8) HDMI2 ^h
Financial Education	0.311*** (0.0909) [0.0000]	0.274*** (0.0951) [0.0050]	0.196*** (0.0710) [0.007]	0.133* (0.0794) [0.0860]	0.135** (0.0635) [0.0400]	-0.00455 (0.0732) [0.9491]	$\begin{array}{c} 0.0383 \\ (0.0561) \\ [0.4985] \end{array}$	0.203** (0.0862) [0.0200]
Financial Diary	0.295*** (0.0991) [0.0082]	0.285*** (0.102) [0.0092]	-0.0679 (0.0739) [0.3798]	0.148* (0.0819) [0.0771]	0.110^{**} (0.0531) [0.0422]	-0.0897 (0.0828) [0.2979]	0.0048 (0.0838) [0.9423]	$\begin{array}{c} 0.1094 \\ (0.1004) \\ [0.2599] \end{array}$
Controls Observations ¹	Yes 2149	Yes 2149	Yes 1793	Yes 2149	Yes 2149	Yes 2149	Yes 2149	Yes 2149

Table 2.3: Main Results - Treatment Effects on Main Outcome Indices

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table shows an ITT effect from an OLS regression. Dependent variables are summary indices of all measures, normalized to be mean 0 and SD 1 in the control group. The index weights individual outcomes using the inverse of their variance-covariance matrix, as proposed by Anderson (2008). For each index, positive values correspond to more favorable outcomes. Details on the index construction are described in section 3 and in appendix 2.E. Standard errors (in parentheses) are clustered at the village level (level of randomization). The adjusted RI p-value using Young (2019) is given in brackets.

^a This index is constructed using answers to the seven financial questions.

^b This index is constructed using the original three questions on compound interest, inflation and risk as in Lusardi and Mitchell (2008).

^c Financial Self-Efficacy Score is adapted from the validated measure in Farrell, Fry and Risse (2016).

^d The saving index is constructed using the related individual saving behaviour items.

^e The debt index is constructed using the related individual saving behaviour items. Higher values mean better outcomes.

^f Institutions is constructed using the related items on formal financial institutions (commercial banks).

^g Household decision making index is constructed based on the participant being the sole decision maker with respect to the four main intra-household expenditure items.

^h Household decision making index is constructed based on the participant being the sole or joint decision maker with respect to the four main intra-household expenditure items.

¹ There is some attrition in the answers for the FSES scale. Since this is a validated scale, we exclude an observation if there is a missing value for any item within the scale. participants answered this question correctly. The relatively poor performance on this topic is in line with the literature (see Lusardi and Mitchell (2008)).¹⁸ The treatments also did not improve participants' awareness of the benefit of formal banking services (microfinance bank is excluded), such as saving accounts. One possible explanation is that most of the participants tend to be unbanked and do not hold other sophisticated financial instruments. Financial inclusion enables women to access credit, to make transactions and to familiarize themselves with financial activities (Hung, Yoong and Brown (2012), Ashraf et al. (2010)). Therefore, the lack of access to formal institutions may mean that participants lack the necessary contexts in order to understand formal banking services or to be able to understand and apply compound interest rates as a concept.

The second component of the Huston (2010) definition of financial literacy is having the confidence to apply awareness of financial topics to money management. The third column in Table 2.3 shows that participating in the financial training program improves the level of financial self-efficacy by 0.196 SD, while the financial diary treatment has an insignificant effect on the FSES score. The mean and distribution of FSES scores among participants do not differ significantly to existing studies, such as Farrell et al. (2016). As illustrated in Figure 2.3, the distribution of FSES is quite similar for participants in the control and diary treatments, while more than 50% of participants in the financial education treatment score above the standard FSES.

In Table 2.5, we examine the effect of the financial diary and financial education treatments on the individual items of the FSES scale. Relative to the control group, participants in the financial education treatment have statistically higher financial self-efficacy on topics that are related to controlling one's finance and financial goals;

¹⁸Lusardi and Mitchell (2008) found that in the Health and Retirement Study in the United States, of 1264 respondents aged 50 or above, that only 60% of female respondents answered this question correctly. Considering that those respondents were much more highly educated and were likely to have encountered compound interest rates throughout their life, it is expected that their performance on this topic would be better than participants in our study.

	Lursadi 3-part questionaire			Exte			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Compound ^a	Inflation ^b	Risk ^c	Simple ^d	Budget ^e	Loan ^f	Saving ^g
Financial Education Financial Diary	$\begin{array}{c} 0.0546 \\ (0.0938) \\ [0.5605] \\ 0.119 \\ (0.102) \\ [0.2579] \end{array}$	0.161** (0.0803) [0.052] 0.117 (0.0755) [0.1331]	0.297*** (0.0897) [0] 0.292*** (0.0906) [0.0022]	$\begin{array}{c} 0.182^{***} \\ (0.0624) \\ [0.004] \\ 0.190^{***} \\ (0.0629) \\ [0.0032] \end{array}$	$\begin{array}{c} 0.224^{***} \\ (0.0794) \\ [0.009] \\ 0.205^{**} \\ (0.0858) \\ [0.0092] \end{array}$	$\begin{array}{c} 0.0466 \\ (0.0935) \\ [0.6284] \\ 0.0258 \\ (0.0926) \\ [0.7874] \end{array}$	$\begin{array}{c} 0.121 \\ (0.0915) \\ [0.1769] \\ 0.0568 \\ (0.0856) \\ [0.5277] \end{array}$
Control mean	0.823	0.7636	0.865	0.724	0.867	0.332	0.381
Baseline	Yes	Yes	Yes	Yes	Yes	Yes	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2149	2149	2149	2149	2149	2149	2149

Table 2.4: Treatment Effects on Financial Literacy Individual Outcomes

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table shows ITT of a linear probability model. Standard errors are clustered at the village level and reported in parentheses. All models include the lagged outcome at baseline, except for column (7), in which the baseline test is not available. The adjusted RI p-value using Young (2019) is given in brackets. The dependent variables are dummy variables that take the value 1 if the participant correctly answers the questions for each of the topics. More details can be found in appendix 2.E. All models include a set of baseline controls including age, household size, household structure, income and NGO membership.

^a Understanding of compound interest rates.

^b Understanding of inflation.

^c Understanding of risk diversification.

 $^{\rm d}$ Understanding of simple interest rates.

^e Understanding of budgeting.

^f Understanding of income-generated loans.

^g Understanding of savings using formal financial institutions.



Figure 2.3: Observed Financial Self-Efficacy Scale Score, by Treatment groups

namely, sticking to planned spending when unexpected expenses arise, making progress toward personal financial goals and confidence in managing personal finances (items 1, 2, and 5). Meanwhile, participants in the financial diary treatment only exhibit higher self-efficacy than the control group on progressing towards realizing their financial goals (item 2). Being in either one of the interventions lowers participants' self-belief in their capabilities to handle retirement by 0.129 points for the financial education group and 0.119 for the financial diary group. These results may reflect how retirement is generally perceived in Bangladesh. The cultural norm is that elders in Bangladesh generally expect to rely financially on their children. Our interventions may have raised awareness of participants' financial situation and the financial risk that retirement and old age poses. This finding matches our survey responses in Section 2.3.2, below in which our treatment groups reported that they were more focused on saving for retirement following the interventions.

2.3.2 Downstream financial behavior

Columns (4), (5), and (6) in Table 2.3 provide the main results for downstream financial behavior. As discussed in section 3, each index represents positive behavior in the specific financial domain. The financial education treatment improves participants' savings index by 0.149 SD and debt index by 0.138 SD. Noticeably, participants in the financial diary treatment exhibit a similar and sizable improvement in saving (0.171 SD) and debt behavior (0.116 SD). The results suggest that a simplified intervention that targets positive financial behavior reinforcement can be just as effective as teaching that behavior in those two domains.

We do not find any significant effect of either treatment on improving awareness of financial institutions, as measured by exposure to formal financial services. The result is consistent with previous findings on the effect of financial education. For example,

	FSES Individual Item						
	(1) Item 1 ^a	(2) Item 2 ^b	(3)Item 3 ^c	$\begin{array}{c} (4) \\ \text{Item 4} \ ^{\text{d}} \end{array}$	(5)Item 5 ^e	$\begin{array}{c} (6) \\ \text{Item } 6^{\text{f}} \end{array}$	
Financial Education Financial Diary	$\begin{array}{c} 0.131^{***}\\ (0.0462)\\ [0.005]\\ -0.0134\\ (0.0476)\\ [0.780] \end{array}$	$\begin{array}{c} 0.265^{***}\\ (0.0618)\\ [0.001]\\ 0.153^{**}\\ (0.0674)\\ [0.025] \end{array}$	$\begin{array}{c} -0.0309\\ (0.0545)\\ [0.571]\\ -0.0880\\ (0.0559)\\ [0.120] \end{array}$	$\begin{array}{c} 0.0263 \\ (0.0499) \\ [0.590] \\ 0.0503 \\ (0.0526) \\ [0.311] \end{array}$	$\begin{array}{c} 0.118^{*} \\ (0.0618) \\ [0.054] \\ -0.0292 \\ (0.0718) \\ [0.660] \end{array}$	-0.129* (0.0738) [0.085] -0.119* (0.0717) [0.093]	
Observations ¹	1793	1793	1793	1793	1793	1793	

Table 2.5: Treatment Effects on FSES individual items

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table shows the effect of the financial diary and financial education treatments on individual items in the FSES scale. The statement for each survey item is below. A higher score for each item corresponds to higher self-efficacy. Standard errors are clustered at the village level and reported in parentheses. All models include the lagged outcome at baseline and control covariates. Adjusted RI p-value using Young (2019) is given in the brackets.

^a "It is hard to stick to my spending when unexpected expenses arise".

^b "It is challenging to make progress towards my financial goals".

- ^c "When unexpected expenses occur, I usually have to borrow money".
- ^d "When faced with financial challenges, I have a hard time figuring out a solution".
- $^{\rm e}\,$ "I lack confidence in my ability to manage my finances".

^f "I worry about running out of money in retirement".

¹ There is some attrition in the answers for the FSES scale. Since this is a validated scale, we exclude an observation if there is a missing value for any of the item within the scale. Cole, Sampson and Zia (2011) analyze results from a large scale RCT in Indonesia and find that while literacy is positively correlated with higher savings, financial education does not increase demand for bank savings accounts. In our context, the main presence of formal financial institution in Khulna and Satkhira is in the form of commercial banks, in which the majority of the transactions are conducted in person. In addition to financial literacy, women face other constraints restricting their mobility outside the home, which likely impedes their ability to visit a bank, open a bank account or even know where their local bank account is located. Therefore, improvement in financial literacy may not translate to greater awareness of formal financial services until there is a significant improvement on the supply side of formal institutions or the development of digital finance.

We now turn to examine selected individual components within each of the behavioral indices to ascertain the specific positive behaviors that the women have exhibited. Table 2.6 provides the treatment impacts on selected individual components of saving and debt behavior. Our intervention's main impact on the debt index comes from the increase in the usage of a formal channel. Our treatment groups are more likely to apply for a loan via a bank or local microfinance institution - the difference is 0.133 for the training and 0.139 for the diary group. We find no significant effect on the allocation of loan repayments. The result from column (5) of Table 2.6 is suggestive that the intervention may have led our participants, regardless of which treatment, to improve their debt behavior through expanding their formal credit channel. Our analysis is limited to how well the participants have been able to utilize formal credit channels, and a further study is needed to analyze the household's ability to make timely payments for new loan applications. Among the individual outcomes within the savings index, the strongest effect is the increase in the percentage of those who were saving for their retirement. The effects are 0.17-0.18 SD for both treatment groups. The result is particularly encouraging, given that a major financial risk that women incur is financial insecurity in old age (Huston (2010)).

Overall, we find mixed results for the effect of the treatments on downstream behaviour. The findings are mostly consistent with the modest, yet significant, improvement found in financial education interventions (see meta-analyses by Fernandes et al. (2014), and Brown et al. (2016)). As noted in Huston (2010), other influences such as cognitive biases, self-control problems, as well as economic and institutional background can affect financial behaviors and financial wellbeing. Therefore, in order to achieve a more significant effect on downstream behaviour, financial training and/or financial diary treatments could be combined with other types of interventions, such as the graduation program discussed in Banerjee et al. (2015)).

Table 2.0. Theatment Encets on Daving and Debt Denavior - marviatian Outcome	Table 2.6: 7	Treatment	Effects of	on Saving	and Debt	Behavior	- Individual	Outcomes
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	Saving Behaviour			Debt Behavior			
	(1)	(2)	(3)	(4)	(5)	(6)	
	Regular Saver	Deposit	Retirement	Not in debt	Formal lender	Loan repayment	
Financial Education	-0.00283	0.0869	0.177^{**}	0.0434	0.133^{*}	-0.0132	
	(0.0597)	(0.0818)	(0.0816)	(0.0741)	(0.0706)	(0.0749)	
Financial Diary	$\begin{bmatrix} 0.9651 \\ 0.0559 \\ (0.0553) \\ [0.2929] \end{bmatrix}$	[0.2858] 0.0383 (0.0732) [0.5696]	$\begin{bmatrix} 0.035 \\ 0.170^* \\ (0.0874) \\ [0.0512] \end{bmatrix}$	$\begin{bmatrix} 0.5725 \\ -0.0092 \\ (0.0708) \\ [0.8933] \end{bmatrix}$	[0.065] 0.139** (0.0683) [0.0521]	[0.8762] 0.0561 (0.0709) [0.4308]	
Baseline	Yes	Yes	Yes	Yes	Yes	Yes	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	2149	2149	2149	2149	2149	2149	

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table shows ITT of linear probability models. Standard errors are clustered at the village level and reported in parentheses. All models include the lagged outcome at baseline. Adjusted RI p-value using Young (2019). All models include a set of mean-centered baseline covariates, including the participant's age, education, household size, household structure, (active) bank account ownership and MFI membership.

^a Regular saver is a dummy variable that equals 1 if the participant saves regularly.

^b Deposit is a dummy variable that equals 1 if the participant has a positive deposit account.

^c Retirement is a dummy variable that equals 1 if the participant has started saving for old-age.

^d Not in debt is a dummy variable that equals 1 if the participant does not currently owe any significant amount of money.

^e Formal lender indicates the participant's most recent loan is not from a local money lender.

^f Loan repayment represents the total percentage of household savings set aside to pay back the loan.

2.3.3 Financial empowerment - surveys and experimental measures

Survey measures

Columns (7) and (8) of Table 2.3 show the effect of the treatments on whether the participant reports having sole autonomy (HDMI1 in Column (6)) or joint autonomy (HDMI2 in Column (8)). Neither treatment increases the likelihood that the participant is the sole decision-maker. The financial education treatment, but not the financial diary treatment, increases the likelihood that the participant is a joint decision-maker, relative to the control.

Table 2.7 shows the effect of the treatments on whether the participant reported having either sole or joint autonomy to decide on specific household expenditure decisions. Participants in the financial education treatment were statistically more likely than participants in the control to report having some say regarding decisions relating to major expenses, food, children's education and farming. However, the treatment effects for the financial diary were consistently small and insignificant. Taken together, the results suggest that participation in the financial education treatment results in the financial empowerment of women, as reflected by their self-reported responses about joint decision making on household expenditure.

The survey results suggest that access to financial education had a much larger impact on financial empowerment than the financial diary treatment. However, such a strong effect may have been the result of either: (1) a placebo effect from being in actual classroom training; (2) an effect from socializing in a small group with other women; or (3) reflect that self-reported surveys may contain social desirability bias or, in this case, the desire to over-evaluate to compete with other participants in the same class. We address these potential biases by employing preference-elicit artefactual games,

	Panel A - Can solely decide on:					
	(1) Household ^a	$\begin{array}{c} (2) \\ Food^{b} \end{array}$	(3) Children ^c	(4) Farming ^d		
Financial Education	0.0201 (0.0547) [0.7173]	0.0384 (0.0667) [0.5835]	0.150^{*} (0.0838) [0.073]	-0.0696 (0.0040) [0.3600]		
Financial Diary	$\begin{array}{c} -0.0126 \\ -0.0624 \\ [0.8444] \end{array}$	$\begin{array}{c} 0.0335 \\ -0.0742 \\ [0.6406] \end{array}$	0.127 -0.0826 [0.1391]	$\begin{array}{c} -0.1090^{*} \\ (0.0038) \\ [0.0981] \end{array}$		
	Can jointly decide on:					
	(1) Household	(2) Food	(3) Children	(4) Farming		
Financial Education Financial Diary	$\begin{array}{c} 0.1090 \\ (0.0728) \\ [0.1289] \\ 0.0055 \\ (0.0813) \\ [0.9463] \end{array}$	$\begin{array}{c} 0.214^{**} \\ (0.0845) \\ [0.012] \\ 0.0834 \\ (0.0898) \\ [0.3369] \end{array}$	$\begin{array}{c} 0.168^{**} \\ (0.0809) \\ [0.037] \\ 0.0204 \\ (0.0906) \\ [0.8204] \end{array}$	$\begin{array}{c} 0.1093 \\ (0.0889) \\ [0.2138] \\ 0.1391 \\ (0.1037) \\ [0.1610] \end{array}$		
Baseline Controls Observations	Yes Yes 2149	Yes Yes 2149	Yes Yes 2149	Yes Yes 2149		

Table 2.7: Treatment Effects on Female Autonomy in Household Expenditure

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table presents the results from a linear probability model of the estimated impact of the financial interventions on the participant's expense autonomy in her household. Outcomes are dummy variables that take the value one if the participant can solely or jointly decide on certain categories of expenditure in the household. Standard errors are clustered at the village level and reported in parentheses. All models include the lagged outcome at baseline.

- ^a Household is a dummy variable that equals 1 if the participant can solely decide/jointly decide on major household item expenditure.
- ^b Food is a dummy variable that equals 1 if the participant can solely decide/jointly decide on food expenditure.
- ^c Children is a dummy variable that equals 1 if the participant can solely decide/jointly decide on children's education expenditure.
- ^d Farming is a dummy variable that equals 1 if the participant can solely decide/jointly decide on farming expenditure.

focusing on household bargaining power, as an alternative to survey-based measures of empowerment, and compare the differences between them.¹⁹

Experimental measures using incentivized Tasks

As outlined in Section 3, the experiment involved performing two tasks. The first task, which was designed to elicit investment (and level of risk) preferences, focused on individual decision making, while the second task entailed a coordination game between each participant and either her spouse or a random male from the village. The participants were only made aware of the second set of tasks after making their decisions in the first set; hence, latter decisions are not expected to confound the decisions made beforehand. In the second task, the roles of first and second mover were assigned randomly within each pair. In this task, the second mover can exert power by changing the investment decision after their partner's preference is clearly stated. The female participant's decision as the second mover can be used to ascertain whether she overrules (1) her husband or (2) a random male on spending/investment decisions. Panel A of Table 2.8 presents the results when the woman is the second player in the game. In Column (2), we show that women who participated in the financial diary treatment were 15.3% more likely to overrule their partner's decision. We define the compromise level by the absolute difference between the woman's final decision and the initial amount proposed by her partner. As shown in Column (3) of Table 2.8, on average participants in the financial diary treatment chose to deviate from their partner's investment level by 15.62 units, which is almost twice the magnitude of participants in the control group.²⁰ Given that we find that financial education increases joint autonomy based on the survey responses, one might expect a similar

¹⁹Participants in our games are the same as the sample as a whole in terms of baseline characteristics. We do not find any differences between the selected sample for the game and the overall sample in the RCT.

²⁰Conditional on overruling, the net difference between the final amount and the initial amount proposed is 24.71 units.



Figure 2.4: Overruling Decision - Within and Across Household

impact of training on empowerment measured in the game. However, using these incentivized tasks, we find that participants in the financial education treatment do not respond significantly different from those in the control group. We report the results when the man makes the decision in Panel B of Table 2.8. There is no significant difference between the control and each of the two treatment groups, indicating no spill-over effect to male partners within the treated households.

Figure 2.4 shows the extent to which women overruled their male partner within and across households. Overall, 42% of the women in the financial diary treatment overruled their male counterpart's decision, compared to only 23-25% of participants in the financial education treatment and 20% of participants in the control group. Participants in the financial diary treatment exhibited a similar proclivity to overrule, irrespective of whether the partner in the game was their spouse or a random male. However, participants in the financial education treatment were much more likely to overrule if the partner was a random male than their spouse. If we think of overruling in these two contexts as a matter of intra-household decisions and outside work/business decisions, then it appears that the financial diary treatment improves empowerment in both contexts. The effect of financial education is only significant, though, for the non-spousal pairing, indicating that financial education does not improve their intra-household power.

We used a focus group approach at the end of our study to rule out some possible mechanisms as to why the overall effect is smaller for intra-household decisions.²¹ During the focus group, women from the same sessions were asked to discuss the main reasons why they did not choose to overrule. On the basis of their answers, we ruled out the two channels: (1) Women have more trust in their husband's judgment and, thus, are less likely to overrule or (2) women share the same risk preference as their husbands and, thus, do not need to overrule. The remaining plausible explanation is that women tend to overrule less to avoid marital conflict.

When the participant chooses to overrule her partner's decision, she must also decide how much of their joint-endowment to invest in the lottery. We analyze the difference between the revised amount selected by the woman and the initial amount proposed by her partner. The magnitude of the amount was largest for women who participated in the financial diary treatment. As shown in column (3) of Table 2.8, the average net difference for the the control group is 16.07 units. Being in the financial diary treatment increase the net difference by 15.62 units, while the corresponding difference for the financial education treatment is 4.5 units, although the latter is not significant. Finally, we check to see if the woman selects an overrule amount that solely reflects her preferences or selects a number that represents a compromise between her preference and those of her husband. We find no significant difference between the level of compromise between the three RCT arms, both conditional and unconditional on overruling.

We proposed three hypotheses that we tested with the game (see Section 3). All

 $^{^{21}\}mathrm{Results}$ from the focus group are discussed in more detail in Section 5.4 below

	Panel A: Analysis when Player 2 is female					
	(1) Initial Investment ^a	(2) Overrule ^b	(3) Net Overrule Amount ^c			
Financial Education	-1.561 (4.871)	0.0557 (0.0680)	4.447 (3.836)			
Financial Diary	(4.511) -6.193 (4.510)	(0.053^{*}) (0.0788)	(5.62^{**}) (6.495)			
Pairing version ^e	(1.010)	-0.0267 (0.0668)	-6.565 (4 840)			
Initial Preference ^d		(0.000931^{*}) (0.000490)	(1.040) 0.0430 (0.0325)			
Constant	53.31^{***} (8.562)	0.191^{*} (0.107)	16.07^{*} (7.925)			
Observations ^e	547	280	280			
	Panel B: An	alysis when	Player 2 is Male			
	(6) Initial Investment	(7) Overrule	(8) Net Overrule Amount			
Financial Education	-3.122 (9.742)	-0.000922 (0.0842)	-2.495 (14.43)			
Financial Diary	(12.389) (8.379)	0.0615 (0.0797)	1.463 (15.07)			
Pairing version	`	0.128^{**} (0.0622)	-4.049 (11.97)			
Initial Preference Difference		-0.000183 (0.000553)	0.155 (0.111)			
Constant	36.67** (13.37)	0.0768 (0.110)	31.30 (25.43)			
Observations	547	262	262			

Table 2.8: Results from the Artefactual Experiment

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports the treatment effects of the financial education and financial diary treatments on various decisions made by the participants in the artefactual game. Panel A presents the results when the participant is Player 2. Panel B presents the result when the participant is Player 1. In this game, Player 1 proposes an initial investment amount, which Player 2 can overrule and substitute an alternative amount.

^a Initial investment is the investment choice the participant records in Task 1 (individual game).

^b Overrule decision is a dummy variable that equals one if Player 2 decides to overrule the decision made by Player 1.

^c Net overrule amount is defined as the net difference between the initial investment amount proposed by Player 1 and the revised amount substituted by Player 2.

^d Pairing version is a dummy variable equal to one if the players are spouses.

^e The total sample is 547 couples. Columns (1) and (4) report the individual decisions of the female and male participants respectively. There are 5 couples that did not participate in Task 2.

three hypotheses are supported for the financial diary treatment, but not financial education treatment. Specifically, participants in the financial diary treatment are more likely to overrule their male partners than participants in the control (hypothesis 1). Conditional on overruling, participants in the financial diary treatment are more likely to overrule their spouse than a random male (hypothesis 2) and more likely to select their preferred investment than compromising with their partner (hypothesis 3). None of the three hypotheses, however, are supported for the financial education treatment.

Our results for the effectiveness of the two treatments in increasing female empowerment differ between the experiment and survey measures. The lack of correlation between the two measures is consistent with other findings in the literature. Almås, Armand, Attanasio and Carneiro (2018) also use an incentivized task to elicit the level of female empowerment and, similarly, find little correlation between their experimental and individual survey measures. Our results show that financial education may have improved participants' sense of joint autonomy reflected in survey responses, these responses may be affected by social desirability bias. The financial diary treatment affects actual behavior in exerting more authority in investment decisions.

2.4 Channels, heterogeneity and insights from focus groups

2.4.1 Intermediate outcomes

There are several channels through which our interventions could lead to better financial outcomes. While it is not possible to examine all possible channels, and we do not have the data to do so, we consider three possible mediators; namely, numeracy, time preference and risk preference. People with better numeracy skills tend to have better financial literacy levels and exhibit better financial behavior (Lusardi (2012)). Several studies have suggested that having poor financial capabilities is correlated with risk-loving tendencies and higher levels of impatience (Meier and Sprenger (2013), De Meza, Irlenbusch and Reyniers (2008)). Lack of willingness to take risks may restrict financial choices and negatively affect individual financial wellbeing Aren and Zengin (2016).

Following Baron and Kenny (1986) and MacKinnon et al. (2007), the conditions to establish a plausible mechanism through the mediators are: (1) the treatment is significantly correlated with the mediator; (2) the mediator is significantly correlated with the outcome variable; and (3) when regressing the outcome variable on both the treatment indicators and the mediated variable, the treatment effect becomes smaller in size.²² If both conditions are satisfied, at least a partial mediation relationship is established. Table 2.9 presents the results for the two stages of the mediation analysis.

Panel A documents how the two treatments affect the three possible mediators. Overall, only financial education improves the arithmetic ability of the participants, while the financial diary treatment was associated with increased willingness to take risk. Both treatments improved the patience level of participants by a similar magnitude. Columns (4), (5), (6) of Panel B show the effect of each channel on the financial outcome of interest. The results suggest that numeracy mediates the positive relationship between financial education and each of financial literacy (financial test scores and FSES), savings behavior, formal institutions and self-reported joint autonomy over expenditure decisions (HDMI2). Time preferences mediate the relationship between both treatments and each of financial test scores, savings behavior, debt behavior and

 $^{^{22}}$ The first stage of a mediation analysis is to determine the relationship between the treatments and outcome variable. This is discussed in Table 2.3. There may still exist a mediated relationship between the treatment and the main outcome even when there is no significant treatment effect, see Shrout and Bolger (2002).

HDMI1.²³

2.4.2 Heterogeneity in treatment effects

We examine the difference in treatment effects among subgroups with different characteristics to identify the subgroups who benefit more from our interventions. Tables 2.B.1 and 2.B.2 in Appendix 2.B compare the impact of the interventions based on the education and age of the participants. We classify an individual as highly-educated if she has completed secondary school (Panel B1) and define the older cohort as those whose age is above the median. Overall, the only notable difference is that in the treatments, higher educated participants tend to under-perform in financial self-efficacy, which reflects that they had higher FSES pre-intervention.²⁴ As shown in Table 2.B.2, the effect of the financial interventions on behavior appears to be independent of age, except that the older cohort tends to improve more in terms the three basic concepts of financial knowledge (inflation, compounding rate, and risk diversification).

Table 2.B.3 provides evidence that among participants in the financial diary treatment, program beneficiaries who did not have an active bank account at baseline were more likely to improve their savings behavior. One possible explanation is that non-banked households often have more limited capacity to manage their day-to-day personal finance circumstances, and that women from these households might benefit more from an informal book-keeping method such as maintaining a financial diary. Similarly, as shown in Table 2.B.4, women who did not have any savings at baseline tend to benefit more from a financial education program.²⁵ Overall, we find that replications target-

 $^{^{23}}$ It should be noted that the coefficient of 0.321 on risk preference in Column (3) is only weakly significant (p-value approaching 10%). Similarly, the relationship between time preference and financial test score are also weakly significant.

 $^{^{24}}$ At baseline, participants who had completed at least secondary education scored approximately 10% higher in FSES, however, the difference is not significant.

²⁵Among participants in the financial diary treatment, approximately 11% kept some form of income and expenditure records on their own. This group tends to perform better in the saving index than those who had no experience with keeping a financial diary prior to the treatment.

	Panel A: The treatment effects on mediators					
	(1)	(2)	(3)			
	Numeracy Score ^a	Time Preference ^b	Risk Preference ^c			
Financial Education	0.146*	0.376**	0.257			
	(0.0796)	(0.149)	(0.196)			
Financial Diary	0.0870	0.321**	0.361^{*}			
	(0.0791)	(0.154)	(0.196)			
Observations	2149	2146	2141			
	Panel B: Mediator	rs effects on financia	al outcomes			
	(4)	(5)	(6)			
	Numeracy Score	Time Preference	Risk Preference			
Financial Test - Full	0.581^{***}	-0.0337*	0.0294**			
	(0.0463)	(0.0133)	(0.0114)			
Saving Behaviour	0.191^{***}	0.0405^{***}	0.0241**			
	(0.0517)	(0.0144)	(0.0107)			
Debt Behaviour	-0.0493	0.00900	-0.00751			
	(0.0418)	(0.0134)	(0.00987)			
Financial Institution	0.209^{***}	-0.00467	-0.0253**			
	(0.0548)	(0.0127)	(0.0127)			
HDMI2	0.255^{***}	0.0135	-0.0316**			
	(0.0636)	(0.0145)	(0.0129)			
FSES	0.209^{***}	-0.00587	-0.00122			
	(0.0452)	(0.0138)	(0.0103)			
Baseline	Yes	Yes	Yes			
Controls	Yes	Yes	Yes			
Observations	2149	2149	2149			

Table 2.9: Potential Mediators

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports the sub-group analysis based on the participants' demographic characteristic at the time of baseline. Panel A presents the impacts of the financial education and financial diary treatments on each of the three mediated outcomes. Panels B present the impacts of each of the potential channels on the final outcomes of interest.

^a "Numeracy Score" is the standardized financial literacy index constructed from performance on the numeracy quiz.

^b "Time Preference" denotes the participant's patience level, measured by the total number of times that the participant chose to receive 1000 taka plus interest at a later point over taking 1000 taka now.

^c "Risk preference" indicates willingness to take risk, measured by the total number of times that the participant selected a risky investment over the risk-free option in seven hypothetical scenarios.

ing the poorest individuals with weak financial market opportunities or educational background may help to improve the program impact and lower mistargeting risks.

2.4.3 Findings from financial diary data

Methods

We seek to predict household subsequent financial behavior based on their income and expenditure pattern as revealed in the financial diaries entries, together with their characteristics at baseline.

In the financial diary treatment, participants track their spending by recording itemized entries for each purchase. To facilitate the process, we group the spending data into seven distinct budgetary categories: food, education, health, clothing/entertainment, housing, children and household care.

After the data cleaning and processing, in step 3 we trained models using a variety of algorithms and hyperparameter settings to find the best option for our purposes. The model training itself progresses in an iterative loop, cycling through hyper-parameter tuning, model training and testing. We considered the following methods: linear regression, gradient boosting machines, random forests and support vector regressors. After scoring the models on the full data, we conduct the analysis on a case study basis, in order to determine whether additional rounds of processing and training are needed, and the cycle begins anew.

In order to train a model that is applicable to different target groups, we separated the data into three groups:

• Training Set (60 percent of sample): Used to fit the models in order to determine the form of the relationship between income and the feature set.



Figure 2.5: Financial Diary development process flow

- Validation Set (20 percent of sample): Used in parallel with the training set, to tune the hyperparameters and guard against overfitting.
- Testing Set (20 percent of sample): Used to assess the predictive power of the final model on observations not used for training.

Results

In total, we restrict the prediction exercise to 694 households in the financial diary treatment who maintained a daily financial diary that is free from reporting errors. Approximately 60 percent of this group had at least one outstanding loan at the beginning of the treatment. The average outstanding loan amount was 21000 taka (\$250) in the first week of the treatment, and the amount reduced to 12273 taka at the end of the treatment.

	Debt, Savings, Income, and Expenditure						
	(1) Outstanding loan	(2) Active Savings	(3) Income	(4) Expenditure	(5) Difference		
Week	-486.4*** (29.11)	25.80 (18.54)	-71.97** (32.74)	-119.4^{***} (30.61)	46.40^{***} (13.02)		
Constant	$23884.4^{***} (1369.5)$	8353.1^{***} (1483.1)	5964.0^{***} (977.2)	6744.9^{***} (897.7)	-786.2^{***} (281.9)		
Observations	6314	7370	17358	17358	17358		

 Table 2.10: Household Expenditure and Consumption - Financial Diary

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports the weekly change in household expenditure/consumption over the 28-week period, using random a forest model to cluster the standard errors. All expenses are reported in taka. Outstanding loan is defined as the the total amount of money currently owed.

Active savings is defined as the total weekly amount of money set held in a deposit account, held as emergency savings or savings held in cash at home.

Income is defined as total income divided by the number of working adults in the household.

Expenditure is defined as total expenditure per capita.

The negative shock to household income mostly stems from the decrease in small business owner income - approximately 30% of the sample has a microfinance business set up. We do not have a record of household business performance, relative to income and expenditure, to draw a definitive conclusion as to the connection between maintaining a financial diary and the decrease in business profit. The income volatility likely reflects agricultural business cycles and crop risk in Bangladesh.²⁶

The degree to which household decreases their expenses varies significantly across categories of expenditure. As reported in Table 2.11, every week households in the financial diary treatment reduced their food and entertainment expenditure by average 19.28 taka and 13.87 taka respectively. On the other hand, there is no significant change over the time in rigid expenses such as education, health, and household bills. This suggests the possibility that households decrease their major, yet flexible, expenses such as food and entertainment in order to repay the outstanding loan amount, as seen in Table 2.10.

Table 2.11: Household Expenditure and Consumption - Financial Diary

	Weekly Expenditure:						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Food	Education	Health	Entertainment	Bills	Children	Personal care
Week	-19.28^{***}	0.180	-1.741	-13.87^{***}	-6.127	-4.969^{***}	-6.263^{***}
	(1.659)	(0.252)	(1.176)	(1.359)	(4.023)	(0.783)	(0.917)
Observations	18030	18030	18030	18030	18030	18030	18030

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports the weekly change in household expenditure/consumption over the 28-week period, using a random forest model to cluster the standard errors.

All expenses are reported in taka.

2.4.4 Insights from the field: Understanding the participants' perspectives

We interviewed participants to better understand how they felt about the intervention and what could be done to improve future interventions. The session was conducted

²⁶Bangladesh has three main harvest seasons: The aus season rice crop is planted during March-April and harvested during June-July. The aman season rice is planted in June-July and harvested during November-December. The boro season rice is planted in December-January and harvested during May-June.

as a focus group at the end of the intervention.²⁷ Figure 2.B.1 suggests that onethird of participants strongly agreed that the program was beneficial. Participants believed that maintaining a diary assisted them to keep track of their debt and their spending, improve saving and reduce unnecessary expenses. The most challenging factor in maintaining the diary was the time that it entailed, with just under 40% of participants reporting that it was time consuming to keep track of the diary. This suggests the need to reduce the opportunity cost of filling in the diary if the program is to be replicated.²⁸ Finally, more than half of the participants reported that they intended to maintain a diary after the program finished with 15% of participants strongly agreeing that they intended to use a diary in the long-term. We cannot rule out survey desirability or experimental demand biases here; however, these evaluations are promising. Moreover, about one third of participants in the financial education treatment strongly agreed that the training classes helped them manage their debt and improve savings. More than one-third (35%) of the participants indicated that they would participate in more classes if the opportunity arises (see Figure 2.B.2).

2.5 Conclusions

Financial interventions to improve financial literacy are at the forefront of policy dialogue in many countries around the world. The strong association between having a low level of financial literacy and poor financial wellbeing and behavior is welldocumented in the literature (van Rooij, Lusardi and Alessie (2012), Carpena et al. (2015)). In the context of populations in developing countries, it has been argued that the standard approach of financial literacy education is both too complex and rigid to be effective in assisting less educated individuals to make better financial decisions.

²⁷About half of the participants accepted invitations to take part in the focus group.

 $^{^{28} \}rm One$ possible suggestion is to make the diary available digitally. However, this creates a barrier for people without a smart phone.

It can also be relatively expensive. The challenges suggest that the effectiveness of financial interventions crucially depends on the form in which the training is provided.

We contribute to the literature on which form of financial intervention - simplified or traditional- is most appropriate, and cost-effective, in improving financial outcomes, especially for less-educated low-income populations. Overall, we find that maintaining a financial diary can just be as effective as financial training in improving financial test scores, downstream behavior and female empowerment. The results presented in our study complement recent evidence on the impact of financial training interventions, which often present mixed results. We find that both treatment arms in our intervention improve financial test scores by a large margin. We elicit the bargaining power of women using a sequential investment game, in which women are given the opportunity to overrule their partners' decision. We find that while financial education may improve participants' self-reported joint autonomy over expenditure decisions, only participants in the financial diary treatment change their behavior in an incentivized setting.

While maintaining a financial diary may have the same effect as a formal training class in some respects, we believe that these approaches are complementary and may simultaneously address the overlapping set of constraints that women may face in the financial market. Maintaining a financial diary could possibly be bundled, at relatively low cost with existing financial education programs. However, the comparison between traditional and alternative financial interventions raises the important issue of cost-benefit considerations, which to date have rarely been undertaken in the field. Given the budget limitations of conducting field experiments, the findings of this study have the potential to assist educators and policymakers in designing appropriate and effective programs to improve the level of financial literacy among women in developing countries.

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2.A Timeline

ACTIVITY	START	END
Preparation	Apr-18	
Final Version of the curriculum	Apr-18	
Materials for diary + counselling	Apr-18	
Materials for trainers	Apr-18	
Translation	Apr-18	May-18
Pilot	May-18	May-18
Revise	Jul-18	Aug-18
Project Start	Jan-00	
Information Session	Jan-00	
Pre-treatment test	Aug-18	Jun-18
Household Survey	Aug-18	Sep-18
Randomization	Sep-18	Sep-18
Financial Training Sessions	Oct-18	Sep-18
Financial Diary - Initial Visit	Oct-18	
Financial Diary	Oct-18	Mar-19
Second randomization	Apr-19	
Financial Counselling - First visit	May-19	
Financial counselling	Jun-19	Nov-19
Post-treatment	Nov-19	
Games (Artifactual)	Dec-19	Feb-20
Wrap up	Feb-20	
2.B Appendix Tables and Figures

	Coefficients ^a					
	(1)	(2)	(3)	(4)	(5)	
	Education	\mathbf{FE}	FD	FE*Education	FD*Education	
Financial Test - Full	0.397***	0.321***	0.312***	-0.0233	-0.0790	
	(0.0934)	(0.0984)	(0.106)	(0.133)	(0.129)	
Financial Test - Lursadi Questionaire	0.459^{***}	0.281^{***}	0.328^{***}	-0.0854	-0.112	
	(0.0870)	(0.0962)	(0.105)	(0.148)	(0.123)	
Saving Behaviour	0.0532	0.131	0.145^{*}	0.0812	0.0216	
	(0.0874)	(0.0875)	(0.0869)	(0.112)	(0.118)	
Debt Behaviour	0.0961	0.150^{**}	0.156^{***}	-0.130	-0.197	
	(0.100)	(0.0719)	(0.0556)	(0.147)	(0.126)	
Financial Institution	0.432^{***}	0.00508	-0.0594	0.0261	-0.142	
	(0.0882)	(0.0850)	(0.0923)	(0.131)	(0.173)	
Sole Decision on Household Spending	0.172	0.0287	0.0139	-0.0752	0.0151	
	(0.144)	(0.0564)	(0.0532)	(0.181)	(0.185)	
Joint Decision on Household Spending	0.0625	0.190^{**}	0.0957	0.103	0.0761	
	(0.0937)	(0.0959)	(0.107)	(0.124)	(0.153)	
FSES	0.242^{***}	0.204^{***}	-0.0139	-0.0211	-0.317**	
	(0.0833)	(0.0772)	(0.0794)	(0.137)	(0.140)	
Observations	2031	2031	2031	2031	2031	

Table 2.B.1: Sub-group Analysis - Education

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports the sub-group analysis based on the participant's cohort education. Column (1) presents the coefficient of the education group, Columns (2) and (3) present the estimated treatment coefficients FE (Financial Education) and FD (Financial Diary), and Columns (4) and (5) provide the interaction effects.

^a Education is a dummy variable that equals one if the participant finished secondary school. This is only the median value of education in our sample.

^b Outcome variables are all indices discussed in Section 4 and Appendix 2.E.

	Coefficients ^a					
	(1)	(2)	(3)	(4)	(5)	
	Age	FE	FD	FE*Age	FD*Age	
Financial Test - Full $^{\rm b}$	-0.0986	0.320^{***}	0.259^{**}	0.0310 (0.113)	0.0864	
Financial Test - Lursadi Questionaire	-0.263^{***}	(0.105) 0.185^{*}	(0.112) 0.199^{*}	(0.110) 0.221^{*}	(0.105) 0.246^{**}	
Saving behaviour	(0.0842)	(0.109)	(0.114)	(0.117)	(0.112)	
	0.175^{**}	0.152	0.183^{**}	0.00329	-0.0790	
Debt Behaviour	(0.0774)	(0.0953)	(0.0888)	(0.108)	(0.112)	
	0.0177	0.170^{**}	0.149^{**}	-0.108	-0.0714	
Financial Institution	(0.0664)	(0.0759)	(0.0714)	(0.0906)	(0.0994)	
	0.213^{***}	0.0429	-0.0300	- 0.0272	-0.134	
HDMI1	(0.0753)	(0.0966)	(0.0916)	(0.108)	(0.116)	
	-0.0207	0.0269	- 0.0629	-0.0194	0.182	
HDMI2	(0.0769)	(0.0778)	(0.0645)	(0.111)	(0.119)	
	0 108	0 202*	0.0687	0.0374	0 0937	
ECEC	(0.0763)	(0.106) 0.252***	(0.118)	(0.116)	(0.117)	
F SES	(0.0355) (0.0754)	(0.255) (0.0921)	(0.0948)	(0.107)	(0.10830)	
Observations	2031	2031	2031	2031	2031	

Table 2.B.2: Sub-group Analysis -Age

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports the sub-group analysis based on the participant's cohort age group. Column (1) presents the coefficient of the age group, Columns (2) and (3) present the estimated treatment coefficients FE (Financial Education) and FD (Financial Diary), and Columns (4) and (5) provide the interaction effect.

^a Age group is defined as those who were 26 or above at the time of baseline. The median age at baseline is 26.

 $^{\rm b}$ Outcomes variables are all indices discussed in Section 4 and Appendix 2.E.

	Coefficients ^a				
	(1)	(2)	(3)	(4)	(5)
	Bank	FE	FD	FE*Bank	FD*Bank
Financial Test - Full	0.307^{***}	0.331^{***}	0.00882	0.113	-0.159
	(0.0960)	(0.102)	(0.113)	(0.140)	(0.159)
Financial Test - Lursadi Questionaire	0.252^{**}	0.338^{***} (0.108)	0.0353 (0.0935)	0.116 (0.136)	-0.155 (0.143)
Saving behaviour	(0.152^{*}) (0.0800)	(0.191^{**}) (0.0829)	(0.416^{***})	-0.100 (0.140)	-0.278^{*}
Debt Behaviour	(0.0000)	(0.0025)	(0.100)	(0.140)	(0.142)
	0.146^{**}	0.103^{*}	0.0601	-0.111	(0.0510)
	(0.0687)	(0.0562)	(0.104)	(0.121)	(0.126)
Financial Institution	(0.0087) -0.0168 (0.0847)	(0.0302) -0.145 (0.0026)	(0.104) 0.441^{***}	(0.131) 0.0924 (0.141)	(0.130) 0.158 (0.124)
Sole Decision on Household Spending	(0.0847)	(0.0920)	(0.0988)	(0.141)	(0.134)
	0.0273	0.0179	0.0373	-0.0468	-0.0157
	(0.0624)	(0.0610)	(0.126)	(0.151)	(0.161)
Joint Decision on Household Spending	(0.0034)	(0.0019)	(0.120)	(0.131)	(0.101)
	0.206^{**}	0.101	-0.120	0.0771	0.0651
	(0.0025)	(0.110)	(0.102)	(0.120)	(0.120)
FSES	(0.0955)	(0.110)	(0.102)	(0.139)	(0.139)
	0.269^{***}	-0.0290	0.255^{**}	-0.317^{**}	-0.260
	(0.0759)	(0.0713)	(0.103)	(0.144)	(0.187)
Observations	2031	2031	2031	2031	2031

Table 2.B.3: Sub-group Analysis - Active Bank Account Owner

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports the sub-group analysis based on the participant cohort's bank account ownership. Column (1) presents the coefficient of the Age group, Column (2) and (3) present the estimated treatment coefficients FE (Financial Education) and FD (Financial Diary), and Column (4) and (5) provide the interaction effects.

^a Bank is a dummy variable equals 1 if the participant had an active bank account at baseline.

 $^{\rm b}$ Outcomes variables are all indices discussed in Section 4 and Appendix 2.E.

	Coefficients ^a						
	$\begin{array}{c} (1) \\ D2 \end{array}$	(2) FE	(3) FD	$\begin{array}{c} (4) \\ FE^*D2 \end{array}$	$\begin{array}{c} (5) \\ FD^*D2 \end{array}$		
Financial Test - Full	0.344***	0.318***	0.0399	-0.0296	-0.0585		
	(0.0906)	(0.0986)	(0.0746)	(0.111)	(0.111)		
Financial Test - Lursadi Questionaire	0.309***	0.300***	0.0338	-0.0677	0.0123		
	(0.107)	(0.111)	(0.0751)	(0.122)	(0.124)		
Saving behaviour	0.243^{***}	0.246^{***}	0.398^{***}	-0.270**	-0.261**		
	(0.0793)	(0.0837)	(0.0982)	(0.121)	(0.123)		
Debt Behaviour	0.138^{*}	0.0888	0.0797	-0.0454	0.0754		
	(0.0730)	(0.0671)	(0.0637)	(0.100)	(0.107)		
Financial Institution	0.0571	-0.143	0.233^{***}	-0.0996	0.141		
	(0.0925)	(0.102)	(0.0859)	(0.116)	(0.120)		
Sole Decision on Household Spending	0.0779	-0.0185	0.0991	-0.148	0.0900		
	(0.0727)	(0.0521)	(0.0848)	(0.117)	(0.115)		
Joint Decision on Household Spending	0.202^{**}	0.128	0.0467	0.0263	-0.0484		
	(0.102)	(0.120)	(0.0893)	(0.123)	(0.122)		
FSES	0.266^{***}	-0.0808	0.0249	-0.129	0.0148		
	(0.0944)	(0.0804)	(0.0628)	(0.110)	(0.127)		
Observations	2031	2031	2031	2031	2031		

Table 2.B.4: Sub-group Analysis - Personal Saving

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports the sub-group analysis based on the participant cohort age group. Column (1) presents the coefficient of the saving, Column (2) and (3) present the estimated treatment coefficients FE (Financial Education) and FD (Financial Diary), and Column (4) and (5) provide the interaction effect.

^a D2 is a dummy variable equals 1 if the participant had saved some money for herself at baseline.

^b Outcomes variables are all indices discussed in Section 4 and Appendix 2.E.



Figure 2.B.1: Participants Evaluation of the Financial Diary Treatment

Figure 2.B.2: Participants Evaluation of the Financial Education Treatment

2.C Power Calculations

The following are the power calculations for the main effects we are interested in assessing. The estimated standard deviations come from the original pilot conducted in two villages, which are not part of our sample, in June 2018. Our assumptions are:

- Assume a minimum detectable effect size of 0.2 standard deviations when standardizing the mean values of the main outcome variables of interest.
- Assume a take-up rate for the invitation to attend financial training of 90%. Our pilot yields a take-up rate of 100% out of 30 invitations; however, this percentage is unrealistic for a larger project scale. Therefore, we choose our take-up rate assumption based on Gibson, McKenzie, and Zia (2014) and Doi, McKenzie, and Zia (2012) who run financial literacy training workshops for migrants.

We assume completion-rates for the financial training treament to be 80% and financial diary treatment to be 60%. Specifically, we expected 80% of participants to do all the financial training and complete all baseline and post-treatment surveys and 60% of those invited to be in the financial diary treatment to record entries for six months. The assumption is also based on 90% completion rate for the control group. With a sample size 350 for each group, the detectable effect is:

- Effect 1: The impact of the financial education workshop (b1), Power = 0.96
- Effect 2: The impact of financial diary (b2), Power = 0.92

However, take-up rates can be much lower during implementation of all three treatments. Since, we anticipate a high attrition rate among the treatment groups based on other field experiments in Khulna and similar field experiments for financial literacy training in other developing countries, we modify the design of this experiment as:

- Group A: only financial diary 50 villages (with approximately 700-800 individuals).
- Group B: only financial training 50 villages. (with approximately 700-800 individuals)

2.D Financial Education Curriculum

The detailed programs covered the six modules as following:

- Modules 1: Planning and budgeting
 - Session 1- Establishing financial goals
 - Session 2- Understanding income and expenses
 - Session 3- Preparing a budget
- Modules 2: Savings:
 - Session 5- Elements of choosing where to save
 - Session 6- Informal saving services
 - Session 7- Formal saving services
- Modules 3: Borrowing
 - Session 8- Purposes of borrowing
 - Session 9- Borrowing concepts
- Modules 4: Responsible borrowing
 - Session 8- The cost of borrowing
 - Session 9- Borrowing concepts revised
 - Session 10- Good and Bad loans
- Modules 5: Comparing financial services
 - Session 11- Informal financial services
 - Session 12- Formal financial services
 - Session 13- How lenders evaluate your loans

- Module 6: Emergencies and other financial crisis
 - Session 14 Debt liability
 - Session 15 Violation to your right on money
 - Session 16 Violation to your property rights
- Final session Review

Collateral & Default
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Figure 2.D.1: Example of the Slide used in the Financial Training Class

2.E Variables Description

Table 2.E.1: Summary of variable definition

	Variables	Description
Main Index		
	Financial Test - Full	Index constructed from 7 questions financial test. Higher value means better outcome.
	Financial Test - Standard	Index constructed from the three standard financial knowledge test. Higher value means better outcome.
	FSES	Financial Self-Efficacy Score. Higher value means better outcome.
	Saving	Index constructed from saving behaviour related questions. Higher value means better outcome.
	Debt	Index constructed from debt behaviour related questions. Higher value means better outcome.
	Institution	Index constructed from questions related to formal banking institution. Higher value means better outcome.
	HDMI1	Index constructed based on woman being the sole decision maker.
	HDMI2	Index constructed based on woman being the sole or joint decision maker.
Individual Outcome		
Financial Test	Compound	Dummy variable equals one if the participant answer question L1 (compound interest rate) correctly.
	Inflation	Dummy variable equals one if the participant answer question L2 (inflation) correctly.
	Risk	Dummy variable equals one if the participant answer question L3 (risk diversification) correctly.
	Interest	Dummy variable equals one if the participant answer question L4 (simple interest rate) correctly.
	Budget	Dummy variable equals one if the participant answer question L5 (budgeting method) correctly.
	Loan	Dummy variable equals one if the participant answer question L6 (effective loan) correctly.
	Saving	Dummy variable equals one if the participant answer question L7 (safe saving method) correctly.
Financial Self-Efficacy Scale	FSES - Item 1	Response (4-point Likert Scale) to "It is hard to stick to my spending when unexpected expenses arise"
	FSES - Item 2	Response (4-point Likert Scale) to"It is challenging to make progress towards my financial goals"
	FSES - Item 3	Response (4-point Likert Scale) to "When unexpected expenses occur, I usually have to borrow money"
	FSES - Item 4	Response (4-point Likert Scale) to "When faced with financial challenges, I have a hard time figuring out a solution"
	FSES - Item 5	Response (4-point Likert Scale) to "I lack confidence in my ability to manage my finances"
	FSES - Item 6	Response (4-point Likert Scale) to "I worry about running out of money in retirement"
Saving Index	Regular Saver	Regular saver is a dummy variable equals 1 if the participant save regularly.
	Deposit	
	Retirement	
Debt Index	In debt	
	Formal	
	Repayment	
HDMI	Household	Dummy variable equals 1 if the participant can solely decide/jointly decide on major household item expenditure.
	Food	Dummy variable equals 1 if the participant can solely decide/jointly decide on food expenditure.
	Children	Dummy variable equals 1 if the participant can solely decide/jointly decide on children education expenditure.
	Farming	Dummy variable equals 1 if the participant can solely decide/jointly decide on farming expenditure.
Experimental outcome		
	Overrule	Dummy variable that equals one if Player 2 decides to overrule the decision made by Player 1.
	Net overrule amount	Net difference between the final amount by and the initial proposed amount.

Chapter 3

Myopia and Investment Decisions: From the Laboratory to the Field

3.1 Introduction

The remarkable acceleration in market news and stock-market trading has raised an important economic question: Does more frequent information result in more efficient asset allocation and investment strategy? Pioneered by Benartzi and Thaler (1995) in an attempt to explain the equity premium puzzle, myopic loss aversion (MLA) is a behavioral trait that combines loss aversion and myopia in mental accounting.¹ An agent who suffers from MLA is more aware of losses than gains and suffers from narrow temporal framing, inducing a negative response to frequent information in price movements of the risky asset. Due to the high volatility nature of the equity market, feedback intensity plays a key role in determining investors' preferences over assets under the MLA theory.

Yet, determining the effect of feedback frequency in markets remains challenging. On the one hand, existing evidence on MLA and its role in investment strategy rely almost exclusively on laboratory evidence that may not adequately represent real-life investment-decision processes. Alternatively, parsing market data to isolate mediators and moderators consonant with MLA represents a difficult empirical challenge. The main purpose of this paper is to combine laboratory and unique field data to explore if data from each setting are consonant with predictions from MLA theory.

In a creative set of studies, Thaler, Tversky, Kahneman and Schwartz (1997) and Gneezy and Potters (1997) demonstrate the effect of MLA using experimental laboratory settings in which participants were asked to make investment decisions involving risky assets under different levels of feedback frequencies.² In accordance with MLA

¹The "equity premium puzzle" refers to the empirical observation that the return on stocks is much larger than the risk-adjusted bond yield. Loss aversion refers to the tendency to emphasize losses over gains of equal size. Conversely, myopia in mental accounting refers to the tendency for individuals to disproportionately focus on the near term when making decisions involving a temporal component.

²In Thaler et al. (1997), laboratory investment returns were provided to mimic either a monthly, a yearly, or five-yearly horizon. In Gneezy and Potters (1997), subjects either made a decision and received feedback every round or in every block of three rounds.

theory and observations about the equity premium puzzle, both papers found that participants in the low-frequency condition tended to invest more in risky assets. Evaluating stocks or other risky assets daily raises the likelihood of assets yielding lower (or even negative) returns than safer options, such as bonds and saving accounts. This finding has been advanced to several modified experimental settings, such as using an asset market (Gneezy, Kapteyn and Potters (2003)), a setting with flexibility in investment horizon (Fellner and Sutter (2009)), and settings with professional traders in a framed (Haigh and List (2005) and a natural field experiment (Larson, List and Metcalfe (2016)).

In this study, we take a different approach. We combine two quite different sources of data: controlled data from a framed field experiment and naturally-occurring data from private investment accounts. In this spirit, we not only are able to examine the power of MLA across controlled and naturally-occurring settings, but we can also explore the external validity of the original MLA lab insights. We do so by recruiting a sample of traders across eight brokerages in the Dhaka Stock Exchange (DSE) in Bangladesh to participate in a framed field experiment measuring their individual MLA. Most importantly, we link their laboratory choices with their actual trading activities over a two-year period to examine the comparability between investment decisions in a controlled laboratory setting and their actual trading decisions on the Dhaka stock market.

In our data generation, we leverage the standard lab treatment Gneezy and Potters (1997), but use a within-subject design to estimate person-specific MLA from the framed field experiment. In Task 1, subjects were randomly assigned into either the high feedback frequency where they made the decision and learned about the outcome every individual round or the low feedback frequency in which decisions (and feedback) were made in blocks of three rounds. In Task 2, we switched treatment and repeated the experiment under the other feedback frequency. Our within-subject de-

sign not only permits us to examine data from a standard between-subjects approach, but also provides a unique MLA measure for each individual. In this manner, our approach also allows us to explore the effect of learning (sequencing) and other individual characteristics can mitigate the degree of MLA.

We report several findings. First, behavior in the lab is largely consonant with MLA theory, as we find a significant treatment effect under the standard between-subject design.³ Specifically, subjects invested 18.6% more when receiving a lower feedback frequency. This higher investment profile maps into higher experimental earnings, showing that information provision can have real financial implications.

Second, turning to the correlation between experimental MLA and real-life trading patterns of the same traders, the results using the daily transaction and portfolio data of each trader identify several interesting patterns. For example, traders who exhibit a high degree of MLA tend also to hold a smaller portfolio size (as measured by both volume and value). This result is consistent with the notion that MLA is correlated with portfolio holdings. An interesting second result is that MLA is also correlated with trade frequency: those with higher MLA trade more frequently. Finally, while our participants as a whole demonstrated a strong disposition effect (sell the "winner" and hold onto the "loser"), those who exhibited MLA in the lab had a lower degree of the disposition effect.

Our third result is methodological in nature. We find that when using a within-subject design, measured MLA is considerable lower. More specifically, when we exposed each subject to both treatments, thus allowing learning and carry-over effects, the average difference fell to 5.86%. We also analyzed the within-subject distribution and found that 51.03% of our subjects exhibited MLA. Yet, the order of the treatment in the within-subject design matters. Only 42.77% exhibited MLA in the group with

³We first examine the prevalence of MLA among these traders using the standard between-subject design to avoid the potential confound in our within-subject design.

infrequent feedback first, compared to 58.24% for the other group. However, the order difference does not change our final conclusion on the existence of MLA. Although our design does not allow us to pinpoint why this effect occurs, the overall set of results is consistent with learning opportunities, sequencing effects, and experience of trading.

We view our results as speaking to several literatures. First, we contribute to bridging the gap between experimental and natural trading behavior by examining the decisions made by the same group of non-professional traders in two quite distinct environments. Financial traders are a vital component of financial decision-making and price-setting processes. Thus, observing their behavior under both experimental and natural domains serves several purposes. For instance, our study provides evidence for the results of Gneezy and Potters (1997) not only via replication among professional traders, as in Haigh and List (2005), but also with non-professional traders. In addition, we provide insights into the behavior of traders in an emerging market context - an area that remains underexplored in the literature. In this manner, our results confirm the findings of several studies that generate empirical evidence from the developed world (see Barber and Odean (2013), Barber and Odean (2000), Barber and Odean (2001), Grinblatt and Keloharju (2000), Grinblatt, Keloharju and Linnainmaa (2011)). Our analysis also contributes to a growing area of research exploring the link between the experimental lab and the field - we show that MLA in the lab partially extends to the field and remains a viable explanation for the equity premium puzzle.

A second literature our work relates to is the growing research agenda documenting the financial decisions of stock-market traders using both experimental and naturally occurring data (see, e.g., Alevy, Haigh and List (2007). Using professional traders from the Chicago Board of Trade as a treatment group, Haigh and List (2005) explored the boundary conditions of Gneezy and Potters (1997). Somewhat unexpectedly, the professional traders in their study exhibited a higher degree of MLA than university students. In a more recent paper Larson et al. (2016) extends the literature by using different timing in price realizations in a natural field experiment. Their setting was designed to mimic the complexity of trading platforms and market interactions. The paper confirms that MLA exists even in a natural setting.

Finally, our study also contributes to the understanding of MLA by reporting evidence that mental accounting dynamics play a role in reducing or exacerbating the degree of risk-taking (see Fellner and Sutter (2009), Evers and Imas (2019), Imas (2016), Langer and Weber (2005)). In general, repeating the same decision over multiple periods of high feedback frequency exacerbated participants' willingness to invest in the risky lottery. However, exposing subjects to both low and high feedback frequencies reduced individual MLA. Overall, this pattern is consistent with limited feedback and increased market experience causing traders to avoid narrow framing and behave less myopically. If the key mediator works in that fashion, our findings imply that stock-market traders may benefit from alternating between periods of high and low information feedback frequencies. More research is necessary, of course.

A key fruit of the longitudinal aspect of our design is that it provides the distribution of individual MLAs. The lack of a within-subject design in the literature hinders our understanding of heterogeneity and the mechanisms of experimental treatment (Charness, Gneezy and Kuhn (2012) and Czibor, Jimenez-Gomez and List (2019)). Our design allows us to examine whether, and the extent to which, MLA exists at the individual level among a group of traders. The evaluations of traders' behaviors under different feedback frequencies may benefit the targeted communication strategies of fund managers and also improve long-term investments in the stock market. For example, a risky trust fund could strategically issue financial statements less frequently to improve the sheer volume of investment and avoid market volatility.

The remainder of our paper proceeds as follows. Section 2 outlines the experimental design and sample selection. Section 3 summarizes the experimental results and the results of the randomization check. Section 4 describes the financial transactions and

portfolio data set and outlines the empirical results. Section 5 concludes.

3.2 Experimental Design and Conceptual Framework

In the spirit of Fehr and List (2004), we embedded our experiment within a financial training program for non-professional traders in the DSE. We recruited 341 traders from eight brokerage firms in Dhaka and offered them participation in a free intensive training program on trading techniques and risk diversification.⁴ Before any of the professional training began, we conducted incentivized games to study the traders' behavioral biases regarding time preferences, risk aversion, ambiguity avoidance, and MLA. We focus on MLA in this paper.

In brief, the MLA experiment proceeded as follows. First, subjects read and signed a consent form. Second, subjects were informed that (i) the experiment consisted of four segments that would last 2 hours each, (ii) their payments in each game depended on their performance, and (iii) all payments were blind and anonymous. At the beginning of each game, subjects received detailed written instructions; all instructions were also read aloud by the field staff. The subjects were given a few additional minutes to examine the instructions and (privately) ask questions, if any. The demographic and trading information survey was conducted on the next day.

For each part of the experiment, the participants were informed of the payment procedure ex ante. The experimental instructions for each task were generally not handed out until the previous task had been completed. Our research assistants were in-

⁴The training involved six sessions over a three-week period, and all the training and materials were free of charge. Each training session was conducted by senior professional traders in the brokerages—all the trainers were Chartered Financial Analysts at the time of training. The curriculum covered basic terminologies in the stock market, how to manage portfolio risk to maximize sound money-management principles and risk-analysis techniques, and how to utilize trading tools and market information available in the market. Traders who enrolled in this program consented to giving us their actual trading data via their brokerage.

structed to use neutral terms for all instructions. A translated sample of the instructions for all the games can be found in Appendix B (the version used in our experiment is written and announced in Bengali). The next sections discuss the details of our experimental design.

3.2.1 Experimental design

Treatments

We adopted a similar treatment design to that of Gneezy and Potters (1997) and Haigh and List (2005). Specifically, we randomly assigned participants to two treatment groups: frequent treatment, F, and infrequent treatment, I. Under Treatment F, the participants made a series of investment decisions over nine periods. In each period, the participants were given an endowment of 100 units (1 unit = 100 takas) that could be invested totally or partially (the possible investment amount [X] ranged from 0 to 100 units inclusive) in a lottery L(1/3, 2.5X; 2/3, -X). Thus, the participants had a one-third chance of winning 2.5 times the amount invested and a two-thirds chance of losing the amount. Under this treatment, the participants placed an investment in every single round and learned about the outcome of each round directly after they recorded an investment and before they made their next investment.

The lottery and investment decisions under Treatment I were similar; however, the allocation decisions were made in blocks of three rounds. Specifically, in each decision round t in 1, 4, 7, the participants placed their investments for rounds t, t + 1 and t + 2. The investment allocation had to be identical across the blocks of three rounds. At the ends of rounds 3, 6, and 9, the participants were informed of their combined earnings for the three blocks. In both treatments, the participants were informed that their final payments would equal the sum of all earnings of each round. Essentially, the two group decision tasks were identical in all aspects except in the frequency of

feedback (see the upper part in Figure 3.2.1).

Experimental setting

Before the session, the enumerator randomly allocated the participants into two groups: approximately half the participants (182 participants) were allocated to Group F-I, and the remaining traders (159 participants) were allocated to Group I-F. As illustrated in the lower panel of Figure 1, the two groups were exposed to both frequent and infrequent feedback but in the opposite order. The following two-task procedure was adopted:

- In Task 1, each group invested under their initial randomly assigned treatment, that is, participants in Group F-I received frequent feedback and participants in Group I-F made decisions under infrequent feedback.⁵
- In Task 2, we swapped the treatments between two groups. Participants in Group F-I were reassigned to the infrequent feedback treatment, while participants in Group I-F invested under frequent feedback.⁶

We essentially have the full sample of 341 observations in a within-design experiment with order effects controlled for and two between-subject comparisons. First, denote investment amount under frequent feedback as F1 (Task 1) and (F2) in Task 2; similarly, the infrequent feedback level of investments is referred to as I1 (Task 1) and I2 (Task 2). For simplicity, we refer to infrequent feedback as the "control" setting. The treatment effect of high-frequency feedback was obtained by comparing the means of the two groups.

⁵We also allowed a difference in endowment by asking subjects to play an additional three rounds. They received no additional starting amount; they played the game with their own earnings up to that point equally divided into three. 3.A presents the results of the varied endowment setting.

⁶Subjects also invested in three additional rounds, as in Task 1. Panel B of Appendix Table 3.A.3 presents the results of the varied endowment setting.

| Decision |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Outcome |

Treatment F

Treatment I

Figure 3.2.1: Illustration of treatment and task design

Notes: In Treatment F, participants record their decision at the beginning of each round, then receive the feedback at the end of the same round. In Treatment I, partipants make the decision in block of three round, and receive the cumulative feedback at the end of every third round. Group FI was exposed to Treatment F in Task 1, then invests under Treatment I in Task 2. Group I-F follows the opposite direction of treatment allocations. In Task 1, the control group was Group I-F, so the average treatment effect of high feedback frequency would be F1 I1. If the difference in the amount of money invested in F and I in Task 1 is significantly negative, then there is evidence of MLA. Notably, this analysis is identical to Gneezy and Potters (1997).

The second set of between-subject comparisons is the reversal of the control-treatment group in Task 2. In this task, the control group is now group F-I, whose average investment amount is I_2 . Hence, the treatment effect of frequent feedback is now $(F_2 - I_2)$ if the assumption of independence between the two tasks holds (a very strong assumption). The variation between these two between-subject comparisons, if any, is likely due to learning or experimental carry-over effects.

Combining Tasks 1 and 2, we analyze myopia and investment decisions under the scope of a within-subject design - the within-difference is now $F_1 - I_2$ and $F_2 - I_1$. This also captures real stock-market trading conditions, which involve non-professionals alternating between periods of high and low feedback frequency.

3.2.2 Conceptual framework

MLA with no prior experience

We first rely on Benartzi and Thaler (1995) for MLA in a static setting. Consider an individual who has the following value function:

$$\begin{cases} u(z) = -\lambda z^{\alpha} & \text{for } z < 0\\ u(z) = z^{\beta} & \text{for } z \ge 0 \end{cases}$$
(3.1)

in which the parameter λ reflects his loss aversion ($\lambda > 1$ for risk-averse agent) and z represents the change in wealth. Tversky and Kahneman (1992) referred to α and β ($0 < \alpha, \beta < 1$) as the diminishing sensitivity. When α is small, the agent is more

risk-averse in the gain domain and risk-seeking in the loss domain and the opposite relationship applies for β . For the linear case $\alpha = \beta = 1$, the benchmark case of 'pure loss aversion' is included into the analysis.

Let S_n denote the value of the aggregate distribution of n independent draws of the gamble L(-x, 2/3; 2.5x, 1/3), with a linear case $\alpha = \beta = 1$ an individual who faces gamble S_1 and S_3 will obtain:

$$S_1 = -\frac{2}{3}\lambda x + \frac{2.5x}{3} \tag{3.2}$$

$$S_3 = \frac{1}{27}7.5x + \frac{6}{27}4x + \frac{12}{27}0.5x - \frac{8}{27}\lambda 3x \tag{3.3}$$

While S_1 is negative for any $\lambda \geq 1.25$, S_3 remains positive as long as $\lambda \leq 1.5625$. In other words, a loss averse individual perceives three gambles more positively if they evaluate such gambles in a form of a single unit bundle. The average traders who fail to properly evaluate a sequence of investment should always find lotteries with frequent feedback less attractive (see Figure 3.A.1).

MLA with prior experience

For some trader types, current investment decisions are not only based on expected outcomes (i.e., forward-looking evaluations) but also on the negative or positive reference points generated in previous games (i.e., backward-looking evaluations).

To analyze the effects of a previous gain or loss on a risk-taking decision, we modified the value function to examine the effect of a previous experience on a subsequent decision. Supposedly, rather than using the status quo (zero) as a reference, agents maximize the total utility of a course of action and compare the expected value of future decision(s) with previous lottery outcome(s) as a reference. For example, it might be the case that for some myopic types, investors who had just won in the previous round should find the risky asset less desirable, as the reference has now shifted from zero to positive. In non-myopic backward evaluations, over time, the difference between single and bundle evaluations was expected to diminish.

$$\begin{cases} u(z) = -\lambda z^{\alpha} & \text{for } z < r \\ u(z) = z^{\beta} & \text{for } z \ge r \end{cases}$$
(3.4)

Depending on the choice of reference point r, we can have investors who base the reference point on their accumulated winning in the past by evaluating

$$\begin{cases} u(z) = -\lambda z^{\alpha} & \text{for } z < \sum_{1}^{t-1} L\\ u(z) = z^{\beta} & \text{for } z \ge \sum_{1}^{t-1} L \end{cases}$$
(3.5)

or myopically evaluate

$$\begin{cases} u(z) = -\lambda z^{\alpha} & \text{for } z < L_{t-1} \\ u(z) = z^{\beta} & \text{for } z \ge L_{t-1} \end{cases}$$
(3.6)

Combining (5) and (6) leads us to three predictions: (1) forward-looking myopia decreases investment under high-frequency feedback; (2) myopic traders deviate from their ex ante investment plans to take on more risk after a short-term loss; and (3) risk-taking is greater for myopic traders with higher backward-looking myopia.

These predictions can be tested using our design summarized above. Prediction (1) can be tested using the average treatment effect in a standard between-subject design, as in Gneezy and Potters (1997). Predictions (2) and (3) can be analyzed by a dynamic setting using the same design. In particular, we test the following:

- Hypothesis 1: Higher feedback frequency leads to a lower investment in risky assets
- Hypothesis 2: The reference point, defined as recent gain or loss, affects the

degree of myopia

• Hypothesis 3: The reference point, defined as cumulative gain or loss, affects the degree of myopia?

3.3 Experimental Results

3.3.1 Balance and participant characteristics

Between-subject designs rely on the success of the random assignment of the treatment. Table 3.3.1 provides the balance check for the randomization. The two groups were homogeneous across several behavioral preferences and demographic characteristics. Most participants were male and held at least a bachelor's degree (61% held a master's degree). The average age of the participants was 37 years, and their average monthly earnings was 780 USD. These levels of education and income reflect the general distribution of the average non-professional traders in Dhaka. The participants had approximately five years of trading experience, and nearly 40% worked in the business sector.

3.3.2 Between-subject results

Task 1

We first examine the prevalence of myopia in a standard setting (as in Gneezy and Potters (1997) and Haigh and List (2005)) by comparing the difference in average endowment allocations made by the two groups in Task 1. We compare the unconditional mean difference between the investment levels under high-frequency feedback (F_1) and those under low-frequency information (I_1) . Table 3.3.2 shows the raw data

	Panel A - Group F-I				Panel B - Group I-F				Difference ^c
	Mean	SD.	Min	Max	Mean	SD	Min	Max	
Age (years)	37.46	9.30	22	65	37.46	9.02	24	72	0
Trading starting year	2011.15	3.43	1989	2016	2011.378	3.60	1994	2016	-0.268
Endowment ('000 taka)	777.23	184.52	5	2000	704	143.5	5	1100	73.23
Having a Master degree	0.61	0.49	0	1	0.66	0.48	0	1	-0.05
Male	0.95	0.21	0	1	0.96	0.21	0	1	0.01
Married	0.72	0.45	0	1	0.74	0.44	0	1	-0.02
Main job in business sector	0.40	0.49	0	1	0.38	0.49	0	1	-0.02
Monthly income ('000 taka)	56.35	62.09	6	600	60.30	64.19	0	540	-3.95
Observations		177	b			156	Ь		

Table 3.3.1: Demographics information and behaviour preference across two treatment groups

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports descriptive statistics for the traders in our sample at the time of survey. Panel A provides information on group F-I (initially assigned to Frequent) and Panel B provides the figures for group I-F (initially assigned to Infrequent). The last column represents the difference between these two groups - none of the difference is statistically significant using t-test.

^a Explanation for the games design and index construction can be found in Section 3.A.

^b 8 traders (5 in group FI and 3 in group IF) did not fill in the demographics questionnaire.

^c Last column reports difference between two groups. All the differences are not different at 10% level of significance.

of the mean differences and standard deviations of the investment allocations of the two treatment groups.

First, we consider the average investments across all rounds. We observe that traders in control group I bet 69.92 units, while those in treatment F only bet 58.95. To attenuate data dependencies, we also divide the rounds into blocks of three and analyze the differences between the two treatments in each block, as shown in the last three rows of the upper panel of Table 3.3.2. In every block (blocks 1–2-3, 4–5-6 and 7–8-9), the average allocation into the risky lottery is higher in Treatment I. Using Mann-Whitney non-parametric tests, we find that the average investment across the blocks is statistically different (ρ -value=0.1248 for block 1-3, 0.0012 for block 4-6, 0 for block 7-9 and the block of all rounds).

To explore the robustness of our findings, we use a simple Tobit model to control for the panel structure of our data (Specification 1) and a random-effects Tobit model (Specification 2) to regress individual investments on the dummy variable of treatment allocation. The dummy variable takes a value of 1 when an agent is assigned to

	Panel A - Ave	erage investme	Panel B - Treatment Effect			
	(1) Treatment F	(2) Treatment I	(3) Total	(4) Difference	(5) Z-statistics	
All Rounds	58.95 (25.56)	69.70 (26.05)		10.75	4.101***	
Rounds 1-3	63.00 (27.70)	67.62 (28.50)	65.16 (28.12)	4.62	1.535 **	
Rounds 4-6	59.00 (31.38)	69.12 (30.28)	63.72 (31.24)	10.12	3.250***	
Rounds 7-9	54.84 (33.83)	73.02 (29.70)	63.31 (33.20)	18.18	5.078***	
Observations	182	159	341			

Table 3.3.2: Raw data summary and Mann-Whitney test for treatment effect - Task 1

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports the raw data summary (mean and standard deviation) and Mann-Whitney test for differences in investment level in Task 1.

Panel A presents the average investment level in the first row and standard deviation in parentheses. Average investment is the mean of investment across all 9 rounds of investment. Panel B reports the average difference treatment effect $(\bar{I}_1 - \bar{F}_1)$ and Mann-Whitney z-stats for the difference between two Tasks.

The first row presents data across all rounds. We also report average amount in block 1-3, 4-6, and 7-9 in the next three rounds. Data is drawn exclusive from Task 1.

^a All investment levels are in unit of experiment. One unit of experiment equals 100 taka.

Treatment F.

Table 3.3.3 shows the results for both models in relation to the data from Task 1. The coefficients are significant at 1%, and their signs support our findings from the raw data analysis. We find that participants in Treatment F bet 16.9 fewer units per round than those in Treatment I. In Specification 2, we use a random-effects Tobit model with the inclusion of the time effect and find that participants bet nearly 20 units less when they receive more frequent feedback. Both results are consistent with MLA among average traders. ⁷

	Dependent variable: Investment amount					
	(1) Simple Tobit ^b	(2) Random-effect Tobit ^b				
Treatment F ^a	-16.33^{***} (1.98)	-19.41^{***} (5.94)				
Constant	84.1^{***} (1.73)	89.42*** (5.12)				
Subject Random Effects Time Effects	No No	Yes Yes				
Observations	3087	3087				

Table 3.3.3: Panel regression result (Task 1) - MLA

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports the panel regression result of investment level on the dummy variable of treatment allocation. Dependent variable is the amount of investment in each decision round.

^a Treatment F indicates the participant received Frequent feedback.

^b The Tobit regressions are censored at 0. Bootstrap Standard errors in parentheses.

The results from Task 1 are consonant with the idea that MLA is prevalent amongst our traders; however, reference points generated by previous experiences may affect the degree of MLA. Over the course of the decision rounds, participants repeated their allocation decisions under the same feedback conditions, so in each subsequent round,

⁷Our results do not change after controlling for several demographic characteristics, such as (log of) income, (years of) education, and age.

participants could reflect on their previous investment outcomes. In this case, previous experience may generate reference points from previous losses or gains. In contrast to the findings of Gneezy and Potters (1997), we find that investment under frequent feedback decreased over the course of the experiment. That is, in the same highfrequency treatment, our data suggest that as experienced is gained, less is invested in the risky asset. The decreasing monotonic trends in investment under frequent treatment over the course of the experiment support the results of both Haigh and List (2005) and Larson et al. (2016) and, to a certain extent, suggest that the participants' investment levels in each round were not independent.

One possible explanation for this result is that subjects were making backward-looking evaluations to mentally account for their risky decisions. The lottery was designed so that participants in Treatment F would be more likely to experience losses than gains on average (these participants experienced six losses and three gains, while those in the infrequent treatment group received one loss and two gains). If participants revised their strategies to take less risk after a recent loss to avoid disappointment, we would see a lower investment level under frequent feedback, but that does not necessarily reflect the participants' narrow framing behaviors.⁸

We also regress the investment amount in each round on the outcome from the previous round(s) to see if the treatment effect is generated by disappointment or myopia. Table 3.3.4 shows the estimation of the effects of wins/losses in the previous round(s) on participants' investment decisions in Treatment F. The regressions include a set of dummy variables as controls; the first dummy takes a value of 1 if the participant won the most recent round, and the second dummy means the cumulative earning of all previous rounds were positive. The first column uses only data from the first task, while the second column presents the pooled data in both tasks. Under both

⁸Previous research has suggested that the form of learning has an effect on behavior, such that participants repeat behaviors that they have previously associated with gains and avoid behaviors that have previously coincided with losses.

samples, a gain in the previous round decreased participants' average bets in the lottery by approximately ten units in Treatment F. The effect of cumulative gains is smaller. These results suggest that participants did not decrease their investment due to disappointment.

	Dependent variable: Investment amo			
	(1)	(2)		
Winning in previous rounds (cumulative)	-8.406***	-6.662***		
	(3.054)	(2.003)		
Winning in the most recent round	-10.89***	-9.470***		
	(2.002)	(1.352)		
Round	-1.212***	-0.760**		
	(0.457)	(0.295)		
Group FI ^c		7.681**		
-		(3.089)		
Constant	69.40***	58.52***		
	(2.952)	(4.693)		
Observations	1456	2728		

Table 3.3.4: Panel regression result (Task 1) - Effect of previous result investment level

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports the panel regression result of previous outcome on current investment level. Dependent variable is the amount of investment in each decision round. For column (1), the data only includes observations in Task 1. For column (2), the data includes pooled observations in both tasks. We exclude Round 1 out of the analysis since there is no previous outcome at round 1.

^a The dummy variable indicates the cumulative number of wins exceed the number of losses in preceding rounds , as shown to the participant before each decision round.

^b For treatment F, it is the single winning result at round t-1.

^c Group FI is a dummy variable equals one if the trader invested under Frequent Feedback first.

Task 2

In Task 2, we seek to explore a different aspect of the trading experience by swapping the feedback frequencies between the two groups. Specifically, the 182 participants

	Panel A-	Investment under	Panel B - Task 1 versus Task 2				
	(1)	(2)	(3)	(4) ^c	$(5)^{d}$	(6) ^e	
	Frequent (\bar{F}_2)	Infrequent (\bar{I}_2)	z-statistics ^b	$(\bar{F}_2 - \bar{F}_1)$	$(\bar{I}_2 - \bar{I}_1)$	(Task 2- Task 1)	
All Rounds	65.84	69.70	3.86	6.89^{***}	-0.22	-7.11 ***	
	(29.04)	(26.01)					
Round 1-3	68.69	66.40	-2.29	5.69**	-1.22	-6.91***	
	(29.33)	(29.33)					
Round 4-6	64.58	68.67	4.09	5.58^{***}	-0.45	-6.03***	
	(33.42)	(31.83)					
Round 7-9	64.25	74.03	9.78^{**}	9.41***	1.01	-8.4 **	
	(33.04)	(33.24)					
Observations	182	159	341				
N / * /01	** .005 ***	. 0. 01					

Table 3.3.5: Average Treatment Effect - Comparison between Task 1 and Task 2

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports the treatment effect in Task 2 and the difference in investment level under these two tasks. Panel A presents the raw data summary (mean and standard deviation) of investment levels under Frequent and Infrequent Feedback. Panel B shows the difference between Task 1 and Task 2 using Mann-Whitney test.

^a All the average investment levels are measured using unit of experiment. Each unit of experiment equals 100 taka. Average investment amount is in the first row, the standard deviation in parentheses beneath

^b Column (3) reports Mann-Whitney z-statistics for the difference between Frequent and Infrequent treatment in Task 2.
 ^c Column (4) presents the difference between average investment level under Frequent Feedback in Task 1 and Task 2

 $(\bar{F}_2 - \bar{F}_1)$. ^d Column (5) presents the difference between average investment level under Infrequent Feedback in Task 1 and Task 2 $(\bar{I}_2 - \bar{I}_1)$.

^e Column (6) presents the difference between average treatment effects under two task $((\bar{F}_2 - \bar{I}_2) - (\bar{F}_1 - \bar{I}_1))$.

who had previously been assigned to Treatment F (i.e., the high-frequency investment condition) in Task 1 were now reassigned to Treatment I. Similarly, the 159 participants who were initially under Treatment I was assigned to Treatment F. The participants were informed of the new feedback frequency at the start of Task 2. Table 3.3.5 compares the results from both between-subject designs, in which panel A shows the raw data and the Mann-Whitney rank-sum tests for the investment amounts in Task 2. We compare the investment decisions in Tasks 1 and 2 in panel B. As shown in panel A, in Task 2, the mean difference in investment amount across all rounds is only 3.86, as compared to the 10.97-unit between-treatment difference in Task 1 (see Table 2 and column (6), Table 5). Thus, participants' degrees of MLA appear to be reduced by either learning, carry-over effects, or other psychological factors, as outlined in Charness et al. (2012).⁹

 $^{^{9}}$ Overall, as documented in column (6), panel B, the average treatment effect decreases when we compare across each block of three rounds.

We also attempt to account for the initial endowment difference using a separate new task: at the ends of Tasks 1 and 2, we asked each group to repeat the game under the same frequency treatment. However, this part differed in two respects: (1) The investment only lasted for three rounds and (2) we gave no initial endowment, so each subject had to play with their earnings earnings up to that point. As we can see from Appendix Table 3.A.3, MLA still holds even with differences in the starting endowment of each trader.¹⁰

Finally, to further explore the robustness of our findings in Task 2, we use a simple Tobit model (Specification 1) and a random-effects Tobit model (Specification 2) to regress individual investments on the dummy variable of treatment allocation. The dummy variable takes a value of 1 when an agent is assigned to Treatment F. We control for the payment in Task 1 by including the total amount of payment each traders receive as a covariate.

3.3.3 Within-subject Results

Within-subject distribution

While within-designs have certain weaknesses, a strength is that data generated from them can go beyond marginal distributions to produce the full joint distribution under certain assumptions (see Czibor et al., 2019). This is because the combination of Tasks 1 and 2 generate data whereby all participants were exposed to both frequency environments. We can therefore tabulate the difference in investment allocation for each individual.

¹⁰Task 1, when traders had no prior experience of the other treatment (the treatment to which they were not initially assigned), had a 10% level of significance. These results support the existing literature on the prevalence of myopia, even when we relax the assumption of fixed initial endowment. When we switch the treatment, the raw data show that MLA still exists even with a different endowment, but such a difference is not significant if we consider it under a non-parametric test. This further enforces our hypothesis that giving the subjects experience with both evaluation frequencies reduces myopia.

Figure 3.3.1: Distributions of Within-subject treatment effect

Figure 3.3.1 shows a histogram of the linear difference between the percentage of units allocated in high- and low-feedback treatments. A negative value indicates that the respondent made decisions consistent with MLA theory. While the average treatment effects show a great difference between the two treatments, this distribution shows that many subjects did not invest less under high-frequency feedback. Interestingly, the data reveal that the average MLA treatment effect is economically and statistically significant but is driven by a relatively small number of traders who show strong MLA patterns.

We classify MLA traders as those who invest more under infrequent feedback. Table 3.3.6 provides the distribution of traders who invest less, the same, or more under frequent feedback. Overall, 51.03% of the participants exhibited MLA, investing an average of 25.45 experimental units (33.8%) less under high feedback frequency. Of the traders who did not exhibit MLA, 58 behaved exactly the same under both feedback frequencies, and those who invest more under infrequent feedback account for 31.96% of the data.

Order effects

In a within-subject design, subjects may behave differently in the treatment they play second because of their exposure to the first treatment. If participants had been exposed to infrequent evaluations in Task 1, they might have effectively learned how to evaluate the lottery sequence in a more aggregated manner, even if they received the high-frequency feedback in Task 2. Conversely, if participants evaluated gains and losses based on their historical returns, I-F participants would have bet significantly more under the frequent feedback condition in Task 2 than Group F-I bet in Task 1. Thus, Tasks 1 and 2 may not be truly counterfactual.

The raw data analysis in panel B of Table 3.3.5 confirms that the order of treatment matters for the between-subject analysis, but only for the decisions made under Treatment F. As shown in column (4), under Treatment F, participants allocated 6.89 units more in Task 2 than the average amount in Task 1. However, investment levels under infrequent feedback did not differ between the two tasks, as detailed in column 5 in panel B of Table 3.3.5.

In the within-subject analysis, we investigate the differences in the distribution of MLA and non-MLA traders across frequency orders. As shown in column (3) in panel (B) and column (5) in panel (C) of Table 3.3.6, the percentage of subjects who exhibited MLA was higher if they were assigned to Treatment F in Task 1. The percentage of MLA traders is smaller for Group I-F (those who were exposed to infrequent feedback first)—only 42.77% exhibited MLA, as compared to 58.24% in Group F-I. In Figure 3.3.1, we observe that the two groups have different distributions ¹¹ but not markedly. These results from both between- and within-subject analysis suggest that while the order matters, it does not change our inference: the average treatment effect remains significant, and approximately half the subjects exhibited MLA. However, the strong

 $^{^{11}\}mathrm{The}$ distribution is significantly different at 5% using Kolmogrov-Smirnov test for equality of distribution

average treatment effect is still mainly driven by the traders at the left tail of the distribution.

	Panel A- Pooled data		Panel B- Only F-I		Panel C - only I-F	
	(1) Distribution	(2) Difference	(3) Distribution	(4) Difference	(5) Distribution	(6) Difference
MLA Traders	$174 \\ 51.03\%$	-25.45 (-33.89%)	$106 \\ 58.24\%$	-25.78 (-33.91%)	68 42.77%	-24.93 (-33.87%)
Neutral Traders	58 17.01%	0	$27 \\ 14.84\%$	0	$31 \\ 19.50\%$	0
Myopic Seeking Traders	$109 \\ 31.96\%$	16.71 (31.86%)	$49 \\ 26.92\%$	15.83 (32.41%)	$60 \\ 37.74\%$	17.43 (31.46%)
Observations	341		182		159	

Table 3.3.6: Within-subject distribution

Notes:

This table provides information on the within-subject distribution of participants who invest more, the same, or less in Frequent Feedback as compared to Infrequent Feedback.

Panel (A), (B), and (C) uses data from all participants (pooled), group F-I (play Frequent game first), group I-F (play Infrequent game first), respectively.

In each panel, the first column shows the numbers of observations in the first rows and the percentage in the second row. The second column gives the difference between investment under Frequent Feedback and Infrequent Feedback.

Who are the MLA traders?

A significant share of traders did not reduce their investment levels in response to high-frequency feedback in the market. However, more than half the traders did behave myopically. It is of interest to both policymakers and stock brokerages to identify the relevant sub-groups that are MLA types. Of course, there are both observed and unobserved correlates for such behavior. As reported in Table 3.3.7, the most important predictors of MLA are age, the initial level of capital endowment, and trading behavior. On average, older traders and those with greater capital endowments were 12–15% more likely to exhibit MLA. Those who traded for short-term opportunities were also more likely to exhibit MLA; however, this was not significant.¹² The correlation is the opposite sign for those who update market news more frequently—they were 11.7% less likely to exhibit MLA.¹³ In terms of other correlates, we find that

¹²The average treatment effect, however, is significantly correlated to short-term trading.

¹³The within-subject analysis allows us to categorize traders into three categories of myopia (Table 3.3.6). Considering only MLA and non-MLA may not fully reflect the heterogeneity in treatment effect of feedback frequency. We re-examine the heterogeneity among the three levels of within-subject
observable characteristics, such as gender, education, total income, and income from one's main occupation, are not significantly or consistently correlated to myopia.

Table 3.3.7: Sub-group analysis: Correlation between MLA and individual characteristics

	Dependent Variable: MLA								
	$(1)^{a}$	$(2)^{a}$	(3) ^b	$(4)^{\rm b}$					
Older than median age	0.119^{**} (0.0542)								
Initial level of capital above median level		0.150^{***} (0.0539)							
Trading on short term opportunity			0.0471 (0.0706)						
Check market news at least every week				-0.117^{*} (0.0657)					
Group FI ^c	-0.147^{***} (0.0542)	-0.143^{***} (0.0540)	-0.157^{***} (0.0539)	-0.155^{***} (0.0536)					
Constant	$\begin{array}{c} 0.665^{***} \\ (0.0874) \end{array}$	0.644^{***} (0.0881)	0.731^{***} (0.0838)	0.831^{***} (0.0965)					
Observations	333	333	341	341					

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table provides linear probability regression of MLA on several observable or self-reported characteristics. Each panel controls for the order of the game an individual plays.

^b Panel (3) and (4) show the correlation between MLA and self-reported trading behaviour. Trading behaviour survey was conducted on the training date, before the first training session.

 $^{\rm c}\,$ Group FI is the dummy variable equals one if the trader plays the game under Frequent Feedback First.

We are also interested in the extent to which individual characteristics correlate with

MLA. Figure 3.3.2 shows the average treatment effects by sub-group characteristics.¹⁴

^a Panel (1) and (2) report the correlation between MLA and age of the respondent, and capital endowment. Age is defined as those who were above 35 (the median age of the sample) at the time of the survey. The initial level of the capital endowment is the dummy variable that takes value one if the respondent has a capital level above the median value (100000 takas). There were eight traders did not report this information.

myopia, as shown in Figure 3.A.2 in Appendix 3.A. There are no significant difference between the demographic information of myopic neutral and and myopic risk seeking trader.

¹⁴The treatment effect here is referred to the difference between investment levels of an individual under frequent and infrequent feedback.



Figure 3.3.2: Average Treatment Effect by different demographics and trading characteristics

Overall, a higher degree of MLA is correlated with several observable characteristics, such as age and initial endowment. The top left in Figure 3.3.2 shows that the older age group¹⁵ and those with higher capital endowments had twice the average treatment effect. Those who often engaged in short-term or day-trading activities in real life were also more affected by MLA. Notably, a negative correlation existed between the self-reported frequency of checking market news and MLA. While our setting does not allow for a causal interpretation, one possible explanation is that those who suffer more from MLA were aware of the effect of high-frequency news on their trading behavior and reduced their tendency to update market news too frequently in real life.¹⁶

¹⁵Older age group is defined as those who were above the median age (35).

¹⁶The traders also participated in a risk-preference elicitation in a similar setting to Holt and Laury (2002). We find no apparent correlation between risk behavior and MLA; those results are available upon request.

3.4 Naturally-occurring trading data of participants

3.4.1 Data description

In this section, we explore the confidential individual-level investment data from our experimental participants in the DSE.¹⁷ We collected a unique, account-level dataset of all the participants consisting of official hard-copy transaction statements recording all transactions from January 2015 through April 2017. We focus on their trading of common stocks and mutual funds from October 2015 to September 2016.¹⁸ For our complete analysis, we merge four datasets: individual transaction ledger data, individual portfolio holdings data, DSE market data, and the experimental/survey data.

Transaction ledger data

The transaction ledger contains information on each transaction recorded daily for each trader at their respective brokerage firm. This dataset reflects the trading activity, including purchases, sales, IPO applications and allocations, and transaction and other administrative costs associated with the account and each activity. Some traders had more than one transaction on the same stock on the same day. To mitigate the effect of day trading and its noise, we netted all same-day trades of the same stock by the same investor and averaged their buying or selling prices.¹⁹

¹⁷Founded in 1954, the DSE is the largest and the main stock exchange in Bangladesh. As of 2018, the combined market capitalization of listed companies on the DSE stood at over \$47 billion. The DSE is open for trading Sunday through Thursday between 10:30 am and 2:30 pm BST, except for holidays declared by the Exchange in advance. In the month of Ramadan, the Exchange is open for trading between 10:00 am and 2:00 pm BST.

¹⁸Our participants also received trading training intervention as part of the RCT. The first session started from 2 September 2016, after this framed-field experiment was conducted.

¹⁹For example, if an investor buys 1,000 of stock A at 20 takas, sells 700 of the same stock later that day at 22 takas, and buys 100 more of stock A at the end of the day at 21 takas, our data would record all three transactions as a net buy of 400 stocks at a price of 20.091.

Portfolio holding data

The brokerages provided us with the portfolio holdings of the traders from 30 October 2015 to 31 July 2016. Based on these data, we constructed and cross-verified the traders' daily portfolio holdings over this period excluding non-trading days (i.e., weekends and public holidays).²⁰

Market data

Our market dataset comprises the day-end statistics of all the common stocks listed on the DSE from 1990 to 2017. We exclude stocks not actively traded at any given time from 2015 to 2017 or any companies lacking information on daily stock returns, trading turnover, market capitalization, or the fraction of shares held by institutional investors. We also exclude those who were inactive during that period as a sample restriction.

Table 3.4.1 summarizes all the data gathered for the daily transactions of the traders. Our data not only includes our experimental participants but also individuals chosen at random from the list of traders in these brokerage houses. The final sample comprised traders with a diverse range of individual characteristics, so most trading measurements varied considerably among the traders.

Panels A and B report the trading characteristics at the individual stock level and the overall portfolio diversification statuses of the traders. The traders tended to trade at a loss; that is, the average cost (450,000 takas) exceeded the average market value (360,000 takas). The average beta for a single stock was 1.18 (compared to a beta of 1 for the DSE).²¹ However, the average weighted beta of the portfolio was 0.43, indicating

 $^{^{20}}$ Our constructed portfolio holdings on 31 July 2016 are exact duplicates of the official version from the brokerages, confirming the reliability of the data.

²¹Our beta is measured by regressing stock-price variation on the market index variation of the day. A beta larger than 1 implies that the stock risk is higher than the systematic market risk.

that traders diversified by placing insignificant weights on risky assets. Panel C shows the purchase and sale frequencies aggregated daily and measured in number, volume, and value. On average, our traders made a total of approximately 19,000 sales and 22,000 transactions (each transaction had a volume of 1,260 shares for sales and 1,235 shares for purchases) from September 2015 to August 2016.

3.4.2 Experimental measures and actual trading

Theoretical and experimental evidence has shown that MLA lowers investor willingness to participate in the stock market. True to the equity premium puzzle, if MLA in the laboratory correlates with real-life trading, a reduced-form set of results is that MLA types should hold smaller portfolios in both size and volume, have lower portfolio betas, and react more strongly to short-term movements in the market.

Stock market exposure and MLA

In order to establish the link between the lab and field, we utilize the results from the within-subject analysis and correlate them with the natural occuring data. We define MLA tendency by two measurements: a binary indicator of MLA, and the degree of MLA.

Table 3.4.2 presents the correlations between myopic MLA tendency and several measurements of traders' portfolio positions and trading frequencies. Overall, traders who exhibited high degrees of myopia tended to hold smaller portfolios (as measured by both volume and value). The daily average cost of each stock for the non-myopic group was 0.5 million takas (61% higher than that of those with narrow framing). Relative to the daily aggregate level, the MLA types had a portfolio size (i.e., the total cost of the portfolio of the day) of 2.65 million takas, while the other group had a portfolio

	Panel A - Variable ^a at stock level								
	Observations	Mean	Standard Deviation	Min	Max				
Stock Beta	361711	1.18	0.44	-1.15	2.44				
Total cost of the stock (million taka)	366819	0.45	1.48	0.00	22.55				
Stock's market value by day, in million taka	400788	0.36	1.12	0.00	21.38				
Quantity of stock purchase , in volume	20924	4278.7	10783.3	1.00	500000.0				
Quantity of stock sale (daily), in volume	18769	4862.4	13757.9	1.00	600000.0				
Value of stock purchase (daily), in taka	20912	147341.9	297062.9	2.25	9901927.0				
Value of stock sale(daily), in taka	18769	166288.7	344379.9	0.00	7322603.5				
		Panel B -	- Portfolio diversificati	on					
	Observations	Mean	Standard Deviation	Min	Max				
Weighted average beta	73977	0.43	0.53	-0.52	2.44				
Dominant sector: Bank/Financial Institution	73977	0.23	0.42	0.00	1.00				
Pharmaceuticals being dominant industry	73977	0.12	0.33	0.00	1.00				
Ceramic being dominant industry	73977	0.01	0.10	0.00	1.00				
Daily total number of DSE sectors in the portfolio	73977	3.60	2.58	0.00	16.00				
Daily total variety of stocks in the portfolio	73977	5.43	5.91	1.00	59.00				
Maximum daily value of stock by sector	73977	0.69	0.25	0.16	1.00				
		Panel C -	Daily aggregate tradi	ng					
	Observations	Mean	Standard Deviation	Min	Max				
Daily total cost of the portfolio (million taka)	73977	2.24	8.14	0.00	125.21				
Daily number of sales transaction	73977	0.26	0.77	0.00	15.00				
Daily number of buy transaction	73977	0.30	0.83	0.00	16.00				
Daily volume of sales transaction	73977	1260.70	8612.47	0.00	636577.0				
Daily volume of buy transaction	73977	1235.9	7142.5	0.00	500000.00				
Daily value of sales (million taka)	73977	0.04	0.23	0.00	9.82				
Daily value of purchases (million taka)	73977	0.04	0.21	0.00	9.90				
Total daily market value of the portfolio (million taka)	73977	1.97	6.62	0.00	98.57				

Table 3.4.1: Trading transactions description

Notes: This table reports the descriptive data on transaction ledger and portfolio position of the sample. In Panel A, the data is measured at the stock level. Panel B and C provides data at the aggregate portfolio level. ^a Variable Description is given in Table 3.A.2.

size of 1.32 million takas.²²

Relative to the total cost level, myopic traders tended to have a higher exposure to the stock market in terms of trading frequencies. They had a higher level of both purchases and sales in terms of raw numbers, volume, and value. Perhaps non-myopic traders tend to adopt a long-term strategy of investing lump sums at the beginning and then only trading when a necessity to rebalance arises. Conversely, myopia induces traders to react more to short-term market movements, which is a characteristic of stock markets. The myopic group also underperformed in terms of the rate of turn on papers (the myopic group traded at an 11% loss, while the benchmark group traded at a 7% loss).

Disposition effect and MLA

According to prospect theory and mental accounting, the disposition effect is the tendency of traders to sell stocks as soon as their prices increase but hold onto stocks whose value has declined over a long period. The difference between the market price and the purchase price of the stock remains a paper gain or loss until the account holder decides to sell the share(s) (only then is the gain or loss realized). An investor is said to have a disposition effect if that investor tends to realize gains significantly more often than losses. Adopting the approach of Odean (1998), we calculate the proportion of realized gains (PGR) against total gain opportunities (realized gains plus paper gains). The proportion of realized losses (PLR) is calculated using the

 $^{^{22}}$ The difference in portfolio size does not stem from the difference in the initial level of wealth. Traders in the myopic group reported having average 846,695 takas in their initial endowments when they first started, 20% higher than those in the neutral group.

	$\mathbf{Panel}\ \mathbf{A}$ - Portfolio size and trading frequency at the stock level											
	Whole	(1) Sample	(i Non-	2) ·MLA	(M	(2) ILA	(4) Difference					
Variables	Mean	SD	Mean	SD	Mean	SD	Mann-Whitney z test					
Stock holding (quantity)	9849.64	34705.41	10399.27	38244.13	8896.65	23985.23	-13.19***					
Total cost of the stock, (million taka)	0.45	1.47	0.50	1.67	0.32	0.63	-26.14***					
Daily stock market value, in million taka	0.36	1.11	0.40	1.25	0.28	0.57	-26.36***					
Average holding period	86.59	77.96	91.31	80.77	71.44	66.91	60.66***					
Rate of return	-0.08	1.18	-0.07	1.37	-0.11	0.23	-46.20***					

Table 3.4.2: The correlation between MLA and portfolio holdings

	${\bf Panel}\ {\bf B}$ - Portfolio size and trading frequency at the daily aggregate level												
	(Whole	(1) Whole Sample		(2) Non-MLA		3) LA	(4) Difference						
Variables	Mean	SD	Mean	SD	Mean	SD	Mann-Whitney z test						
Daily total cost of the portfolio, million taka	2.23	8.05	2.65	9.58	1.32	2.29	-4.92***						
Daily market value, million taka	1.95	6.55	2.29	7.77	1.23	2.07	-3.60***						
Daily number of sales transaction	0.27	0.77	0.26	0.77	0.31	0.82	-8.54***						
Daily number of buy transaction	0.30	0.83	0.29	0.86	0.32	0.82	-7.47***						
Daily volume of sales transaction	1259.56	8505.8	1301.5	9341.0	1108.77	6125.33	-7.65***						
Daily volume of buy transaction	1231.31	7061.86	1259.86	7489.40	1102.52	5665.39	-6.91***						
Daily value of sales transaction, million taka	0.04	0.22	0.05	0.25	0.04	0.14	-7.49***						
Daily value of buy transaction million taka	0.04	0.21	0.04	0.23	0.04	0.14	-6.82***						
Weighted average beta	0.43	0.53	0.41	0.53	0.47	0.52	-19.95***						

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01

Notes: This table reports the correlation between MLA and several index in Portfolio position. Individual traders are aggregated into either Non-MLA or MLA. Variable description is given in Appendix 3.A. Column (1) provides the sample size, mean, and standard deviation for whole sample, while the second and third columns present Non-myopic and Myopic group respectively. Z-statistic for Mann-Whitney non-parametric test is given in the last column. Panel A presents the daily statistics at the individual stock level and Panel provides the daily aggregate data.

same structure:

$$PGR = \frac{Realized Gains}{Realized Gains + Paper Gains}$$
(3.7)

$$PLR = \frac{Realized \,Losses}{Realized \,Losses + Paper \,Losses} \tag{3.8}$$

The null hypothesis for the disposition effect is that $PGR \leq PLR$. The average PGR for non-myopic traders is 0.47, while their PLR is 0.39. The within-group absolute difference for non-myopic traders was 0.08 (compared to 0.05 for the myopic group). The null hypothesis for the differences was rejected at the 1% and 10% significance levels using a standard t-test for the mean difference. However, the significance level did not hold when we conducted the Mann-Whitney non-parametric test on the PGR-PLR differences between the two groups of traders. Thus, while both groups exhibited a certain degree of the disposition effect, there was insufficient evidence to conclude that MLA correlates to the degree of the disposition effect.

Notably, the disposition effect is a sophisticated measure that relates to several dimensions of market trends and personal characteristics. Thus, an aggregate measurement may not be the best approach to capture this behavioral bias. We use the panel structure of our data and run the following regressions to examine the prevalence of the disposition effect and how it correlates with the personal characteristics of the traders:

$$Sale_{ijt} = \alpha + \beta_1 Gain_{ijt} + \beta_2 MLA_i + \beta_3 MLA_i * Gain_{ijt} + \sum \beta (MLA_i * ReferencePrice) + \varepsilon_{ijt}$$

$$(3.9)$$

in which:

- The dependent variable $Sale_{ijt}$ is the dummy variable that takes value of one if the stock j was sold by an individual i at time t.
- $Gain_{ijt}$ is a dummy variable that equals one if the asset's open price exceeds its

purchase price.²³

The mean of the dependent variable is the probability of selling a particular position given that an investor sold something on that day. The gain coefficient measures the marginal effect of the probability of selling a stock if that position is at a gain position. If the gain coefficient is positive, it implies that a trader is selling a winner (disposition effect). Conversely, a negative coefficient represents the reverse disposition effect. The interaction coefficient between gain and behavior indicates how such elicited behavioral preferences in the laboratory correlate to real trading behaviors.

Table 3.4.3 shows a strong disposition effect (i.e., the coefficient sign was consistently positive) among our participants. When the stock is at a gaining position as compared to its cost (purchase price plus transaction fee), the traders in our sample tend to sell. To better understand the magnitude of the coefficients, consider an investor who must decide whether to sell Stock A, which is trading above the purchase price, or Stock B, which is trading below the purchase price. The non-myopic trader has a coefficient of 0.713 for stock at a gaining position; that is, the probability of selling the winner Stock A is 67% higher $(\frac{\exp^{0.713}}{1+\exp^{0.713}})$ than stock B - the "loser".

On average, for any given transaction, a trader who exhibited MLA in the lab has a higher propensity to sell a losing stock—the propensity of selling is 64.25%, which corresponds to a log of the odds of 0.586. Those who suffered more from myopia were less likely to sell a winner—for example, the MLA interactions with the gain dummy of 0.0969 suggests that the probability of selling a winner decreases from 67% to 64%. The propensity to sell is generally correlated with whether a stock has held a gaining position for a certain period. Some traders use market movement as their price benchmark to decide whether to sell. Thus, a winning stock is defined as having a current market price that exceeds its previous market price. Table 3.4.3 also sets out

 $^{^{23}}$ We also define gain as a dummy equal to 1 if the stock was at a gain position in the previous week. However, this result does not change qualitatively.

	Dependent variable: The propensity of sell versus hold										
	Coeffic	cient	Confide	nce Interval	Transformed Coefficient						
	Benchmark	MLAx	Benchmark	MLAx	Benchmark	MLAx					
MLA ^a	$\begin{array}{c} 0.586^{***} \\ (0.0644) \end{array}$		[0.46; 0.71]		64.25						
${\rm Gain^b}({\rm Market\ Price\ >Cost})$	$\begin{array}{c} 0.713^{***} \\ (0.0255) \end{array}$	-0.0969** (0.0484)	[0.66; 0.76]	[-0.19;-0.0022]	67.11	64.93					
Market Gain ^c - 1 Day	$\begin{array}{c} 0.455^{***} \\ (0.0219) \end{array}$	-0.133^{***} (0.0424)	[0.41; 0.50]	[-0.22; -0.050]	61.18%	57.98%					
Market Gain - 1 Week	$\begin{array}{c} 0.421^{***} \\ (0.0232) \end{array}$	-0.147^{***} (0.0452)	[0.38; 0.47]	[-0.24 ; -0.059]	60.37%	56.81%					
Market Gain - 1 Month	$\begin{array}{c} 0.325^{***} \\ (0.0241) \end{array}$	-0.0921^{*} (0.0472)	[0.28; 0.37]	[-0.18; 0.00053]	58.05%	55.80%					
Market Gain - 1 Year	0.245^{***} (0.0340)	-0.163^{**} (0.0679)	[0.18; 0.31]	[-0.30 ; -0.030]	56.09%	52.05%					

Table 3.4.3: Disposition effect versus Laboratory behavioral preference

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports results of a panel random effect logit regression with the dependent variable being dummy variable taken value one when a trader sold a stock for which the cost is known. If no purchase or sales decisions are made, the dependent variable obtains the value of zero, indicating "Hold". We provide the transformed coefficient in (4) to ease the interpretation of the log of the odds. ^a Myopic Loss Aversion is a dummy variable that takes the value of one if subject invests myopically in the laboratory. The definition

is given in Table 3.A.1. The benchmark column corresponds to the non-MLA trader.

 $^{\rm b}$ Stock gain takes value of 1 if the Open market price of the day exceeds the purchase price.

^c Reference price one day, one month, and one year take dummy value of one if the market price the stock exceeds its past market price one day, one month, and one year ago, respectively.

Unreported are individual characteristic of the age, experience, and income dummy that equals one if the trader's income rank above the median level. the coefficients of the short-term (one day and one week), medium-term (one month), and long-term price changes (one year). We find that myopia also reduced the disposition effect in both short-term and long-term market fluctuations—the coefficients for the interactions between MLA and reference prices are all negative. Overall, myopia reduced the probability of selling a winner by 2.17% (when the market gain is defined as the stock-market price exceeding its price one year ago) to 4.04% (when the market gain is defined as the stock-market price exceeding its price one month ago). Notably, if a trader reacts more to short-term movements and less to long-term movements, a stronger effect of short-term price gain should be found. While the effect is larger for a one-year gain, the difference is not significant.

3.5 Conclusions

MLA provides a theoretical explanation for the equity premium puzzle, while providing predictions on how feedback affects investment profiles. In this paper, we use standard tools to measure MLA among a group of non-professional traders/investors from eight brokerage houses in Dhaka and correlate those experimental results with their transactions and portfolio positions. A key contribution of our work is to show that the experimental data correlate with essential real-world trading analogs of nonprofessional traders. To be specific, we find that MLA correlates to a lower portfolio cost and a higher disposition effect, but MLA traders do not necessarily trade more on a daily basis.

Methodologically, our results from the within-design reveal that once participants are exposed to both high and low feedback frequency, their degree of MLA decreases considerably. We also make a methodological contribution by showing that experience can aggravate or mitigate the degree of MLA. This follows because experience with gains and losses act as a reference point, and we find that MLA can be curtailed at the individual level if professional traders are first presented with lower-frequency feedback. However, the effect remains the same if they had experienced frequent feedback prior.

In closing, we would be remiss not to mention generalizability of our experimental and empirical results. To do so, we follow four transparency SANS conditions outlined by List (2020).²⁴ First, our selection of traders is based on responses to the random invitation to all clients of our partnered stock brokerages. These traders did not have a financial advisor at the time of the study. In other words, they made investment decisions based on their own strategy. Our sample reflects the non-professional traders in the market. Second, we have a zero attrition rate in the experiment, and more than 90 percent of the traders consent to give access to their trading data. Third, our subjects are placed under both ends of the spectrum of the naturalness of the choice task and investment environment. The experimental session happens in a laboratory setting, in which investment decisions are potentially on the artificial margin and the experiment uses a certain type of risk portfolio that is standard in the literature.²⁵ We then observe the same traders' naturally-occurring data from the stock market by analyzing their trading decisions. Finally, to understand the effect of feedback frequency on the stock market, replications need to be completed to understand if our results can be extended in other settings such as using institutional and professional traders of the markets.

²⁴SANS conditions are Selection, Attrition, Naturalness, and Scalability.

²⁵The literature offers mixed conclusion to what degree the MLA experimental results depend on the risk profile of the lottery (see Beshears, Choi, Laibson and Madrian (2017)).

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3.A Additional Tables and Figures

Variables	Origin	Definition
Myopic Loss Aversion Treatment effect MLA Trader Myopic Neutral Trader	Experiment	Difference degree of MLA Investment under Frequent - Investment Under Infrequent Dummy value = 1 if (Investment under Frequent - Investment Under Infrequent)> 0 Dummy value = 1 if (Investment under Frequent - Investment Under Infrequent)= 0
Age Age group	Survey Survey	Age of the participants in years Dummy variable equals 1 if Age > 35
Above-median capital endowment	Survey	Dummy variable equals 1 if Capital level > 100000 taka
Income	Survey	Current monthly income of the participants in 1000 taka
High Income	Survey	Belong to the top quartile income
Gender	Survey	Gender of the participants $(1=Male, 0 = Female)$
Master degree	Survey	The education level of the participants (1=Having a master degree, 0=Not)
Trading starting year Risk aversion	Survey Experiment	The year the participant joined stock market Index computed by the crossover level risk-sensitivity approach. Crossover point = winning probability which subjects are willing to take risk.
Ambiguity avoidance	Experiment	Index computed by the crossover level ambiguity-sensitivity approach.

Table 3.A.1: Summary of experimental variables' definition

Variables	Data sources	Definition		ncy	
			(1) ^a	$(2)^{b}$	
Number of transactions	Transactions data	Number of purchases and sales	Average values	Daily	
Trades volume	Transactions data	Volume of purchases and sales (in million taka)	Average values		
Market trades volume	Transactions data	Volume of purchases and sales divided by market volume	Average values		
Buy-sale ratio	Transaction data	Number of purchases divided by number of total trades	Average values	Daily	
Buy-sale volume ratio (percentage)	Transaction data	Volume of purchases divided by total trading volumes	Average values	Daily	
Portfolio value	Portfolio data	Portfolio value at every business day for entire period (in million taka)	Average values	Daily	
Portfolio positions	Portfolio data	Number of holdings at every business day for entire period	Average values	Daily	
Big industry	Portfolio data	Dummy variable indicating the dominant stock is bank and institution, ceramic, engineer industry			
Stock variety	Portfolio data Portfolio data	Number of different stocks (variety) in the portfolio Weighted-average beta of the portfolio	Average values Average values	Daily Daily	
DSE Index	Market data	Percentage daily change in Dhaka Stock Exchange		Daily	
Volatility 1y	Portfolio+Market data	One-year market gain or loss position		Daily	
Volatility 1w	Portfolio+Market data	One-week market gain or loss position			

Table 3.A.2: Summary of financial index variables' definition

Each financial index is derived either from the transaction data, portfolio data, or the market data.

^a Data in Column (1) is used in Table 3.4.2, measuring the indices by averaging all the trading activities by each trader. ^b Data in Column (2) is used in Table 3.4.3, using trading activities at daily level.

	Panel A - Supplementary Game Task 1										
	Average investment (SD) Treatment Effect										
	Treatment F	Treatment I	Total	Difference	Z-statistics						
Round 1-3	161.03	181.3	170.3	-20.07	-1.761*						
	(117.2)	(118.3)	(118.1)								
Observations	182	159									
	Panel B - Supplementary Game Task 2										
	Average	investment (S	D)	Treatment Effect							
	Treatment F	Treatment I	Total	Difference	Z-statistics						
Round 1-3	180.1	197.22	189.12	-17.12	0.0719						
	(134.0)	(142.5)	(124.1)								
Observations	151	168									
Notes: $* n < 0.1$	** n < 0.05 ***	n < 0.01									

Table 3.A.3: The differences between two treatments in Supplementary Games

p < 0.01Notes: * p < 0.1, ** p < 0.05, ***

This table reports the raw data summary (mean and standard deviation) and Mann-Whitney test for differences in investment level in the supplementary games of Task 1 (Panel A) and Task 2 (Panel B).

The first three columns present the average investment level in the first row and standard deviation in parentheses. Average investment is the mean of investment across all 9 rounds of investment. The last two columns reports the average difference treatment effect $(\bar{I}_1 - \bar{F}_1)$ and Mann-Whitney z-stats for the difference between two Tasks.

^a All investment levels are in unit of experiment. One unit of experiment equals 100 taka.



Figure 3.A.1: Plots for Equations (2) and (3)

Notes: This figure compare and contrast the value function of loss-averse agents on repeated evaluation of single lottery versus joint evaluation of multiple lotteries.



Figure 3.A.2: Heterogeneity in within-subject myopia

3.B Experimental Instructions

General instructions for subjects - English version

Welcome to our experimental study of decision-making. The experiment will last about 2 hours. The instructions for the experiment are simple, and if you follow them carefully, you can earn a considerable amount of money. All the money you earn is yours to keep, and will be paid to you, privately and in cash, immediately after the experiment or on an agreed date later. The experiment will consist of 4 tasks. After each task has been finished, the instructions for the next task will be distributed to you. When everyone is seated, we will go through the instructions of task 1 of the experiment. After that, you will have the opportunity to study the instructions on your own, and to ask questions. If you have a question, please raise your hand, and I will come to your table. Please do not talk or communicate with the other participants during the experiment. These apply to all tasks. Are there any questions about what has been said until now?

Task 4 (Myopic loss aversion)

General instruction for both treatments

The experiment will consist of two parts. The instructions for the second part will be distributed to you after the first part has been finished. Before we start the experiment, however, you will be asked to pick one envelope from this pile. In the envelope you will find your Response Sheet. This form will be used to register your decisions and earnings.

Task 4: Myopic loss aversion Instructions for Treatment F

Part 1

Part 1 consists of 9 successive rounds. In each round you will start with an amount of 100 units (1 unit=10 taka). You must decide which part of this amount (between 0 units and 100 units) you wish to bet in the following lottery: "You have a two-thirds chance (67%) to lose the amount you bet and a one-third (33%) to win two-and-a-half times the amount you bet." You are requested to record your choice on your response sheet. Suppose you decide to bet an amount of X units ($0 \le 100 \le 100$) in the lottery. Then, you must fill in the amount X in the column headed Amount in lottery, in the row with the number of the present round. Whether you win or lose in the lottery depends on your personal win colour. This colour is indicated on top of your response sheet. Your win colour can be red, blue, or white, and is the same for all 9 rounds. In any round, you win in the lottery if your win colour matches the round colour that will be drawn by an enumerator, and you lose if your win colour does not match the round colour.

The round colour is determined as follows. After you have recorded your bet in the lottery for the round, the enumerator, in a random manner, pick one colour from a cup containing three colours: red, blue, and white. The colour drawn is the round colour for that round. If the round colour matches your win colour you win in the lottery; otherwise, you lose. Since there are three colours one of which matches your win colour the chance of winning in the lottery is one-third (33%) and the chance of losing is two-thirds (67%).

Hence your earnings in the lottery are determined as follows. If you have decided to put an amount of X units in the lottery, then your earnings in the lottery for the round are equal to -X if the round colour does not match your win colour (you lose the amount bet) and equal to +2.5X if the round colour matches your win colour (you

win two-and-a-half times the amount bet).

The round colour will be shown to you by the enumerator. You are requested to record this colour in the column Round colours, under win or lose, depending on whether the round colour does or does not match your win colour. Also you are requested to record your earnings in the lottery in the column Earnings in lottery. Your total earnings for the round are equal to 100 units (your starting amount) plus your earnings in the lottery. These earnings are recorded in the column Total earnings, in the row of the corresponding round. Each time we will come by to check your response sheet for errors in calculation.

After that, you are requested to record your choice for the next round. Again you start with an amount of 100 units, a part of which you can bet in the lottery. The same procedure as described above determines your earnings for this round. It is noted that your private win colour remains the same, but that for each round, a new round colour is drawn by the enumerator. All subsequent rounds will also proceed in the same manner. After the last round has been completed, your earnings in all rounds will be summed. This amount determines your total earnings for part 1 of the task. Then, the instructions for part 2 will be announced.

Part 2

Part 2 is almost identical to part 1, but differs in two respect. First, part 2 consists of three rounds (instead of 9 rounds). Second, in part 2 you do not get any additional starting amount from us. You play with the money you have earned in part 1. To that purpose, we first decide your earnings in part 1 by three. The resulting amount is your starting amount S for each of the three rounds. Again you are asked which part of this amount (between 0 and S) you wish to bet in the lottery. "You have a two-thirds chance (67%) to lose the amount you bet and a one-third (33%) to win two-and-a-half times the amount you bet."

You are asked to record your choice on the response sheet. If you decide to bet an amount of X units ($0 \le X \le S$), then you must fill in the amount X under Amount in lottery.

Your private win colour is the same as in part 1 and can be found on top of your response sheet. After you have recorded your bet for the present round, the enumerator will again, in a random manner, pick one colour from a cup containing three colours: red, blue, and white. The colour drawn is the round colour. If this round colour matches your win colour, you win in the lottery, otherwise you lose.

If you have decided to bet an amount X in the lottery, then your earnings in the lottery are equal to -X if the round colour does not match your win colour (you lose the amount bet for the round) and equal to +2.5X if the round colour does match your win colour (you win two-and-a-half times the amount bet for the round).

You are again requested to record the round colour and your earnings in the lottery on the response sheet. Your total earnings for the round are equal to your starting amount S plus your earnings in the lottery. You are asked to record these on your response sheet. We will come by to check your form for errors.

After that you are requested to make your choice for the next round. Again you can choose to bet part of your staring amount in the lottery. The same procedure as described above determines your earnings. Round 3 will proceed in the same manner. After that, your earnings in the three rounds will be added. This amount determines your total earnings in parts 1 and 2 of the task.

Task 4: Myopic loss aversion Instructions for Treatment I

Part 1 consists of 9 successive rounds. In each round you will start with an amount of 100 units (1 unit=10 taka). You must decide which part of this amount (between 0

units and 100 units) you wish to bet in the following lottery: "You have a two-thirds chance (67%) to lose the amount you bet and a one-third (33%) to win two-and-a-half times the amount you bet."

You are requested to record your choice on your response sheet. Suppose you decide to bet an amount of X units ($0 \le 100 \le 100$) in the lottery. Then, you must fill in the amount X in the column headed Amount in lottery, in the row with the number of the present round. Please note that you fix your choice for the next three rounds. Thus, if you decide to bet an amount X in the lottery for round 1, then you also bet an amount X in the lottery for rounds 2 and 3.

Whether you win or lose in the lottery depends on your personal win colour. This colour is indicated on top of your response sheet. Your win colour can be red, blue, or white, and is the same for all 9 rounds. In any round, you win in the lottery if your win colour matches the round colour that will be drawn by an enumerator, and you lose if your win colour does not match the round colour.

The round colour is determined as follows. After you have recorded your bet in the lottery for the round, the enumerator, in a random manner, pick one colour from a cup containing three colours: red, blue, and white. The colour drawn is the round colour for that round. If the round colour matches your win colour you win in the lottery; otherwise, you lose. Since there are three colours one of which matches your win colour the chance of winning in the lottery is one-third (33%) and the chance of losing is two-thirds (67%).

Hence your earnings in the lottery for the three rounds are determined as follows. If you have decided to put an amount of X units in the lottery, then your earnings in the lottery for the three rounds are equal to X for each round colour that does not match your win colour (you lose the amount bet) and equal to +2.5X for each round colour that matches your win colour (you win two-and-a-half times the amount bet). The three round colours will be shown to you by the enumerator. You are requested to record these colours in the column Round colours, under win or lose, depending on whether the round colour does or does not match your win colour. Also you are requested to record your earnings in the lottery in the column Earnings in lottery. Your total earnings for the three rounds are equal to 300 units (three times your starting amount) plus your earnings in the lottery. These earnings are recorded in the column Total earnings, in the row of the corresponding rounds. Each time we will come by to check your response sheet for errors in calculation.

After that, you are requested to record your choice for the next three rounds. For each of the three rounds you again start with an amount of 100 units, a part of which you can bet in the lottery. The same procedure as described above determines your earnings for these three rounds. It is noted that your private win colour remains the same, but that for each round, a new round colour is drawn by the enumerator. The subsequent three rounds (7-9) will also proceed in the same manner. After the last round has been completed, your earnings in all rounds will be summed. This amount determines your total earnings for part 1 of the task. Then, the instructions for part 2 will be announced.

Part 2 Part 2 is almost identical to part 1, but differs in two respect. First, part 2 consists of three rounds (instead of 9 rounds). Second, in part 2 you do not get any additional starting amount from us. You play with the money you have earned in part 1. To that purpose, we first decide your earnings in part 1 by three. The resulting amount is your starting amount S for each of the three rounds. Again you are asked which part of this amount (between 0 and S) you wish to bet in the lottery. "You have a two-thirds chance (67%) to lose the amount you bet and a one-third (33%) to win two-and-a-half times the amount you bet."

You are asked to record your choice on the response sheet. If you decide to bet an amount of X units ($0 \le X \le S$), then you must fill in the amount X under Amount

in lottery. Again you fix your choice for the next three rounds. Thus, if you decide to bet an amount X in the lottery for round 1, then you also bet an amount X in the lottery for rounds 2 and 3. Your private win colour is the same as in part 1 and can be found on top of your response sheet. After you have recorded your bet for the present round, the enumerator will again, in a random manner, pick one colour from a cup containing three colours: red, blue, and white. The colour drawn is the round colour. If this round colour matches your win colour, you win in the lottery, otherwise you lose.

If you have decided to bet an amount X in the lottery, then your earnings in the lottery are equal to -X for each round colour that does not match your win colour (you lose the amount bet for the round) and equal to +2.5X for each round colour that matches your win colour (you win two-and-a-half times the amount bet for the round).

You are again requested to record the round colours and your earnings in the lottery on the response sheet. Your total earnings for the three rounds are equal to three times your starting amount S, plus your earnings in the lottery. You are asked to record these on your response sheet. We will come by to check your form for errors.

After that you are requested to make your choice for the next round. Again you can choose to bet part of your staring amount in the lottery. The same procedure as described above determines your earnings. Round 3 will proceed in the same manner. After that, your earnings in the three rounds will be added. This amount determines your total earnings in parts 1 and 2 of the task. Chapter 4

The impact of microfinance participation on fertility in Bangladesh

4.1 Introduction

Population growth is an impediment to economic development. When parents have large families, they are less able to invest in the healthcare and schooling of each of their children, which reduces the child's productivity when he/she enters the workforce later in life (Schultz (2007)). As such, reducing fertility rates has become an important development objective. Fertility decline not only improves investment in children's health care and human capital, but increases the working-age share of the population, which, in turn, may increase income, savings and investment. Fertility decline is also associated with greater female empowerment and higher rates of female labour force participation (Becker (1960). There is a virtuous cycle between demographic transition and economic growth, through which fertility decline generates improvements in health and human capital attainment of children, female labour force participation and reduced dependency ratios and these improvements, in turn, lead to reduced fertility and other economic benefits (Becker, Murphy and Tamura (1990)).

Microfinance has been linked to several positive outcomes including asset building and consumption smoothing (Kaboski and Townsend (2011)), improved health and nutrition (Pitt, Khandker, Chowdhury and Millimet (2003)), greater food security (Islam, Maitra, Pakrashi and Smyth (2016)) and lower incidence of poverty (Imai and Azam (2012)). Gertler, Levine and Moretti (2009) and Islam and Maitra (2012) show that microfinance can be effective in mitigating the effect of health and income shocks. Microfinance has also been shown to increase female empowerment (Rai and Ravi (2011); Pitt, Khandker and Cartwright (2006)), which could lead to fertility decline, for example, through giving women greater say in the use of contraception.

In this paper, we try to establish whether access and expansion of microfinance in Bangladesh has contributed to fertility decline. To this end, we also examine the relationship between access to microfinance and attitude towards contraception in Bangladesh. We use a unique household level panel datasets of microfinance households with detailed information on fertility and associated behaviour. We use two waves (1997-98 and 2004-05) of an panel collected by the Bangladesh Institute of Development Studies (BIDS) on behalf of the Palli Karma-Sahayak Foundation (PKSF) to assess program evaluation.

Bangladesh is a particularly interesting case study to examine the effect of microfinance on fertility decline for a couple of reasons. One reason is the sheer scale of microfinance in Bangladesh with 700 microfinance institutions (MFIs), including well-known MFIs such as the Association of Social Advancement (ASA), Bangladesh Rural Advancement Committee (BRAC) and the Grameen Bank, serving 33 million customers (Mia (2017)). Second, MFIs have, as one of their objectives, to reduce fertility. As Kuchler (2012), notes, members are expected to recite at MFI meetings, "we shall plan to keep our family small". A third reason is that Bangladesh is often held up as an exemplar of a country which has been successful in promoting economic development through increasing female empowerment. This success is often attributed, in part, to the role of microfinance in promoting female entrepreneurship (Hashemi, Schuler and Riley (1996)). Bangladesh has also been lauded for reducing fertility. According to the Bangladesh Demographic Health Survey (BDHS) 2011, the total fertility rate in Bangladesh was 2.3, a significant decline from 6.3 in 1975. Several authors have suggested that there has been a causal chain from microfinance access to greater female empowerment to fertility decline (Hashemi et al. (1996); Schuler, Hashemi and Riley (1997); Pitt et al. (2006)).

There are multiple channels through which microfinance could reduce fertility. One such channel is through increasing household income. If household income increases, there will be income and substitution effects. If children are a normal good, if income increases the income effect will be to have more children, but if children are an inferior good, the income effect will be to have less children. In addition, as income increases the opportunity cost of having children will be higher, suggesting couples will choose to substitute in favour of having less children. The evidence suggests that as income increases, couples have less children, which implies that either children are either inferior goods or children are normal goods, but the substitution effect outweighs the income effect.

Baland and Robinson (2000) explore a possible link between child labour and fertility. In the early stage of economic development, the relative cost of educating children is high, while the wage received by the child is considered valuable to household finance. Therefore, parents substitute from child schooling to child labour. Child income as a supplement to household income provides incentives to the household to have more children. However, with rising parental income, the importance of earnings from child labour to supplement household income reduces. With rising income, parents prefer to invest in child quality rather quantity, thus decreasing the demand for children.

Microfinance can also increase female labour force participation through providing access to finance to fund female employment opportunities and break down cultural norms that impede women entering the labour market. If female labour force participation increases, including providing woman with access to her own sources of income, this will increase women's intra-household bargaining strength. This will give her greater control over use of contraception and family planning and the allocation of resources within the household. There is much evidence that women value much more the quality of children over the quantity of children compared to men and are more likely to invest in the education and health care of their children (Pitt and Khandker (1998)). This suggests that women will prefer to have less children and to invest more in the children that they bear.

An increase in the female labour force participation rate is also likely to directly affect social norms regarding the optimal family size. Hinde (2003) observes that in late nineteenth century Britain, "once economic pressure led to smaller families becoming more common, it is also likely that they became more fashionable". In the Bangladesh context, Munshi and Myaux (2006) show how changing reproductive social norms, associated with greater female empowerment, contributed to fertility decline in rural Bangladesh.

The extant literature on the effect of access to microfinance on fertility is scarce (Pitt and Khandker (1998); Steele, Amin, Naved et al. (1998); Islam (2011); Kuchler (2012)). While a few studies find that access to microfinance has a negative effect on fertility (Steele et al. (1998); Basher (2007)); other studies find either no relationship (Duvendack and Palmer-Jones (2017)) or a fragile relationship (Kuchler (2012)). Most of these studies (Steele et al. (1998)), use cross-sectional data that does not address self-selection of more independent women or those with lower fertility into microfinance programs (Pitt and Khandker (1998)) and/or are based on responses from a self-administered survey to a small number of participants and hence are not necessarily representative (Basher (2007)). Importantly, apart from Kuchler (2012), each of these studies use total fertility - the total number of children to whom a woman has ever given birth - to measure fertility, rather than recent fertility - the number of children to whom a woman has given birth since joining a microfinance program.

Using BDHS datasets, Duvendack and Palmer-Jones (2017) examine the effect of access to microfinance on fertility behaviour in Bangladesh. Duvendack and Palmer-Jones (2017) use the total number of children ever born, do not consider the fertility since a woman joined a microfinance program. This is perhaps BDHS datasets do not have information on timing of the participation in a microfinance program, and it is also difficult to define the appropriate treatment and comparison group using BDHS datasets since the survey was not designed to study the effects of microfinance.Our survey was primarily designed to measure the impact of microfinance, and at the time of the survey it was representative of programs in Bangladesh. The dataset has de-

tailed records of membership with both large and small MFIs, including timing of the individual membership in a program. The avaiability of panel datasets at the household level allowed us to circumvent issues such as non-random selection into participation by using difference-in- difference (DD) and panel fixed effects. We also examine both on total fertility (total number of children born to a woman) and recent fertility (children born since a woman joined a MFI). We argue that total fertility is not the right way to measure fertility in this context. Instead, to properly evaluate the effect of microfinance on fertility decisions, the correct measure of fertility should be the number of children to whom a woman gives birth in the period after she joined a microfinance program.

4.2 Program background and Data Descriptions

4.2.1 Program background

We use household panel dataset consisting of rural households in Bangladesh, collected by BIDS on behalf of the PKSF. Following the census in 1997, four different survey waves were administered in 1997-1998, 1998-1999, 1999-2000, and 2004-2005. The data covers different modules of village information, household socioeconomic conditions and individual characteristics.

Program villages were drawn from thirteen different-sized MFIs; of which, two were deliberately chosen from the four largest MFIs in Bangladesh. Because control villages cannot be found in some areas, the final survey consists of 11 control villages in round one. Over the following waves, some of the control villages turned into program villages and in the final round only eight control villages remained.

While there are four rounds of survey (in 1997-98, 1998-1999, 1999-2000 and 2004-05),

we choose only the first and fourth round, due to the short time intervals between each round of surveys. In Round 1, a total of 3026 households were drawn from both control and treatment villages, including 1740 participants. Due to split household and drop-out, there were 2842 households in the fourth round. Since the survey followed most of the members of the households that split up, we merged the split household with the original ones to form a single household unit.

We select ever married women, born between 1955 and 1985, to ensure that all participants were still in their reproductive cycle in both baseline and post treatment surveys. Our results are robust when we restrict the sample to women born between 1963 and 1973. We also exclude samples with the lack of pre-program information. Microfinance programs became available at different times across the village we studied here. Many of the households had already participated at the time of the census survey. We so not have timing of the participation of the program for some households as they did not either reveal or could not clearly mention the timing of the participation at the time of the survey. This made it necessary to exclude those who had already enrolled in a microfinance program at baseline.¹ Our final sample consists of 2757 women in the first round and 2706 women in the final round, with the percentage of childless women less than 10% and 5% respectively.

4.2.2 Descriptive Statistics

Table 4.2.1 presents selected descriptive statistics for different village conditions from the baseline (Round 1 of the survey) and the post treatment survey (Round 4 of the survey). In both baseline and post treatment surveys, we generally see that program villages are slightly more developed in terms of educational institutions and other facilities, such as post offices, bus stands and telephone offices. The only exceptions are

¹Due to the time difference between enrolment and set up of microfinance activities, we include women who had enrolled in the program for less than one year at the time of baseline.

the presence of a primary school, fertilizer shops, and having the electricity connected. However, none of the differences (other than access to electricity) are statistically different.

Table 4.2.1: Descriptive Statistics for Control and Treatment Villages in the Program

	Panel A - Round 1					Panel B - Round 4						
	Control		Tre	Treatment Diff		erence Co		Control		atment	Difference	
Variable	N	Mean	Ν	Mean	T-C	p-value	Ν	Mean	Ν	Mean	T-C	p-value
The presence of a secondary school	11	0.27	80	0.28	0	0.99	8	0.13	83	0.24	0.12	0.99
The presence of a primary School	11	0.91	80	0.86	-0.05	0.67	8	1	83	0.83	-0.17	0.67
The presence of a higher education school	11	0.09	80	0.2	0.11	0.39	8	0	83	0.17	0.17	0.39
The presence of a Maktab/Madrasa	11	0.82	80	0.9	0.08	0.42	8	0.63	83	0.76	0.13	0.42
Electricity connection	11	0.17	80	0.26	0.09	0	8	0.34	83	0.48	0.14	0.15
The presence of UP office	11	0.18	80	0.14	-0.04	0.7	8	0.13	81	0.23	0.11	0.7
The presence of post office	11	0.18	80	0.2	0.02	0.89	8	0.63	81	0.4	-0.23	0.89
The presence of telephone office	11	0	80	0.05	0.05	0.45	8	0	81	0.07	0.07	0.45
The presence of bus stand	11	0.09	80	0.15	0.06	0.6	8	0.13	81	0.28	0.16	0.6
The presence of fertilizer shop	11	2	80	1.85	-0.15	0.88	8	3.88	81	4.01	0.14	0.88
The presence of playground	11	0.73	80	0.73	0	0.99	8	0.88	81	1.1	0.22	0.99
Average wage of male adult in boro season	11	57.56	77	57.16	-0.4	0.95	8	46.32	83	51.46	5.15	0.95
Distance to nearest thala	9	3.06	70	2.4	-0.65	0.34	8	11.38	83	7.36	-4.01	0.34

Notes:

This table provides villages' descriptive statistics across the two intervention arms at Round 1 (Panel A) and Round 4 (Panel B). This table reports descriptive statistics for the traders in our sample at the time of survey.

^a The last column in each panel provides p-value for the mean difference test between the treatment and control village.

^b Details on the definition and measurements of all the variables are in Tables A1 and A2 in the appendix.

Table 4.2.2 highlights some of the key information at the household and individual level. In both baseline and post treatment, the members of microfinance programs are more proactive in family planning - the control group has a more negative opinion of contraceptive use and is also less likely to practice family planning methods. For general fertility, both groups have the same actual fertility rates (total number of children ever born) and ideal fertility rates (the self-reported desired number of children).

At baseline, the control group performs better in general literacy - 33% of this group is reported to be able to both read and write, compared to only 27% of the treatment group. Of household characteristics, non-treated households are more educated, with the highest years of schooling by any member of the household around one year higher than for the treated group. Overall, the control group fares better across several dimensions of individual and household characteristics. Therefore, the impact analyses of the microfinance program needs to control for heterogeneity in individual
characteristics.

	Panel A - Round 1			Panel B - Round 4								
	Со	ntrol	Trea	tment	Diff	erence	С	ontrol	Trea	tment	Diffe	erence
Variable	Ν	Mean	Ν	Mean	T-C	p-value ^a	Ν	Mean	Ν	Mean	T-C	p-value ^a
Age at first marriage	702	16.09	1084	16.06	-0.03	0.79	914	16.89	1786	16.15	-0.74	0.79
Years in Marriage	700	12.26	1082	12.93	0.68	0.05	905	10.35	1780	17.01	6.66	0.05
Husband opinion on family planning	1129	0.69	1628	0.81	0.11	0	916	0.7	1790	0.74	0.04	0
Self-opinion on family planning	1129	0.8	1628	0.88	0.07	0	916	0.79	1790	0.83	0.04	0
Currently practice family planning	1069	0.45	1585	0.55	0.1	0	882	0.52	1711	0.65	0.13	0
Desired number of sons	1082	1.25	1582	1.24	-0.01	0.49	912	1.18	1774	1.26	0.07	0.49
Desired number of daughter	1078	1.08	1580	1.08	0	0.79	894	1.1	1763	1.11	0.01	0.79
Desired number of children	1087	2.32	1586	2.32	-0.01	0.81	911	2.22	1783	2.31	0.1	0.81
Number of children everborn	1129	3.03	1628	3.3	0.28	0	916	2.15	1790	3.32	1.17	0
Ratio of girl/total children	1013	46.42	1485	47.47	1.05	0.42	690	51.56	1686	47.46	-4.1	0.42
Number of deceased children	1017	0.48	1490	0.46	-0.02	0.61	878	0.23	1742	0.5	0.27	0.61
Number of deceased son	1017	0.25	1490	0.25	0	0.98	878	0.08	1742	0.17	0.09	0.98
Can read and write	1129	0.33	1628	0.27	-0.07	0	916	0.64	1790	0.34	-0.29	0
Eligibility status	1129	1.45	1628	1.41	-0.04	0.02	910	1.54	1783	1.38	-0.16	0.02
Sex of household head	1129	0.06	1628	0.03	-0.03	0	902	0.12	1764	0.07	-0.05	0
HH highest education	894	7.22	1348	6.35	-0.87	0	870	8.8	1679	7.19	-1.61	0
Total land size of HH	1103	141.82	1587	97.17	-44.65	0	910	170.05	1783	84.46	-85.59	0

Table 4.2.2: Descriptive Statistics For Household and Individual Characteristics

This table provides individual demographic statistics across the two intervention arms at Round 1 (Panel A) and Round 4 (Panel B). This table reports descriptive statistics for the traders in our sample at the time of survey.

^a The last column in each panel provides p-value for the mean difference test between the member and non-member of microfinance program.

^b Details on the definition and measurements of all the variables are in Tables A1 and A2.

4.3 Estimation Strategy

Since microfinance applicants need to meet the eligibility criteria of the program, participants tend to differ in observed characteristics from non-participants, resulting in selection on observable bias in the treatment evaluation. There are also a number of concerns we need to address due to selection on non-observables, including self-selection bias and non-random nature of placement. We estimate the impact of microfinance participation on different fertility decision outcomes while controlling for heterogeneity in education, age and other household and village characteristics.

4.3.1 Measurement of fertility outcomes and microfinance participation

The measurement of fertility outcomes is challenging due to memory lapses of respondents and imperfections in the administration of large-scale questionnaires. We mitigate these problems by matching between multiple rounds of the survey to fill in the missing data. For full representation of fertility choice, we use two different outcomes:

- Total Fertility, measured by the total number of children ever born.
- Recent fertility, measured by the total number of children born in the past six years. This is the time difference between baseline and post treatment survey.

Because microfinance participation should not affect fertility decisions in the prejoining period, the number of births between baseline and post treatment is the more suitable indicator for reproductive behaviour in our context. We measure awareness of contraception and family planning by a binary indicator for whether the respondent has a positive opinion of contraceptive use. Both husband and wife answer this question, so we are able to construct a measure of individual perception for each woman and her partner.

We employ NGO membership as a binary indicator for microfinance participation. A large body of research on the impact of microfinance programs uses the assignment of program (intention to treat) as an indicator. This means any households that are in the treated villages and eligible for the program are considered to be microfinance participants. Such a measure, however, is not appropriate in our context since approximately 30% of eligible households never enrol in the program. Exposure to microfinance can have a spill-over effect among household members and across time. Therefore, we consider a woman to be a member of a microfinance program if her household has at least one member who has ever participated in the program.

4.3.2 Regressions

To address omitted variable bias we employ standard panel fixed effects regression to estimate the impact of microfinance participation on fertility with the following equation:

$$Y_{ijt} = \alpha_i + \beta P_{jt} + \theta_1 X_{ijt} + \theta_2 H_t + \lambda \tau_t + \theta_v t + \varepsilon_{ijt}$$

$$\tag{4.1}$$

in which i denotes the individual, j indexes households, t reflects the round of the survey and

- Y denotes recent fertility or total fertility.
- X is a vector of individual characteristics of the female including her level of education, exposure to family planning/ contraceptive use, years married and child mortality.

- H represents socioeconomic information of the household (highest level of education, household land size and loan amount).
- The dummy time variable t is 1 if the observation comes from the fourth round.
- $\lambda \tau_t$ is the fixed effects of year t
- $\theta_v t$ control for any time-varying village effects.
- The participation dummy variable, P, indicates whether the individual, or any other members of her household, is a member of an MFI.

This assumption ignores heterogeneity in the household's initial conditions, which are likely as can be seen in the descriptive statistics. By adding control variables, we aim to control for the heterogeneity in characteristics that may drive differences in fertility outcomes.

Because of heterogeneity in several households, individual demographic and socioeconomic characteristics at baseline, we use a Difference in Difference (DD) approach to address selection bias. We estimate the average effect of microfinance on different outcomes of reproductive measurement using the following DD regression specification:

$$Y_{ijt} = \gamma_i + \beta_1 T + \beta_2 P_{ijt} + \beta_3 P_{ijt} * T_{ijt} + \theta_1 X + \theta_2 H + \varepsilon_{ijt}$$

$$(4.2)$$

in which:

- Y_{ijt} is the outcome variables of interest for individual woman i in village j at time t, which are total fertility, recent fertility and contraception awareness.
- P_{ijt} is a dummy variable for microfinance participation, in which 1 denotes current or past membership of the program.
- T_{ijt} is a dummy variable that equals 1 if the data is from the post treatment round of the survey

The DD estimates eliminate all possible pre-intervention heterogeneity and time invariant characteristics between two groups. DD coincides with the treatment effect under the critical assumption that, in the absence of microfinance participation, both the treatment and the control groups' fertility decisions would have followed parallel trends over time. It can be argued that other systematic factors (such as infertility or a national wide campaign for family planning) that may have influenced fertility for the control group will also affect the treated group. We are not aware of any family planning programs that specifically targeted the villages included in our sample during this period. Therefore it is reasonable to expect that the average change in outcome of the treatment group should be the same as the control group had they not been treated

4.4 Result

4.4.1 Fixed Effects

Table 4.4.1 and 4.4.2 present the fixed effects estimates of the effects participation in a microfinance program and our two measures of fertility - total fertility and recent fertility, respectively. In each table, column (1) includes only the base model without any control variables, column (2) includes individual covariates and column (3) contains our preferred estimates, which include a full set of individual and household controls.

Results from column (3) of table 4.4.1 suggests that microfinance increases the level of total fertility by nearly 1 point estimate. Unexpected, the coefficient on contraceptive usage is counter-intuitive since it suggests that practicing family planning increases the total number of births. The most plausible explanation for this result is that most of the children may have been born prior to the baseline survey and that this is biasing

the estimates.

	(1) Total fertility	(2) Total fertility	(3) Total fertility
Participation status	0.0673 (1.05)	0.0521 (0.80)	$\begin{array}{c} 0.907^{**} \\ (2.39) \end{array}$
Round	0.599^{***} (16.47)	$0.494^{***} \\ (4.77)$	$0.484^{***} \\ (2.64)$
Practice family planning		$\begin{array}{c} 0.317^{***} \\ (5.69) \end{array}$	0.237^{**} (2.18)
Can read and write		-0.204** (-2.09)	-0.518^{***} (-2.94)
Years in Marriage		$0.0163 \\ (0.98)$	0.0321 (1.12)
Has at least one deceased child		0.0743 (0.90)	-0.113 (-0.74)
Household highest education			-0.0553** (-2.09)
Total land size of HH			$\begin{array}{c} 0.000121 \\ (0.19) \end{array}$
Total actual loan amount of HH			$\begin{array}{c} 0.00000347 \\ (1.43) \end{array}$
Sex of household head			$0.0467 \\ (0.12)$
Constant	$2.717^{***} \\ (66.95)$	$2.267^{***} \\ (12.61)$	$ \begin{array}{c} 1.912^{***} \\ (3.74) \end{array} $
Observations	5462	4323	4076

Table 4.4.1: Fixed Effects Estimates of Microfinance Impact on Total Fertility

 $t\ {\rm statistics}$ in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

Notes:

This table shows panel fixed effects estimates with no controls, individual co-variates, and full controls. The outcome variable is total number of children ever born.

^b Details on the definition and measurements of all the variables are in Tables A1 and A2.

Table 4.4.2 reports the results of the effect on the the number of births since joining a microfinance program. The sign on participation status is negative in the second and third columns and negative and significant in the third column, suggesting that participation in microfinance program causes the level of fertility to decline. The results in column (3) of Table 4.4.2 which uses full set of controls shows that there is a decrease of 1.086 in the recent births of woman in the treatment group.

	(1)	(2)	(2)
Variable ^b	Recent Fertility	Recent Fertility	Recent Fertility
Participation status	0.0107 (0.16)	-0.0160 (-0.25)	-1.086*** (-2.86)
Round 4	-1.802*** (-48.20)	-1.520^{***} (-14.77)	-1.047^{***} (-5.71)
Practice family planning		0.106^{*} (1.91)	-0.181* (-1.67)
Can read and write		-0.0696 (-0.72)	$0.178 \\ (1.01)$
Years in Marriage		-0.0387** (-2.36)	-0.0885*** (-3.09)
Has at least one deceased child		-0.999*** (-12.22)	-1.092*** (-7.15)
HH highest education			-0.175^{***} (-6.61)
Total land size of HH			$0.000411 \\ (0.66)$
Total actual loan amount of HH			-0.00000430^{*} (-1.77)
Sex of household head			-0.442 (-1.14)
Constant	$1.973^{***} \\ (47.33)$	$2.736^{***} \\ (15.32)$	5.544^{***} (10.83)
Observations	5462	4323	4076

Table 4.4.2: Fixed Effects Estimates of Microfinance Impact on Recent fertility

t statistics in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

Notes:

This table reports the treatment effects using panel fixed effect estimates with no control, individual co-variates and full controls. The outcome variable is the total number of births in the past six years. ^b Details on the definition and measurements of all the variables are in Tables A1 and A2.

Overall, the fixed effect regression shows that participation in microfinance programs reduces recent fertility and correlates to an increase total fertility. The correlation with higher total fertility is expected since control group tends to have a better economic and educational background. The treatment group already has fewer children prior to joining the program.

4.4.2 Difference in Difference

Table 4.4.3 presents estimates for DD regressions using total number of children ever born as the fertility outcome of interest. Columns 1 only reports results for the effects of microfinance on total fertility, column 2 and 3 includes individual and household covariates respectively. The treatment indicator is the interaction of MFI membership and the post treatment survey, which indicates the change in total level of fertility of the treatment group post-program. The results for microfinance participation in columns 2 and 3 are not significant, once we control for heterogeneity in individual (and household) characteristics.

Table 4.4.4 examines the effect of the program on the number of births of our respondents in the six years preceding the time of survey (between the first and last round of the surveys). Contrary to the results for total fertility, the findings suggest a significant impact of microfinance on fertility choice when we define the outcome variable as the total number of births since the baseline survey. The point estimates indicate that the participant has less children after joining the microfinance program. For every 10 women in the control group, there were four less births during the six years after baseline. This effect is fairly large considering the short interval of time between the two rounds of the survey. The coefficients are relatively robust to including additional controls of individual and household characteristics, as shown in columns 2 and 3.

Of the other variables, the coefficients on the education variables in all specifications are significant and their signs are intuitive and plausible. A woman who has a higher literacy level generally has a lower fertility rate. The total number of offspring also decreases with the woman's general literacy level. One potentially puzzling result

	(1)	(2)	(3)
	Total Fertility	Total Fertility	Total Fertility
Round 4	-0.917^{***} (-10.55)	-0.306*** (-4.30)	-0.413*** (-5.18)
Treated	0.0183 (0.20)	$0.0574 \\ (0.74)$	-0.0405 (-0.44)
Post treatment * Treated $^{\rm c}$	$1.147^{***} \\ (9.71)$	$\begin{array}{c} 0.0350 \ (0.35) \end{array}$	$0.110 \\ (0.99)$
Age in years		0.0702^{***} (7.27)	0.0696^{***} (6.73)
Practice family planning		0.0615 (1.26)	$\begin{array}{c} 0.0275 \ (0.52) \end{array}$
Can read and write		-0.328^{***} (-6.63)	-0.383*** (-6.75)
Years in Marriage		0.0659^{***} (6.65)	0.0657^{***} (6.25)
Has at least one deceased child		$\begin{array}{c} 0.759^{***} \\ (12.12) \end{array}$	0.791^{***} (11.60)
HH highest education			-0.00854^{*} (-1.69)
Total land size of HH			-0.0000864 (-0.82)
Household loan amount			$\begin{array}{c} 0.00000288^{**} \\ (2.18) \end{array}$
Sex of household head			-0.0348 (-0.32)
Constant	3.070^{***} (46.76)	-0.105 (-0.59)	$0.147 \\ (0.73)$
Observations	4861	3965	3481

Table 4.4.3: Impact of microfinance on total level of fertility

t statistics in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

Notes:

This table provides DD estimates with no controls, individual co-variates and full controls. The outcome variable is measured by the total number of children ever born.

^b Details on the definition and measurements of all the variables are in Tables A1 and A2.

^c This represents the program impact in DD estimation.

	(1)	(2)	(3)
Variables ^b	Recent Fertility	Recent Fertility	Recent Fertility
Round 4	-1.129^{***} (-23.35)	-1.251^{***} (-23.45)	-1.336^{***} (-21.51)
Treated	$0.0598 \\ (0.98)$	0.0841 (1.18)	$\begin{array}{c} 0.0378 \ (0.45) \end{array}$
Post treatment * Treated ^c	-0.442*** (-6.55)	-0.371*** (-4.79)	-0.324*** (-3.65)
Age in years		$\begin{array}{c} 0.00323 \ (0.59) \end{array}$	-0.00407 (-0.71)
Practice family planning		$\begin{array}{c} 0.0146 \\ (0.50) \end{array}$	$0.00284 \\ (0.09)$
Can read and write		-0.0473 (-1.62)	-0.0738** (-2.30)
Years in Marriage		-0.0168*** (-3.06)	-0.0123** (-2.17)
Has at least one deceased child		-0.146*** (-3.94)	-0.155*** (-3.92)
HH highest education			-0.00296 (-1.06)
Total land size of HH			$\begin{array}{c} 0.00000103 \\ (0.02) \end{array}$
Household loan amount			$\begin{array}{c} 0.000000690\\(1.10)\end{array}$
Sex of household head			$0.00686 \\ (0.13)$
Constant	$1.762^{***} \\ (42.42)$	2.024^{***} (18.60)	2.301^{***} (18.84)
Observations	4861	3965	3481

Table 4.4.4: Impact of Microfinance on the Total Number of Recent Births

t statistics in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

Notes:

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This table provides DD estimates with no controls, individual co-variates and full controls. The outcome variable is measured by the total number of births in the past 6 years.

^b Details on the definition and measurements of all the variables are in Tables A1 and A2.

^c This represents the program impact in DD estimation.

is the negative association between child mortality and fertility since both theoretical and empirical evidence suggests that lower child mortality should induce lower fertility. One possible explanation is the reverse causality nature of these two variables. Higher fertility may, in fact, induce higher child mortality since having more children may reduce time and money spent on health care for each child. If so, higher mortality would be related to the effect on infants and children of earlier weaning and reduced care from mothers. Note, in such cases, our main results are however not affected if both participating and non-participating households were affected similarly.

4.4.3 Possible mechanisms

Microcredit may have reduced recent fertility through several mechanisms, including greater female empowerment and increased labour force participation. We examine several potential mechanisms, including mediating effects, in this section.

Attitude towards family planning

We use DD estimates to examine the effect of microfinance on attitudes towards using contraceptive methods. Table 4.4.5 reports the effect of joining the program on both the husband's and wife's opinions towards active family planning. On the whole, women who join the program increase their awareness of contraception use by approximately 5% (see column 3); however, microfinance participation has no effect on the husband's awareness of contraception (see column 6). This result, combined with the decline in recent fertility post-program, suggests that microfinance participation may improve the wife's bargaining power over fertility choices.

	(Self's opinion)			(Husband's opinion)		
Variables ^b	(1)	(2)	(3)	(4)	(5)	(6)
Round 4	-0.0424^{**} (-2.52)	-0.0864^{***} (-4.74)	-0.0882^{***} (-4.52)	-0.0144 (-0.72)	-0.0727^{***} (-3.26)	-0.0737^{***} (-3.01)
Treated	$\begin{array}{c} 0.0395^{***} \\ (2.79) \end{array}$	$\begin{array}{c} 0.0173 \\ (1.05) \end{array}$	$\begin{array}{c} 0.00642 \\ (0.35) \end{array}$	0.0800^{***} (4.45)	$\begin{array}{c} 0.0682^{***} \\ (3.24) \end{array}$	0.0630^{***} (2.60)
Post treatment * Treated $^{\rm c}$	-0.000995 (-0.05)	$\begin{array}{c} 0.0584^{**} \\ (2.54) \end{array}$	$\begin{array}{c} 0.0574^{**} \\ (2.32) \end{array}$	-0.0418 (-1.64)	$\begin{array}{c} 0.0234 \\ (0.83) \end{array}$	$\begin{array}{c} 0.0227\\ (0.74) \end{array}$
Age in years		-0.000145 (-0.07)	$\begin{array}{c} 0.0000372 \\ (0.02) \end{array}$		-0.000483 (-0.17)	-0.000343 (-0.11)
Can read and write		$\begin{array}{c} 0.0154 \\ (1.33) \end{array}$	$0.00248 \\ (0.19)$		$\begin{array}{c} 0.0319^{**} \\ (2.27) \end{array}$	$0.0182 \\ (1.18)$
Years in Marriage		-0.00364* (-1.66)	-0.00368 (-1.60)		-0.00419 (-1.42)	-0.00419 (-1.33)
Has at least one deceased child		-0.0429*** (-3.31)	-0.0451*** (-3.25)		-0.0751*** (-4.81)	-0.0778*** (-4.64)
HH highest education			$\begin{array}{c} 0.00217^{**} \\ (2.46) \end{array}$			$\begin{array}{c} 0.00330^{***} \\ (2.64) \end{array}$
Total land size of HH			$\begin{array}{c} 0.0000105 \\ (0.76) \end{array}$			0.0000299^{*} (1.74)
Household loan amount			$\begin{array}{c} 0.000000499^{*} \\ (1.87) \end{array}$			0.000000609^{*} (1.84)
Sex of household head			-0.0964*** (-3.39)			-0.120^{***} (-3.75)
Constant	$\begin{array}{c} 0.862^{***} \\ (80.83) \end{array}$	$\begin{array}{c} 0.946^{***} \\ (23.98) \end{array}$	$\begin{array}{c} 0.944^{***} \\ (22.04) \end{array}$	$\begin{array}{c} 0.746^{***} \\ (55.27) \end{array}$	$\begin{array}{c} 0.854^{***} \\ (16.30) \end{array}$	$\begin{array}{c} 0.838^{***} \\ (14.65) \end{array}$
Observations	4678	3976	3482	4666	3968	3475

Table 4.4.5: Impact of microfinance on family planning methods

t statistics in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

Notes:

This table provides DD estimates with no control, individual covariates and full controls. The last panel only includes full specification estimates.

^a Dummy variable equals 1 if the respondent shows a positive attitude towards contraception.

^b Details on the definition and measurements of all the variables are in Tables A1 and A2. ^c This represents the program impact in DD estimations.

Mediation Analysis

We employ the mediation analysis to test several plausible mechanisms by which the participation in microfinance could have its effects on fertility. We examine the role of child mortality and labour force participation as mediators of the relationship between microfinance and recent fertility reduction. We use a simple mediation model illustrated in figure 4.4.1, in which the mediator is alternatively child mortality, time allocated to working and child rearing and awareness of family planning.



Figure 4.4.1: Mediation model of microfinance and fertility

We first follows the mediation analysis procedure outlined in Baron and Kenny (1986) and MacKinnon, Fairchild and Fritz (2007). In order to establish a plausible mechanism through the mediators, we need to satisfy two conditions: (1) the treatment significant predicts change in the mediator, (2) the mediated variable is a significant predictor for the dependent variable, and (3) when regress the outcome variables on both the treatment indicators and the mediated variable, the treatment effect becomes smaller in size.² If these conditions are satisfied, we can conclude that there exists a partial or full mediation relationship. Table 2.9 presents the results for the two stages of the mediation analysis.

Panel A of Table 4.4.6 documents how current or past membership of a microfinance program affect the three possible mediators. Overall, the program improves self-perception towards family planning, likelihood to be employed, and reduce hours

²The first stage of a mediation analysis is to determine the effects of the treatments on outcome variables. This is discussed in Table 2.3. However, it should be noted that there may still exist a mediated relationship between the treatment and the main outcome even when there is no significant treatment effect, see Shrout and Bolger (2002).

spent on child rearing. ³ From Table 4.4.6, Panel B shows the effect of each mediated variables on the fertility of interest. Combining the results from both panels, we run the causal mediation analysis developed by Hicks and Tingley (2011) to calculate the average mediated effect, using the parametric algorithm from Imai, Keele and Tingley (2010). Table 4.A.6 in Appendix indicates that approximately 16 % of the impact of microfinance on fertility runs through child mortality - implying that microfinance reduces child mortality which further reduces recent fertility. The mediated effect of time spent on income-generated work and rearing children are reported in table 4.A.7 and 4.A.8. Overall, the total percentage of effect mediated through working hours only accounts for 1% of the impact, while the effect of child rearing time is somewhat puzzling. Microfinance reduces per-child rearing time, but rearing time is negatively associated with having fewer children - implying that a reduction in child rearing time actually has a dis-effect on the reduction of fertility. This result may be due to the endogeneity of child rearing time and fertility decision Finally, awareness family planning accounts for 4.3% of the total effect.

4.5 Robustness Checks

We perform several robustness checks on our results. First, one might be worried that our results might be driven by young or old women who have no, or few, children, who are in the tail ends of the fertility distribution. To examine if this is the case, we restrict our sample to women who were born between 1963 and 1973 and, hence, were aged between 24 and 34 at baseline. We select this age range based on the World Health Organisation classification of the most reproductive age range (WHO et al. (2006)).

³The limitation in data on child mortality does not allow us to test if the child was deceased before or after joining the program. Thus, we can only conclude on the correlation between the treatment and child mortality.

	Panel A: Treatment effect on mediators $M_{ij} = \beta T_{ij} + \varepsilon_{ij} \label{eq:main}$	Panel B: M	ial outcomes	
	(3)	(4)	(5)	(6)
	MFI	Total fertility ¹	Recent fertility (births) ²	Recent Fertility ³
Medicated variables (M) :				
Family Planning ^a	0.0385**	-0.651***	0.0219	0.0205
Child mortality ^b	(0.0155)	(0.119)	(0.0342)	(0.0231)
	- 0.163^{***}	1.739^{***}	- 0.352^{***}	-0.297***
Having a job ^c	(0.0174)	(0.0866)	(0.0230)	(0.0140)
	0.0201^{***}	0.249	-0.0999**	- 0.0588^*
Hours spent on education ^d	(0.0079)	(0.187)	(0.0479)	(0.0341)
	- 0.0979^{***}	-0.0312	-0.00617	-0.00293
Hours spent on work ^e	(0.0253)	(0.0546)	(0.0254)	(0.0220)
	0.572^{***}	0.00591	-0.0238***	-0.0133***
Hours spent on child rearing ^f	(0.0916)	(0.0162)	(0.00465)	(0.00343)
	-0.288***	-0.0779***	0.0735^{***}	0.0376^{***}
<u></u>	(0.0740)	(0.0201)	(0.00734)	(0.00488)
Observations		2687		

Table 4.4.6: Potential Mediators

* p < 0.1, ** p < 0.05, *** p < 0.01

Notes:

This table reports the two-steps in mediation analysis. Panel A presents the estimated effect of participation in MFI P on mediated variable M. Panel B presents the estimated effect of mediated variable M, controlling for participation effects.

¹ Total fertility is measured by the total number of children ever born.

² Recent births is measured by the total number of births in the past 6 years.

³ Recent fertility is a dummy variable equal to 1 if the woman has given birth in the past six years.

^a Family planning is a dummy variable that equals 1 for positive opinion on contraceptive.

^b Child mortality is a dummy variable equal to 1 if the respondent had any deceased children.

^c Having a job indicates the participant is currently have an income-generated job.

^d Having a job indicates the participant is currently have an income-generated job.
^e Time is a continuous variable of hours spent on rearing each child.

^f Time is a continuous variable of hours spent on realing each child.

Table 4.A.3 shows the DD estimates (with different sets of covariates) for the impact of microfinance on recent fertility for the most fertile birth cohort. Based on the results in column (3), which includes a full set of covariates, our results are robust when we restrict our sample to women who were in the most fertile age range at baseline.

Second, one might be concerned that our results may be driven by the small size of the treatment group, which has a high number of births. To explore this issue, we employ a panel logit regression, yielding the hazard of having another birth after joining the program. The fertility outcome variable is remodelled as a binary response that equals 1 if the woman has given birth to a child within the last six years. Table 4.A.4 presents the estimates across three specifications with different levels of controls. Being a member of the program reduces the log-odds of having another child by 1.262 estimate points in our preferred specification (column 3).

Thirdly, we examine the sensitivity of our result to attrition bias by restricting our

data to a balanced panel. We find that our results are not sensitive to the attrition of participants or the split of households. As reported in Table 4.A.5, the signs on all coefficients are fairly consistent with those reported in Table 4.4.4. However, the magnitude of the impact across all columns is lower when we limit our sample to a balanced panel.

Fourth, we check the robustness of our results using alternative definitions of microfinance participation and fertility. In the main analysis, consistent with most of the existing literature, we use the children who survive beyond birth. But, due to the conditions of health facilities during the period studied, the percentage of stillbirths may be a significant component that may affect the fertility rate. Therefore, rather than use children who survive beyond birth, as a check we define recent fertility as the total number of pregnancies in the past six years, including those who are pregnant at the time of post treatment surveys. In unreported results, all the point estimates are reduced in magnitude, but the coefficients remain significant.

In the main analysis, we exclude those women who were already microfinance members at baseline. As a final robustness check, we exclude only those women who were a microfinance member at baseline and had not received actual credit. Defining microfinance in this way increases the sample size by around 200. Our results remain robust.

4.6 Conclusions

Using a large scale panel datasets of a representative household of microfinance members from Bangladesh, We find that microfinance participation results in fertility reduction. A likely channel through which this occurs is through increased contraception awareness among women. Our results show that access to microfinance programs is also robustly associated with increases in contraceptive awareness among women. We find that in terms of the channels through which microfinance influences recent fertility that a reduction in child mortality, and increased awareness of female participants of family planning options, mediates the relationship.

An important implication of our findings is that microfinance can have considerable impact on fertility decisions, even within a short time span. Since microfinance also increases female awareness of active family planning, we expect that the impact of the program on actual fertility will persist in the long term as well. Hence, while fertility decline in Bangladesh may have preceded the introduction and expansion of microfinance as suggested by Duvendack and Palmer-Jones (2017), the program still accelerates further reduction in family size and improves the socioeconomic status of participants.

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4.A Appendix

Variable	Data Description
Age at first marriage	Age of the survey respondent at the time of their marriage , measured in years
Years in Marriage	Average length of the respondent's current marriage at the time of the survey (Almost all of our respondents only marry once)
Husband opinion on family planning	Opinion regarding contraception of the respondent's husband, measured by dummy variable that equals 1 if positive
Self-opinion on family planning	Opinion regarding contraception of the respondent, measured by dummy variable that equals 1 if positive
Practice family planning	Whether the respondent or her husband is using any contraceptive methods.
Desired number of sons	The respondent's answer to the question "How many sons are justifiable to your household condition"
Desired number of daughters	The respondent's answer to the question "How many daughters are justifiable to your household condition"
Desired number of children	The addition of desired number of sons and daughters.
Number of children everborn	The total number of children of the respondent, including deceased, but excluding stillbirth.
Ratio of girl/total children	The total number of daughters didivded by the total number of children.
Number of deceased children	Number of deceased children of the respondent, excluding stillbirth.
Number of deceased son	Number of deceased sons of the respondent, excluding stillbirth.
Can read and write	Dummy variable that equals 1 if the respondent can both read and write.
Eligibility status	Dummy variable that equals 1 if the respondent meets the criteria for microfinance application
Sex of household head	Dummy variable that equals 1 if the head of household is female.
HH highest education	The highest years of schooling of any members in the respondent's household
Total land size of HH	Total land owned by the respondent's household
Total actual loan amount of HH	Total loan amount the respondent's household owned.

Table 4.A.1: Summary of Variables (1)

Table 4.A.2: Summary of variables (2)

Variable	Data Description
Secondary School	The total number of secondary schools in the respondent's village.
Primary School	The total number of primary schools in the respondent's village.
Higher secondary school / College	The total number of higher education institutions in the respondent's village.
Maktab/Madrasa (Religious School)	The total number of religious schools in the respondent's village.
Electricity connection	Dummy variable equals 1 if the respondent's village has access to electricity
The presence of UP office	Dummy variable equals 1 if the respondent's village has at least 1 union parishads (union councils)
The presence of post office	Dummy variable equals 1 if the respondent's village has at least 1 post office
The presence of telephone office	Dummy variable equals 1 if the respondent's village has at least 1 telephone
The presence of bus stand	Dummy variable equals 1 if the respondent's village has at least 1 bus stand
The presence of fertilizer shop	Dummy variable equals 1 if the respondent's village has at least 1 fertilizer shop
The presence of playground	Dummy variable equals 1 if the respondent's village has at least 1 play ground
Wage of male adult in boro season (tk)	Average wage of male adult in the respondent's village during boro season (Jan-Jun rice season), measured in taka
Distance to nearest thala	Distance from the village to the town centre
Round	Dummy variable equals 1 if the data is from the post treatment survey.
Recent fertility	The total number of births in the past 6 years.
Total fertility	The total number of births
Participant status	Dummy variable equals 1 if the respondent or any members of her household is a member of microfinance program

	Recent fertility	Recent fertility	Recent fertility
Round 4	-2.038^{***} (-35.69)	-2.182^{***} (-26.91)	-2.215^{***} (-25.83)
Treated	$\begin{array}{c} 0.257^{***} \\ (3.21) \end{array}$	$\begin{array}{c} 0.264^{***} \\ (2.95) \end{array}$	$\begin{array}{c} 0.262^{***} \\ (2.61) \end{array}$
Post treatment \times Treated	-0.304^{***} (-3.67)	-0.339*** (-3.63)	-0.339*** (-3.29)
Age in years		0.00283 (0.28)	$0.00399 \\ (0.38)$
Practice family planning		-0.0164 (-0.38)	-0.0416 (-0.89)
Can read and write		-0.0742^{*} (-1.78)	-0.0462 (-0.95)
Years in Marriage		0.0169^{**} (2.08)	0.0179^{**} (2.15)
Has at least one deceased child		0.0905^{*} (1.86)	0.0850^{*} (1.75)
HH highest education			-0.0221^{***} (-2.65)
Total land size of HH			$0.000102 \\ (1.03)$
Sex of household head			-0.152** (-2.00)
Household loan amount			-3.66e-08 (-0.06)
Constant	$2.123^{***} \\ (40.47)$	$1.844^{***} \\ (7.93)$	$1.988^{***} \\ (8.18)$
Observations	2014	1704	1505

Table 4.A.3: Impact of Microfinance on Recent Fertility for the most Fertile Birth Cohort

t statistics in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

Notes:

These are the DD estimates for the most fertile birth cohort, as per the definition from World Health Organisation. The outcome variable is the total number births in the past six years.

^b Details on the definition and measurements of all the variables are in Tables A1 and A2.

 $^{\rm c}\,$ This coefficient represents the program impact in DD estimations.

Variables ^b	(1) Recent fertility ^a	(2) Recent fertility	(3) Recent fertility
Participation status	-1.086*** (-15.44)	-0.853^{***} (-8.59)	-0.911*** (-8.28)
Post Treatment	-2.252^{***} (-31.75)	-3.711^{***} (-27.16)	-3.943^{***} (-25.69)
Age in years		-0.000532 (-0.03)	-0.0144 (-0.66)
Practice family planning		$0.0208 \\ (0.21)$	-0.0126 (-0.12)
Can read and write		$0.158 \\ (1.51)$	$0.136 \\ (1.16)$
Years in Marriage		-0.160^{***} (-7.66)	-0.153^{***} (-6.90)
Has at least one deceased child		-1.974^{***} (-14.63)	-1.943^{***} (-13.14)
HH highest education			$0.0153 \\ (1.63)$
Total land size of HH			-0.0000626 (-0.41)
Household loan amount			$\begin{array}{c} 0.00000414 \\ (1.50) \end{array}$
Sex of household head			-0.131 (-0.61)
Constant	2.064^{***} (28.51)	5.587^{***} (13.88)	6.007^{***} (13.68)
/ lnsig2u	-13.53 (-0.87)	-15.03 (-1.01)	-14.98 (-0.14)
Observations	4861	3965	3481

Table 4.A.4: Impact of Microfinance on the Likelihood of Having Another Child After Joining the MFI

 $t\ {\rm statistics}$ in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

Notes:

This table reports panel logit estimates with no controls, individual controls, and a full set of controls.

^a Recent fertility is a dummy variable equal to 1 if the woman has given birth in the past six years. ^b Details of the definition and measurements of all the variables are in tables A1 and A2.

Variables ^b	(1) Recent fertility ^a	(2) Recent fertility	(3) Recent fertility
Round 4	-1.675*** (-31.09)	-1.736*** (-28.82)	-1.789^{***} (-26.55)
Treated	$0.100 \\ (1.45)$	$0.0799 \\ (1.18)$	$\begin{array}{c} 0.0414 \\ (0.52) \end{array}$
Round 4 \times Participation status	-0.161^{**} (-2.15)	-0.173^{**} (-2.30)	-0.149* (-1.72)
Age in years		$0.00638 \\ (0.95)$	-0.000323 (-0.04)
Practice family planning		$0.0500 \\ (1.45)$	0.0771^{*} (1.92)
Can read and write		-0.166^{***} (-4.78)	-0.156^{***} (-3.90)
Years in Marriage		$0.00477 \\ (0.68)$	$0.00976 \\ (1.33)$
Has at least one deceased child		-0.0503 (-1.28)	-0.0721^{*} (-1.72)
Self-opinion on family planning (1=positive)			-0.169^{**} (-2.52)
HH highest education			-0.0181^{***} (-3.34)
Total land size of HH			$0.0000255 \\ (0.44)$
Household loan amount			-0.000000805 (-1.17)
Sex of household head			-0.0196 (-0.26)
Constant	$1.845^{***} \\ (39.19)$	$\frac{1.665^{***}}{(13.10)}$	2.129^{***} (13.08)
Observations	3202	3102	2636

Table 4.A.5: Impact of Microfinance on Recent Fertility

 $t\ {\rm statistics}$ in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

Notes:

This table reports DD estimates on balanced data (excluding those women who are missing at either baseline or post treatment survey).

^a Recent fertility is a dummy variable equal to 1 if the woman has given birth in the past six years.

^b Details on the definition and measurements of all the variables can be found in tables A1 and A2.

^c This represents the program impact in DD estimations.

Effect	Mean	[95% Conf.	Interval]
ACME1	.0025878	.0001445	.0054622
ACME0	.0043528	.0003032	.0092745
Direct Effect 1	0258797	0516881	0029037
Direct Effect 0	0241147	0490037	0026413
Total Effect	021527	0469321	.0006866
% of Total via ACME1	1206495	9814807	.3552418
% of Total via ACME0	2029394	-1.650906	.5975368
Average Mediation	.0034703	.000253	.0072437
Average Direct Effect	0249972	0508254	0027842
$\%$ of Tot Eff mediated $^{\rm c}$	1617944	-1.316194	.4763893

Table 4.A.6: Direct and indirect effect of microfinance on recent fertility through the mediation of child mortality

This table reports the mediation analysis of family planning, using the medeff command in Stata, with 1000 simulation replications.

^a Child mortality is a dummy variable equal to 1 if the respondent had any deceased children.

^c This represents the mediated effect of child mortality.

Effect	Mean	[95% Conf.	Interval]
ACME1	-0.00031	-0.00222	0.001183
ACME0	-0.00039	-0.00302	0.001432
Direct Effect 1	-0.03253	-0.0635	-0.00334
Direct Effect 0	-0.03262	-0.06336	-0.00338
Total Effect	-0.03292	-0.0635	-0.00377
% of Total via ACME1	0.009227	0.004602	0.063876
% of Total via ACME0	0.011829	0.0059	0.081888
Average Mediation	-0.00035	-0.0026	0.001312
Average Direct Effect	-0.03257	-0.06345	-0.00336
% of Tot Eff mediated	0.010528	0.005251	0.072882

Table 4.A.7: Direct and indirect effect of microfinance on recent fertility through the mediation of working time

 $^{\rm c}\,$ This represents the mediated effect of time spent on income gerated job

This table reports the mediation analysis of working time, using the medeff command in Stata with 1000 simulation replications.

^a Time is a continuous variable of hours spent on income-generated job.

Effect	Mean	[95% Conf.	Interval]
ACME1	0034899	0075838	0001751
ACME0	0042351	009219	0001894
Direct Effect 1	024267	0538763	.0037579
Direct Effect 0	0250122	0560396	.0038596
Total Effect	0285021	0596959	.0007266
% of Total via ACME1	.1200903	2800354	1.058815
% of Total via ACME0	.1457341	3398335	1.284912
Average Mediation	0038625	0082576	0001797
Average Direct Effect	0246396	0547466	.0038088
% of Tot Eff mediated	.1329122	3099345	1.171863

Table 4.A.8: Direct and indirect effect of microfinance on recent fertility through the mediation of time rearing children

This table reports the mediation analysis of child-rearing time, using medeff command in Stata with 1000 simulation replications.

^a Time is a continuous variable of hours spent on rearing each child.

^c This represents the mediated effect of child rearing time.

Effect	Mean	[95% Conf.	Interval]
ACME1	-0.00202	-0.00647	0.000119
ACME0	-0.00302	-0.00876	0.000215
Direct Effect 1	-0.0548	-0.09659	-0.01754
Direct Effect 0	-0.0558	-0.09707	-0.01804
Total Effect	-0.05782	-0.09767	-0.02152
% of Total via ACME1	0.035247	0.02073	0.094102
% of Total via ACME0	0.052615	0.030945	0.140472
Average Mediation	-0.00252	-0.00764	0.00017
Average Direct Effect	-0.0553	-0.09676	-0.01776
% of Tot Eff mediated	0.043931	0.025838	0.117287

Table 4.A.9: Direct and indirect effect of microfinance on recent fertility through the mediation of opinion on family planning

This table reports the mediation analysis of family planning, using medeff command in Stata with with 1000 simulation replications.

^c This represents the mediated effect of family planning.

^a Family planning is a dummy variable that equals 1 for positive opinion on contraceptive.

Chapter 5

Conclusion

5.1 Summary of findings

The importance of household finance has increased significantly over time, reflecting, in part, demographic, historical, and technological transition. Arguably, the modern financial environment in which households operate can be just as dynamic and complicated as that in which corporations and institutions engage. The main goal of this dissertation has been to explore the complex and heterogeneous nature of household financial decisions.

Adding to the growing volume of financial interventions in developing countries, Chapter 2 addresses the largely unexplored area of using a financial diary as a cost-effective alternative treatment, as opposed to traditional education programs. We find that maintaining a financial diary largely works just as well as a training class.

Chapter 3 investigates the limited stock market participation of households and their tendency to underdiversify their investment portfolio. We begin by examining the behavior of retail traders/investors making investment decisions in experimental markets. Our results show that the behaviors of traders are consistent with myopic loss aversion, suggesting that information frequency and ordering can importantly impact investment decisions in experimental markets. We find that experimental behaviors help to predict, but do not fully capture, the essential real-world trading analogs of retail traders.

The focus shifts to the impact of household finance on other wellbeing outcomes in Chapter 4. We find that participating in a microfinance program, thus broadening access to the credit system, facilitates the fertility reduction that occured in Bangladesh. We examined several potential mechanism for the treatment effect

5.2 Policy implications and further discussion

A wide range of policies have been deployed to tackle challenges faced by households engaged in financial markets. However, the lack of proper program evaluation against the counterfactual poses several threats to the credibility of these programs. This dissertation contributes to the provision of rigorous impact evaluation that help inform policy decisions and innovations that seek to improve household welfare. In Chapter 2, we provide insights into the effectiveness of different forms of financial interventions. We argue in favor of maintaining a financial diary - a simplified form of treatment - to improve overall levels of financial literacy and behavior and enhance female decisionmaking autonomy. We position our study in the context of a developing country which often face a high level of budget constraints. In Chapter 3, we posit that evaluating a risky asset less often may enhance the willingness to invest and subsequently improve the portfolio diversification of households. Therefore, regulation on the communication strategy of mutual funds and other financial institutions may be welfare-enhancing for non-institutional participants (including households) in the market. Finally, from the conclusion in Chapter 4, we believe that giving households access to credit not only improves their financial wellbeing, but also enhances general household welfare.

Additionally, the three papers collectively lay the groundwork for a number of potential avenues of further research that may be of interest to policymakers. The combination of more than one type of data in Chapter 2 and 3 allows cross checking the external validity of measurement instruments in different contexts.

In terms of future research, it is is important to consider the context in the development and evaluation of the policies interventions that aim to promote household finance. Future research should focus more on using hybrid methodology and data sources in order to more comprehensively assess policy interventions.

Within the domain of financial education, it is important to consider the cost effec-

tiveness of large-scale programs, especially in developing economies. In the context of financial behaviour in the stock market, whether, and to what extent, behavioral anomalies manifest themselves in the field remains of first order importance in finance and economics. Thus, in future research, more experiments in finance should focus on making the investment environment as close to a natural setting as possible.

Further research is needed to understand the necessary requirement to scale the received results. We acknowledge, even for a large scale RCT, that our findings may be limited to the studied context. For example, rolling out a program on a country level requires a significant up-front investment in recruiting training staff and developing good internal processes (see Al-Ubaydli, List and Suskind (2017) and Al-Ubaydli, List and Suskind (2019)). Further studies advancing the techniques on causal statistical inference will also contribute to eliminating the scale-up problem.

Bibliography

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