Essays on Human and Social Capital Formation

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SUMMARY

This dissertation comprises three empirical studies addressing questions related to human and social capital formation and their consequences. Specifically, it presents empirical findings on the family environment's role on adolescents' human capital formation, the nexus between cash transfer programs and social capital, and the role of demand-side factors, such as overconfidence and trust on farmers' information-seeking behavior.

The first empirical study presented in chapter 2 of this dissertation examines the role of siblings' sex ratio on adolescents' human capital development and investigates a number of potential mechanisms by taking Ethiopia as a case study. To study the role of siblings' sex composition on human capital, it relies on the plausible exogeneity of the share of brothers for a given sibling size in the absence of sex-selective reproduction. The results from this study show that having relatively more brothers rather than sisters increases adolescents' human capital outcomes. The chapter also shows that a greater share of brothers reinforces traditional gender norms, improves males' physical wellbeing, and increases the eldest sibling's school attainment. That said, it finds no evidence that the human capital effect of brothers is mediated by either wellbeing or gender norms. Instead, it finds suggestive evidence that the brothers' effect could be driven by spillovers of parental investments in the form of the eldest sibling's role model/tutoring effects.

The second empirical study presented in chapter 3 looks into the effects of randomized conditional and unconditional cash transfer programs on Malawian adolescent women's social capital—an important but less explored outcome. The chapter contributes to the ongoing debate on whether a conditional or unconditional transfer is better at providing a least-cost social protection to the poor. Based on the results, the conditional cash transfer program increases social capital but not the unconditional cash transfer program. Further analyses reveal that adolescents with initial reciprocal beliefs drive the increase in social capital among recipients of the conditional transfer. Interestingly, the chapter shows that both programs reduce real-world altruistic behavior proxied by voting. The chapter suggests that policymakers could generate higher social cohesion by adopting conditional transfers rather than unconditional transfers.

The last empirical study presented in chapter 4 studies the demand-side constraints to information and knowledge in agriculture. Specifically, the chapter investigates the role of overconfidence and trust in farmers' information-seeking behavior using a lab-in-the-field experiment in Ethiopia. The results show that overconfidence is widespread among farmers, and it predicts less information-seeking and is associated with an efficiency loss. Moreover, the chapter shows that farmers tend to seek more information from extension agents than peer farmers and that information-seeking increases when the source is perceived as more knowledgeable. When aiming to increase the adoption of productivity-enhancing practices, farmers' overconfidence in their own information set and their trust in the quality of information shared should not be overlooked.

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To Walelign and Yohannis

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INTRODUCTION

Almost every society aspires to accumulate wealth and achieve higher economic wellbeing. To that end, social scientists, starting from Adam Smith, have been trying to understand how societies could achieve higher economic development. The findings from decades of such scholarly work show that, at the country level, many social, demographic, political, historical, geographic factors, as well as the country's initial conditions explain the wealth that it accumulates (Barro et al., 2003; Acemoglu, 2012; Rostow, 1959; Gallup and Sachs, 2000; Nunn, 2007, 2008). And, at the individual level, factors such as education, health, family background, and access to resources determine their wealth levels (Psacharopoulos and Layard, 1979; Harmon et al., 2003; Case and Deaton, 2005; Airio et al., 2005; Duarte et al., 2018).

Human capital is one of the most important factors to achieving greater economic wellbeing. As a result, increasing the stock of human capital – the knowledge, creativity, ability, experience, and health of individuals – has been identified as one of the main policy priorities by academics and governments. What the revealing saying that "the source of a nation's wealth is the skill of its people" tells us is that human capital is key to a country's success in attaining higher economic development (Schultz, 1961; Galor and Tsiddon, 1997; Mincer, 1981; Frank, 1960; Carneiro and Heckman, 2003). Similarly, at the individual level, higher human capital enables individuals to earn higher incomes and escape poverty (Morgan and David, 1963; Becker, 1975; Card, 1999). Interestingly, what seems almost obvious to us now used to be blurred a few decades ago that even economists paid little attention to studying it (Schultz, 1961).

So, how do individuals acquire and accumulate human capital? As Carneiro and Heckman (2003, p 6) state, "Human capital accumulation is a dynamic process. The skills acquired in one stage of the life cycle affect both the initial conditions and the technology of learning at the next stage. Human capital is produced over the life cycle by families, schools, and firms." Therefore, understanding the factors that affect human capital formation is an important

step to inform policy towards providing an enabling environment. Given that the family environment is where individuals spend most of their childhood and adolescence, it is important to understand how it affects their human capital development. Thus, chapter two of this dissertation contributes to our understanding of the family environments' role in adolescents' human capital formation in a low-income setting. Specifically, it studies the role of siblings' sex ratio on adolescents' human capital development among Ethiopian adolescents and tests some potential mechanisms.

Social capital, through its role in enabling collective action and reducing transaction costs, has also been identified as an important factor to economic development (Ostrom and Ahn, 2009; Ashraf et al., 2021; Algan and Cahuc, 2010). Since humans are the main players in any economy, both their individual and communal (social) behavior are integral to an economy's operations. Adam Smith wrote in his book titled "The theory of moral sentiments" about the different types of human behavior, from "social passions," such as sympathy and generosity to "unsocial passions," such as hatred and resentments to the "selfish passion," and how these behaviors interact with and affect one's economic conditions and ambitions (Smith, 1822). However, economists have only recently started studying the social environment's role in the economy and established an understanding that social factors, such as trust and altruistic/prosocial behavior, play a significant role in lubricating the economy's operation by facilitating the workings of markets (Perelman, 1998; Dasgupta, 2000) and creating conducive political environments (Fowler, 2006; Putnam, 2000). Given that studies such as Putnam (1996) show that social factors are dynamic and subject to changes, chapter 3 studies whether and how these social factors change in response to poverty reduction programs, such as conditional and unconditional cash transfers.

Cash transfers aim to improve the economic wellbeing of the poor so that they are able to invest in their children's human capital and enable them to break the inter-generational transmission of poverty (Cecchini and Soares, 2015). Latin American countries took the pioneering cash transfer initiatives with programs such as Mexico's PROGRESSA and Brazil's Bolsa Familia, and recently, similar programs are expanding to Asia and Africa (Bastagli et al., 2016). The initial model of cash transfer programs requires recipients to adhere to certain behavior, such as sending their children to school, vaccinating children, and attending health care services, earning it the name 'conditional cash transfer' (Duflo and Banerjee, 2011). These cash transfer programs have been extensively evaluated, and the evidence shows that they are largely successful at improving the beneficiaries' education and health outcomes (Gertler, 2004; Paxson and Schady, 2010; Hoddinott and Skoufias, 2004). Given that the conditional cash transfer is paternalistic by design and involves a higher cost of monitoring adherence to conditions, a more liberal model – known as unconditional

cash transfer – has also been introduced and is being scrutinized against the incumbent. Yet, thus far, there is no conclusive evidence suggesting one is superior to the other. Instead, what the evidence shows is that each transfer format has its stronghold in certain outcomes (see, Baird et al. (2013) for an excellent review of evidence). Even though the evaluation literature is rich on primary outcomes, there is limited evidence on the impacts of cash transfer programs on secondary and unanticipated outcomes. To help aid the debate on which cash transfer model is better, chapter three of this dissertation evaluates the effects of conditional and unconditional cash transfer programs on Malawian adolescent women's social capital and 'real-world' collective action behavior (proxied by voting).

Increasing agricultural productivity is another key factor to stirring economic growth and ensuring economic wellbeing as higher productivity in the sector releases more capital and labor to the more vibrant sectors of an economy (Lewis et al., 1954; Johnston and Mellor, 1961; Irz et al., 2001; Ruttan, 2002). Increasing agricultural productivity requires the use of knowledge and improved technology (Ruttan and Hayami, 1973). Cognizant of this, many governments have been designing and implementing agricultural extension services aiming to disseminate agricultural knowledge and technologies. Despite the substantial efforts, the effectiveness of such services in increasing adoption of knowledge and technologies remains weak (Birkhaeuser et al., 1991; Feder and Slade, 1986; Dercon et al., 2009). To understand the reason behind the disappointing achievements of the extension systems, researchers have started studying the supply side by using randomized controlled experiments to identify a more effective format of agricultural extension service delivery (Fafchamps et al., 2020; BenYishay and Mobarak, 2018; Kondylis et al., 2017). To complement these efforts, chapter 4 tries to understand potential demand-side factors, such as overconfidence and trust in the quality of the service on Ethiopian farmers' demand for information.

Recently, insights from cognitive and behavioral sciences have become central to understanding humans' economic decision-making behavior (Angner and Loewenstein, 2007). As a result, instead of assuming humans as rational utility maximizers, they are now seen as boundedly rational, constrained by the availability of information, their mental capabilities to process the available information, and their other-regarding preferences. Many studies have shown that humans often violate many of the characteristics of the "rational" decision-maker: they donate to charities and donate more to attractive solicitors, they procrastinate to invest in high return technologies, and they are loss averse in that they weigh losses more than gains, etc. (Landry et al., 2006; DellaVigna et al., 2012; Duflo et al., 2011; Tversky and Kahneman, 1992). Overconfidence – a mismatch between an individual's actual and perceived ability – is one of such behavioral anomalies that may have repercussions in individuals' decision-making. According to existing studies, most individuals appear to

have inaccurate and exaggerated perceptions/beliefs about their abilities, i.e., suffer from an overconfidence bias (Svenson, 1981; Matthews and Moran, 1986; DellaVigna and Malmendier, 2006). Overconfidence bias is a catastrophic behavioral bias that the Nobel laureate Daniel Kahneman says would eliminate if he had magic wands (Shariatmadari, 2015). It is against this backdrop that chapter 4 studies whether farmers are also susceptible to such behavioral bias and whether it relates to their decision to seek information.

1.1 RESEARCH QUESTIONS

This dissertation consists of three empirical chapters, each independently tackling research questions that are central to the realm of development economics. The chapters address the following research questions:

Chapter 2: Does siblings' sex composition matter in adolescents' human capital development? If yes, what are the reasons?

Chapter 3: How do conditional and unconditional cash transfer programs affect social capital and real-world collective action behavior?

Chapter 4: Do demand-side factors, such as overconfidence and trust, affect farmers' information-seeking behavior?

1.2 METHODOLOGY

To answer the research questions outlined in section 1.1, the chapters in this dissertation use data that come from a "natural" experiment (chapter 2), a randomized controlled experiment (chapter 3), and a lab-in-the-field experiment (chapter 4). This section provides a brief introduction to each of these data sourcing methods.

One of the main challenges social science research faces is the availability of high-quality data that can be used to identify a clear link between a 'cause' and an 'effect'. Even though social scientists already understood that the way to obtain such high-quality data would be to conduct controlled experiments the same way as in the natural sciences, logistical problems, among others, have constrained them from adopting the method to a desirable level. Moreover, most earlier social science experiments relied on what Henrich et al. (2010, p 29) call "Western, educated, industrialized, rich and democratic (WEIRD) societies — and particularly American undergraduates", which makes the results less representative

of most of the world's population and the results less generalizable.[1] Pioneering Economic experiment that also uses WEIRD subjects can be found as early as the 1940s by Chamberlin (1948). Recently, the use of experimental methods in Economics using non-WEIRD subjects has "exploded" according to Banerjee and Duflo (2009). The present "explosion" in the wider adoption of the experimental method can, among others, be attributed to the fact that researchers are able to conduct experiments in low-and-middle-income countries with relatively fewer resources to provide incentives that are significant enough to engage the study participants (Binswanger, 1980).

The strength of the experimental method is that it grants the researcher the ability to control what varies and what remains unchanged. Therefore, the researcher would be able to attribute differences between the experimental and control groups as the result of the thing that was allowed to vary (Banerjee and Duflo, 2009). Harrison and List (2004) categorize social science experiments into four categories based on the nature of the subject pool, type of information they bring to the tasks, the tasks, the rules, and the environment where the experiments are conducted. The categories are conventional lab experiments, artefactual (lab-in-the-field) experiments, framed field experiments, and natural field experiments. According to Harrison and List (2004)'s taxonomy, lab experiments are experiments conducted in university laboratories, mostly with student subjects, usually using abstract framing of tasks and imposed rules. Lab-in-the-field experiments are similar to laboratory experiments but differ in the nature of the subjects in that it uses non-student subjects. Framed field experiments are similar to lab-in-the-field with respect to the nature of the subject pool and the environment but differ in the type of information subjects bring to the task or the nature of the commodity used. Lastly, natural field experiments are conducted on subjects' natural environments, and that they usually might not know they are participating in an experiment. While chapter 3 of this dissertation uses data that comes from a natural field experiment conducted in Malawi, chapter 4 uses data from a lab-in-the-field experiment conducted in Ethiopia. However, in the social sciences, not everything can be experimentally manipulated, and therefore, researchers may have to rely on scenarios/settings that mimic/resemble the experimental environment to draw causal conclusions. Such approaches are referred to as "natural experiments" by Harrison and List (2004), which is what chapter 2 relies on to draw a causal inference.

[1] It is important to mention here that there are some earlier experimental studies that use partly-WEIRD (non-student population but still Western, industrialized, rich and democratic societies) subjects, such as the famous "small world problem" study by Milgram (1967) and the study of discrimination in the housing market by (Kain and Quigley, 1972); however, these types of experiments were rarer than the 'typical' laboratory experiments that rely on college student population.

1.3 OUTLINE

The rest of this dissertation constitutes three empirical chapters and a fifth chapter presenting concluding remarks.

Chapter 2 studies the role of siblings' sex ratio on adolescents' human capital development in Ethiopia. Specifically, the chapter tests whether and how having more brothers rather than sisters would affect adolescents' human capital outcomes. Similar previous studies, which are mostly concentrated in high-income countries, provide inconclusive evidence. An earlier study by Morduch (2000) on two sub-Saharan African countries – Tanzania and South Africa – also finds mixed results where it shows that in Tanzania, sisters rather than brothers increase their siblings' human capital, whereas, for South Africa, the study finds no such effects. The chapter uses the adolescents' highest grade attainment, English language skills, and math skills individually and aggregates them into an index as proxies for human capital.

The identification strategy in this analysis is that, in the absence of sex-selective reproduction, for a given number of siblings, the sex composition is determined by nature and is therefore exogenous to the households' characteristics. The results of this chapter show that having a greater share of brothers rather than sisters increases adolescents' human capital outcomes as opposed to the results from Tanzania reported in Morduch (2000). Next, the chapter examines the potential mechanisms that might be mediating the positive brothers' effect by looking into wellbeing (physical and mental), gender norms, role model/tutoring, and parental-investment spillover mechanisms. The chapter finds that while brothers increase the physical wellbeing of boys and reinforce traditional gender norms, they do not appear to be driving the positive brothers' effect on human capital. The chapter also finds no evidence that role model/tutoring effects drive brothers' effects. It, however, finds suggestive evidence that the effects might be driven by parental investment decisions and a potential spillover effect. The lesson stemming from these results vis-a-vis existing studies is that the family's role on children's human capital looks context-specific. Future research might focus on generating data that could help us understand the main mechanisms, which in turn could enlighten us on why the effects vary across different contexts.

Chapter 3 examines the impacts of conditional and unconditional cash transfer programs on recipients' social capital (proxied by generalized trust and gift-giving behavior) and a real-world collective action behavior (proxied by voting)—outcomes that are important but not directly targeted by the programs. On the one hand, both the idea that programs and policies can generate unintended consequences and that they could change behavior have been documented. Therefore, it is important to understand how cash transfer programs

affect social capital (Merton, 1936; Klitgaard, 1997; Cecchi et al., 2016). On the other hand, the debate on whether a conditional or unconditional cash transfer program is superior is still active; therefore, additional evidence on their unintended consequences would be useful to aid the ongoing debate. Chapter 3 addresses both objectives. The chapter hypothesizes that given that the two transfers follow different formats, and since in the CCT format, recipients have to reciprocate by adhering to certain conditions, it might have a stronger effect on social capital (a conditional behavior) than altruism (an unconditional behavior). The UCT, since it requires no reciprocal behavior from the recipients, might have a stronger effect on altruistic behavior, such as voting. The chapter uses data that come from a randomized cash transfer experiment conducted in Malawi to test these hypotheses. The results show that the conditional cash transfer program increases social capital and that this increase is driven by recipients who hold reciprocal beliefs. Interestingly, both programs decrease the likelihood of voting, which we speculate could be because the transfers were provided by an NGO, which could have plausibly led to lower interest in local politics among beneficiaries. Concerning their effects on unintended outcomes such as social capital and political participation, CCT appears to have the upper hand as it increases social capital while both have similar negative effects on political participation. Future research could further investigate why cash transfers decrease political participation, especially when NGOs provide them.

Chapter 4, using a lab-in-the-field experiment, studies demand-side constraints to information seeking among Ethiopian farmers. To increase farmers access to the latest knowledge and innovation and improve their productivity, many governments, in collaboration with multilateral organizations, such as The World Bank, provide free agricultural extension services. However, studies have shown weak and inconclusive evidence that the extension services are achieving their goals (Birkhaeuser et al., 1991). Consequently, many researchers, including those from The World Bank, have been experimenting with different extension service delivery formats to identify a more effective way of communicating scientific knowledge with farmers (Fafchamps et al., 2020; Shikuku et al., 2019; BenYishay and Mobarak, 2018; Kondylis et al., 2017). However, there is little work that tries to understand the demand-side factors that might be hindering farmers' uptake of information. To contribute to our understanding of the demand-side factors, chapter 4 investigates the roles of farmers' overconfidence with regards to their own knowledge-set and their trust in the knowledgeability of the sources on their information-seeking behavior. The results show that most farmers are overconfident, in line with previous evidence on many other population groups, and it strongly predicts less information seeking. Additionally, the results also show that farmers are responsive to the ability of their information sources in that they seek more information from high-trust and high-ability sources. Therefore, policymakers need to consider the role of such behavioral biases, trust, and quality in the information sources.

Chapter 5 concludes by providing final remarks, highlighting policy implications, discussing limitations of the research, and presenting avenues for future work.

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2

THE EFFECT OF SIBLINGS' SEX RATIO ON HUMAN CAPITAL DEVELOPMENT IN ETHIOPIA

Abstract

We examine the role of siblings' sex ratio on adolescents' human capital development and investigate potential mechanisms. We find that having relatively more brothers rather than sisters increases adolescents' human capital outcomes proxied by grade attainment, math skills, and English language skills. We also find that a greater share of brothers reinforces traditional gender norms, improves males' physical wellbeing, and the educational attainment of the eldest sibling. That said, we find no evidence that the human capital effect of brothers is mediated by either wellbeing or gender norms effects. Rather, it seems to be driven by the role model/tutoring effects arising from gains in the eldest sibling's education.

2.1 INTRODUCTION

The family marks the foundation for most individuals' human capital development (Bubolz, 2001; Bau and Fernández, 2021). Families' effects on human capital development start in utero and continue ex utero. In utero exposure to shocks, such as the 1918 flu pandemic, conflict, and drought have been found to negatively affect human capital development (Beach et al., 2018; Almond, 2006; Cecchi and Duchoslav, 2018; Tafere, 2018; Weldeegzie, 2017). Ex utero, not only parent characteristics but also siblings may affect human capital. For example, Altmejd et al. (2021) find that older siblings affect the educational choices of their younger siblings. Lehmann et al. (2018), De Haan et al. (2014), and Black et al. (2005) show that birth order affects human capital formation: early-born individuals acquire lower human capital than their later-born siblings. Moreover, Downey (1995) shows that larger families lead to lower human capital accumulation.

In this paper, we study the effects of siblings' sex composition on adolescents' human capital outcomes and explore some mechanisms by taking Ethiopia as our case study.

Existing studies have been examining the family environments' role in general and siblings' in particular on various outcomes. For example, Okudaira et al. (2015) study the role of siblings' sex on the development of competitive preferences among Japanese adolescents and find male children with older sisters are less competitive than male children without siblings. They also find a higher taste for competition among female children with younger brothers than female children without younger brothers and conclude that siblings' structure affects the development of such a critical preference. Also, Detlefsen et al. (2018) find that high-school children with same-sex older siblings tend to be more risk-takers than children with opposite-sex siblings and that mixed-sex sibship has stronger effects on trust and trustworthiness than same-sex sibship.[1]

Existing studies also investigate the role of siblings' sex composition on educational outcomes, although results seem to vary by subpopulation. Cyron et al. (2017) for example, find that among kindergarteners in the US, boys with an older sister perform better in math and reading than boys with an older brother, whereas for girls, they find no significant differences between older sisters and older brothers. Kaestner (1996) also reports positive effects from sisters on siblings' educational outcomes but only for Black US citizens and finds no effect for Whites. By contrast, Butcher and Case (1994) show that siblings' sex composition affects educational attainment among women in the US but not among men. Women who grew up with brothers receive more education than women who grew up with sisters. A study from outside the US by Morduch (2000) finds that having all sisters rather than all brothers increases grade attainment in Tanzania irrespective of the child's sex, and concludes that such effects are driven by sibling rivalry in a setting where parents prefer boys over girls. Interestingly, however, he finds no such siblings' sex composition effects/siblings rivalry effects in South Africa.[2] Additionally, Anelli and Peri (2015) find that the sex composition of siblings affects the choice of college majors among Italian students. They find that male children with an older sister are more likely to choose the humanities than male children without an older sister.[3]

[1]The psychology and sociology literature have also been documenting various effects of siblings on individuals. Siblings reinforce delinquent behavior among each other (Breining et al., 2020; Snyder et al., 2005; Slomkowski et al., 2001; Wang et al., 1995) and similarly, parents' and siblings' smoking behavior influences smoking in children, with a stronger effect on same-sex and same-age children (Vink et al., 2003). Middle-and last-born children are more likely to engage in risky behavior compared to first-born children, and fathers influence educational choices and transmit occupation-specific preferences (Argys et al., 2006; Oguzoglu and Ozbeklik, 2016; Dryler, 1998).

[2]Garg and Morduch (1998) also find evidence of sibling rivalry in children's health outcomes in Ghana (Meaning that children have better health outcomes if they are born to an all sisters household rather than to an all brothers household).

[3]There is also some evidence that siblings' sex composition affects earnings. Brenøe (2021) finds that Danish women who grew up with brothers are more likely to conform to traditional gender norms and earn less from their labor than those who grew up with sisters. She also reports that households with mixed-sex children tend to have a gender-specific parenting style (i.e., parents tend to have a parenting style that conforms to the

In sum, while there seems to be some evidence that siblings' sex composition affect the human capital formation, and in various stages of the life-cycle, results seem to be strongly dependent on the context and subpopulation. Moreover, most of the previous studies (with the exception of Morduch (2000)) focus in the context of Western industrialized economies, which provides little insight on sibling effects in low-income countries where family size, structures, and needs may differ from those in the West (see Bau and Fernández (2021) for a detailed discussion on the interaction between culture and the family). Families in developing countries are typically larger than their counterparts in developed countries. For example, in 2018, the total fertility rates in the USA and Europe were 1.54 and 1.73 respectively, compared to 4.7 in Sub-Saharan Africa.[4] Family relations are also likely to differ as male family members in developing countries are vital for household security and livelihoods, especially in weak institutional environments. Sons and brothers may, for example, serve as insurance mechanisms or are responsible for relaxing household liquidity constraints (Guo and Zhang, 2020; Lambert and Rossi, 2016; Zhou, 2014; Hoddinott, 1992). Therefore, our paper builds on the study by Morduch (2000) and uses recent data to extend the small evidence base on the effects of siblings' sex composition on not only on grade achievement, but also on intellectual development of adolescents' in a low-income country context.

We use data from the latest two rounds of the Young Lives project for Ethiopia. Our identification strategy is based on the assumption that, in the absence of sex-selective reproduction, for a given number of siblings, the share of brothers is determined by nature and is orthogonal to adolescent's human capital outcomes. As we elaborate later, using both data and anecdotal evidence, we show that sex-selective reproduction is unlikely in our study setting — corroborating the validity of our identification strategy. We thus estimate the effect of having more brothers instead of sisters on adolescents' human capital outcomes.

Our proxies for human capital outcomes are the highest school grade achieved, math test scores, and English language test scores. To address issues of multiple hypothesis testing, we also provide a standardized aggregate index of these three indicators. Our results show that having more brothers than sisters leads to higher math and English language skills, as well as the highest grade attained by adolescents. While these results are consistent with some previous studies from high-income countries, they contradict the predictions and findings in the siblings' rivalry literature in low-and-middle income countries, such as Morduch

traditional gender norms when they have mixed-sex children). These gender-specific norms tend to persist into the next generation of female children. Another study by Cools and Patacchini (2017) also finds that having a brother reduces women's income by up to 10% within a US sample.

[4]Sources (all visited on June 7, 2021): *https://data.worldbank.org/indicator/SP.DYN.TFRT.IN?locations=US*; *https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210323-2*; *https://data.worldbank.org/indicator/SP.DYN.TFRT.IN?locations=ZG*

(2000)'s results in Tanzania and Lei et al. (2017)'s findings in China. Additionally, we find that brothers improve physical wellbeing, but only of boys, reinforce traditional gender norms for both boys and girls, and increase eldest sibling's school attainment. That said, we find no evidence that the human capital effect of brothers is mediated by either wellbeing or gender norms effects of brothers. Rather, the positive effect seems to be arising from parental investment spillovers emanating from eldest sibling's role model/tutoring effects. Further data and research is required to pin down the exact mechanisms driving the human capital effects of siblings' sex composition and reconcile contradictions in the existing studies from different contexts.

The remainder of this paper is organized as follows. In the next section, we present our theoretical framework. In section 3.3, we present a brief background of the context, discuss the data source, present descriptive statistics, and discuss our empirical strategy. In section 4.4, we present and discuss the results and investigate potential mechanisms. Section 3.5 concludes.

2.2 THEORETICAL FRAMEWORK

To understand the role of siblings' sex composition on adolescents' human capital, we base our analyses on the family model of Becker and Tomes (1986). In the absence of credit constraints, and assuming every child has the same rate of return, the family model states that parents would invest equally in every child until the point where the additional investment equals the expected marginal rate of return. However, if households are credit-constrained, and if sex is correlated with the marginal rate of returns, they would have to allocate their limited resources in a way that maximizes the return on their investments. Consequently, households would invest more in "high-ability" children as they expect a higher return for their investment. Recent empirical evidence from Jakiela et al. (2020) show that households perceive lower returns to investments in girls than in boys. If so, and if parents would indeed invest strictly based on expected returns – and assume that men have a higher expected marginal return than women based on the current labor market outcomes – they would systematically invest more in boys than in girls (Butcher and Case, 1994; Becker and Tomes, 1986).

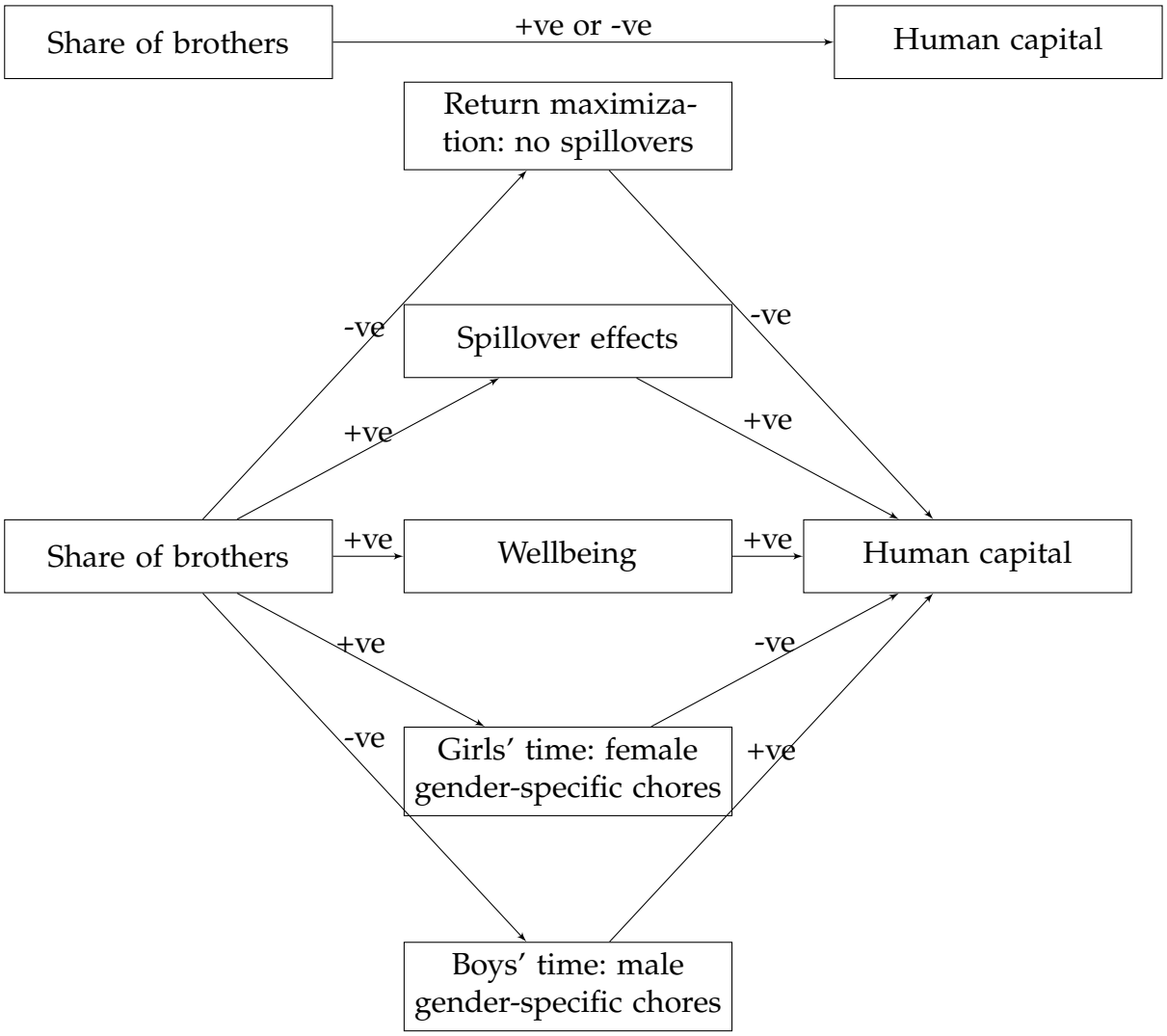
In the absence of spillovers, if parents invest strictly to maximize returns – given a certain budget and keeping the number of siblings constant – a higher share of high-ability (i.e., male) siblings would then necessarily imply a lower share of investments going to the child, regardless of it being high- or low-ability. In this case we should expect the relationship between the brothers-to-siblings ratio and human capital to be negative. However, for some

investments it is harder to assume the absence of spillovers. For example, if parents invest in nutritious food or supplementary books to help increase their returns from boys, girls would also be able to consume the food and use the books. Second, siblings could benefit from household investments in the "more-able" children because the investments could spill over in the form of tutoring or role model effects—increasing siblings' educational outcomes.

There could also be other channels than the parental investment spillover effects we outline above that might mediate the impact of sibling sex composition on human capital development. Firstly, given the gender norms in most low-income countries, boys are more likely to participate in paid work to complement household income than girls. Therefore, adolescents with more brothers could be more likely to enjoy higher consumption and have higher wellbeing–both physical and mental–than counterparts with more sisters. Moreover, a relatively higher share of brothers could lead to better wellbeing. Adolescents with more brothers could be, for example, less likely to be bullied by peers; hence, they will be more likely to feel safe and experience positive socialization with their peers. Studies show that both physical and mental wellbeing are important factors affecting human capital development. For example, Acharya et al. (2019) and Mendez and Adair (1999) show that nutrition has a positive effect on human capital development. Furthermore, studies show that positive emotion is associated with better school performance (see Valiente et al. (2012) for a comprehensive review of evidence on emotions and achievement). There is also evidence that brothers increase the subjective wellbeing of their siblings (Zhou, 2014).

Secondly, given that girls tend to work more on domestic chores than boys, having more brothers could increase girls' domestic workload but decrease it for boys (Alvi and Dendir, 2011; Dammert, 2010). Spending more time on household chores means less time available for study. In this case, we expect that boys with more brothers would have to spend less time in domestic work as they share traditionally male chores, but girls would be disadvantaged. Therefore, we expect the brothers' effect on boys' and girls' education mediated through this channel to be heterogeneous by the adolescents' sex. We discuss the detailed rationale behind each of these mechanisms, along with the regression results in section 2.4.2. Figure 2.1 illustrates the expected direct relationship between brothers and human capital outcomes (panel (a) and the mediated effects (panel (b)), respectively.

(a)



(b)

Figure 2.1: Graphical representation of the expected siblings' sex composition effects; the total effect (a) and the mediation effects (b)

2.3 METHODOLOGY

2.3.1 *Context*

Our study is set in Ethiopia, which has a mandatory (and free) eight years of primary education policy. According to 2015 statistics, the Ethiopian government spends about 4.74% of its GDP on education (WorldBank, 2020).[5] The country has achieved higher accessibility of

[5]Until 1900, education in Ethiopia has been primarily provided by the Ethiopian Orthodox Church to produce its clergy. The first "Western" style school was opened in 1908 following the permission granted by Emperor Menelik II to the European missionary schools. The main aim then was to produce bureaucrats

primary education and has expanded universities and technical and vocational schools (for example, net enrollment rate grew from 29% in 1989 to 86% in 2015).[6] However, the quality of education remains very low and arguably deteriorating (Goshu and Woldeamanuel, 2019). According to a study that uses the Young Lives (YL) data and compares learning outcomes in four countries, Ethiopia, India, Peru, and Vietnam, "At the age of 12, about half of the children in Ethiopia fail to reach the low achievement benchmark for children aged ten years." For the remaining three countries, only about a quarter of the students aged 12 fell below the achievement benchmark for children aged ten (Singh et al., 2014). Ethiopia also has a lower adult literacy rate. According to 2017 statistics, is 51.77% (59.24% for male and 44.42% for female), which is much lower than, for example, its neighboring Kenya, where adult literacy is 81.5% (85% for male and 78.2% for female) (CIA, 2020).

According to Ethiopian law, everyone who has reached the age of 18 and above has the right to form a family through the institution of marriage.[7] The average child per woman in Ethiopia in 2018 is about 4.2 children. In the late 1990 and early 2000 (during the time the adolescents in this study were born), it was about seven children per woman (WorldBank, 2018). Most Ethiopian families have distinct roles to female and male household members where females are on average more likely to be in charge of domestic chores while males are in charge of earning livelihoods (Dinku et al., 2019; Pankhurst et al., 2016).

2.3.2 *Data and descriptive statistics*

For this study, we use data from the last two rounds of the Young Lives (YL) data set collected in 2013 and 2016 GC. The YL data is collected to study childhood poverty and

that can serve the Ethiopian modernization process envisioned by the Emperor and strengthen the country's sovereignty and the power of the monarchy (the education at that time focused on teaching foreign languages). Rulers that followed, from Empress Zewditu (1916-1930); to Emperor Haile Selassie I (1930-1974), to Mengistu Hailemariam (1977-1991), to Meles Zenawi (1995-2012)) have all placed their marks in expanding "modern" education in Ethiopia (Bishaw and Lasser, 2012).

[6]Source *https://wenr.wes.org/2018/11/education-in-ethiopia*, visited on 30 June 2021

[7]Ethiopia is the second-most populous landlocked country located in the horn of Africa, with an estimated population of about 110 million. As is the case in most African countries, most of Ethiopia's population is very young; almost 60% of the population is below the age of 24 while nearly 92% is under the age of 54 (CIA, 2019*a*). According to the law, marriage is a voluntary union between a man and a woman. Because of Ethiopia's long-standing Christian traditions, the majority of its communities prohibit polygamous marriages.[8] The pre-modern law of Ethiopia, which was in place until 1934, known as the *Fetha Nagast*, (translates into "the law of the kings") prohibited polygamy (Heron, 2018). Similarly, Ethiopia's current law bans polygamy but grants regions the autonomy to set up their own marriage laws based on their people's religion, customs, and traditions. As a result, in some regions and communities, polygamous marriages are practiced. According to the Demographic Health Survey (DHS), polygamy is practiced by 11% of the Ethiopian population, with most of it coming from the Somali (29%), Benshangul-Gumuz (21%), Gambella (21%), Afar (19%), Southern Nations and Nationalities Region (16%), Oromia (14%) regions, and least practiced by the Amhara (1%), Addis Ababa (2%), and Tigray (3%) regions (CSA, 2016).

its long-term implications in four developing countries–Ethiopia, India, Peru, and Vietnam. The data is collected by the University of Oxford, The UK, in collaboration with the former Ethiopian Development Research Institute (EDRI), Ethiopia.[9] The YL data set tracks the lives of 3000 children from two age-cohorts since 2002. The older cohort consists of 1000 children born in 1994/95 (aged about eight years at the beginning of the survey), and the younger cohort consists of 2000 children born in 2001/02 (aged about 6-18 months during the first survey round). The data covers 20 sentinel sites from rural and urban areas across five regions–Addis Ababa, Amhara, Oromia, Southern Nations and Nationalities Region (SNNPR), and Tigray regions.

In our analyses, we use the rich information that the YL provides and account for various factors that could potentially affect adolescents' human capital development. These include; demographic factors, such as, sex and age, which all play a role in human capital development (examples, (Buser et al., 2017; Fyfe et al., 2017)); health and human capital development (see a review by (Currie, 2009)); parents' demographic characteristics and children's human capital development (examples, (Alves et al., 2017; Daouli et al., 2010; Becker and Tomes, 1986)); various shocks and human capital development (Haile et al., 2019; Maccini and Yang, 2009). We, therefore, account for adolescents' and parents' demographic characteristics (adolescents and parents age, sex, religion, and ethnicity); health status (whether the adolescent has/experienced any illness); and households' self-reported exposure to various shocks (such as environmental, economic, regulatory, and family shocks) in all of our regressions.

Moreover, studies show that economic status also affects human capital development. While some studies argue that there is an inverse relationship between the number of siblings and educational attainment of children (Rosenzweig and Zhang, 2009; Blake, 1989), others argue that the negative effect of the number of siblings is confounded by the fact that low-income families tend to have more children, and that the effect could be due to a spurious correlation (Downey, 1995). Currie (2009) also provides extensive evidence that supports the relationship between economic status and the development of various dimensions of human capital. Following this, we account for the economic status of families by including households' livestock ownership, land ownership, access to safety net program, and wealth index in our regressions.[10]

[9]Following the change in the government, the EDRI has been restructured in November 2018 and is currently known as the Policy Studies Institute (PSI) (PSI, 2018)

[10]The wealth index takes into account the following three broad dimensions. 1) Housing quality: this includes; the main material of walls, the main material of the roof, the main material of the floor, and household density–the re-scaled value of rooms to household size ratio. 2) Access to services: this includes; access to electricity, access to safe drinking water; access to a safely managed sanitation service; and access to adequate fuel for cooking. 3) Consumer durables: this sub-index is a measure of the household's ownership of common household items, such as TV and other country-specific household items (Briones, 2017).

Table 2.1 presents the descriptive statistics of our outcome variables in panel A; potential mechanisms in panel B and table 2.2 refers to descriptive information related to the treatment variable and other covariates.

2.3.3 *Variables*

Outcome variables

Since we aim to investigate siblings' effect on human capital development, we use the adolescents' highest school grade attained and their scores on mathematics and English language tests as key human capital development indicators. The YL project administered mathematics and English language tests to measure the learning quality across the four countries covered by the YL project. Both tests contain 40-item multiple-choice questions, solved independently by the adolescents. The mathematics test intends to gauge adolescents ability in three mathematical cognitive domains–"Knowing: the facts, concepts, and procedures students need to know"; "Applying: the ability of students to apply knowledge and the conceptual understanding to solve problems or answer questions"; and, "Reasoning: going beyond the solution of routine problems to encompass unfamiliar situations, complex contexts, and multi-step problems" (Azubuike et al., 2017, P. 5). Similarly, the English language test aims to gauge the adolescents' "functional English" skills, defined as "the application of skills in purposeful contexts and scenarios that reflect real-life situations" (Azubuike et al., 2017, P. 6). Note that, since the English language test only involves a multiple choice questions test, it only measures reading skills.[11]

The scores are then converted into percentage correct answers such that, if an adolescent answers all 40 questions, he/she has a score of 100%; or, if one answers 30 questions correctly, he/she has a score of 75%, etc. This means that our dependent variable is the percentage of correct answers in the two 40-item tests. The other indicator for human capital development–the highest grade completed–is the number of years of schooling the adolescent completed during the survey period.

To overcome the possibility of multiple hypotheses testing problems, we construct a human capital index (HCI) by aggregating the three outcome variables. For this purpose, we first standardize each variable (that is, calculate Z-scores) so that they are on an identical scale such that they have a mean of zero and a standard deviation of one. Then, after re-scaling the variables, we use a simple additive approach to construct our HCI. Finally, to make

[11] As one could imagine, implementing writing, speaking, and listening skills tests in a large scale survey are very difficult. As a result, the YL data only conducts the reading skills test as it is comparatively less demanding to implement in terms of logistics.

interpretation more straightforward, we also standardize the HCI to have a mean of zero and a standard deviation of one. While we are interested in the effect on the specific facets of this index, too, we will make reference to the index alone to make interpretations about the overall significance of our results.[12]

Based on the statistics presented in panel A of table 2.1, even though the scores range between zero and about 96, the average math test score is about 37 percent—meaning that the adolescents in our sample are, on average, only able to solve less than half of the questions correctly. Similarly, the average score in the English language test is about 44 percent; again, less than half of the questions are correctly solved. The average year of schooling successfully completed by the adolescents in our sample is about five years.[13] Figure 2.2 shows the distribution of the three human capital outcome indicators and their aggregated index.

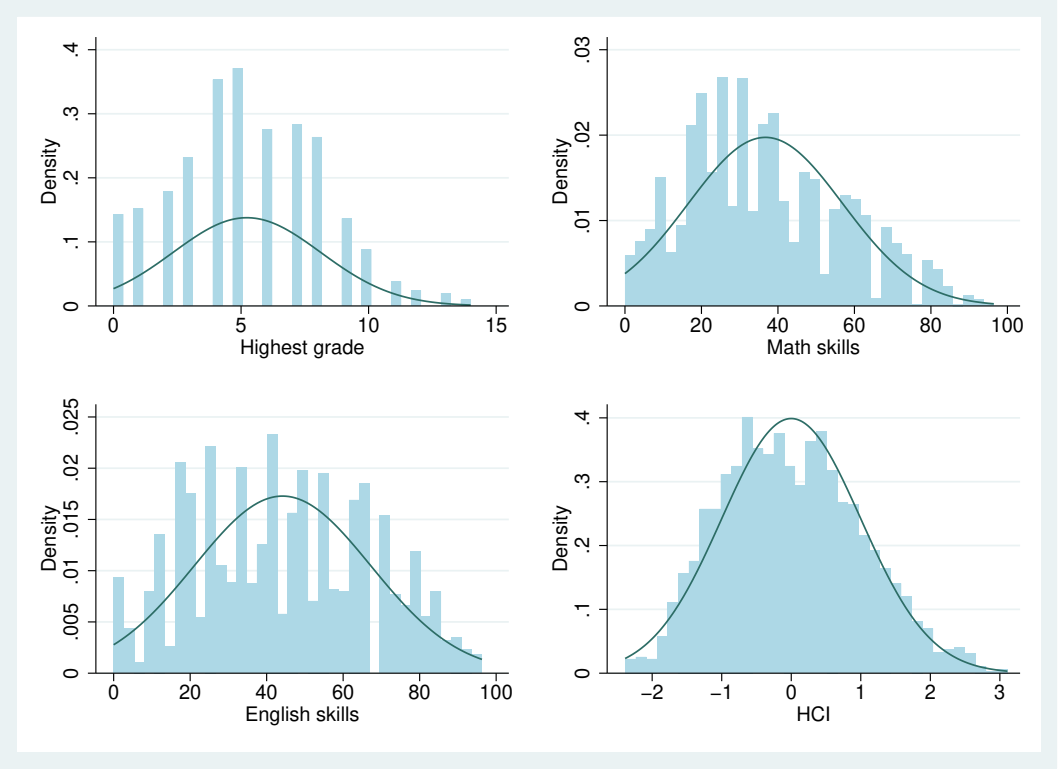


Figure 2.2: Distributions of outcome variables

[12] As we show in section 4.4, the effects of the brother-to-sibling ratio on the individual HC outcomes are all significant at the conventional significance levels–indicating that there is little reason to suspect false positives drive these results. Regardless, the fact that we find similar results when we use the aggregated measure shows the robustness of our results.

[13] Unfortunately, the math and English tests are not administered for the older cohort in 2016–the last round of the survey.

Mechanisms

As we briefly discuss in section 2.2, we hypothesize that the brothers' effect on adolescents' human capital development might be mediated through its effect on adolescents' physical and mental wellbeing and the households' gender norms. In this section, we explain how we measure them and provide descriptive statistics.

We use the BMI-for-age z-scores as a proxy for the nutritional status of adolescents. According to a YL report by Benny et al. (2018), "A child's body mass index z-score (BMIZ) indicates the child's relative position in the distribution of body mass index for a population of the same age and sex. This is expressed in terms of standard deviations from the median BMI of the reference population." Based on the descriptive statistics presented in panel B of table 2.1, the average BMI-for-age among adolescents in our sample is -1.65 standard deviations. To put this number in perspective, according to the World Health Organization, individuals are categorized as follows; Obesity, when Z-scores $> +2SD$; Overweight, when Z-scores $> +1SD$; and, Thinness, when Z-scores$< -2sd >$.[14]

We use the subjective wellbeing (SWB) measure from the YL data as our proxy for mental wellbeing. Information on the SWB in the YL data is generated by asking both adolescents and caregivers the following question; "There are nine steps on this ladder. Suppose we say that the ninth step, at the very top, represents the best possible life for you, and the bottom represents the worst possible life for you. Where on the ladder do you feel you personally stand at the present time?" Hence, SWB takes values from one to nine. As can be seen from panel B of table 2.1, the average SWB level among adolescents in our sample is 5.6.

The proxy for gender norms is the time spent on household chores and household productive tasks. Time spent on household chores is measured by the self-reported number of hours the adolescent spends working on unpaid domestic work per day. Time spent on household productive tasks is measured by the self-reported number of hours the adolescent spends working on family farms and businesses per day. Based on the statistics reported in panel B of table 2.1, on average, adolescents in our sample spend about 2 hours per day working on domestic chores (where females spend about 2.7 hours and males spend about 1.4 hours). Similarly, they spend, on average, about 1.6 hours per day working on productive tasks (where females spend about 0.8 hours and males spend about 2.3 hours). On average, adolescents in our sample spend about 3.6 hours per day on household tasks (taking the sum of hours spent on chores and productive tasks). Lastly, on average, the eldest sibling has about 5 years of schooling.

[14]Cutoffs are available here *https://www.who.int/growthref/who2007_bmi_for_age/en/*, visited on 25 October 2020.

Table 2.1: Descriptive Statistics: Outcomes and mechanisms

Variable	Mean	Std. Dev.	Min.	Max.	N
Panel A: Outcome variables					
Percentage correct in math	36.733	20.213	0	96.429	4191
Percentage correct in reading	44.151	23.087	0	96.296	4134
Highest grade achieved	5.229	2.896	0	14	4592
Panel B: Mechanisms					
Child's SWB	5.607	1.704	1	9	4573
BMI-for-age z-score	-1.651	1.099	-6.100	2.29	4142
Hours/day spent in chores: total	2.029	1.539	0	16	4577
Hours/day spent in chores: females	2.738	1.57	0	16	2151
Hours/day spent in chores: males	1.399	1.200	0	12	2426
Hours in productive tasks: total	1.599	2.303	0	15	4576
Hours in productive tasks: females	.815	1.525	0	12	2150
Hours in productive tasks: males	2.292	2.630	0	15	2426
Total hours in tasks	3.628	2.449	0	16	4576
Eldest sibling's educ	5.132	3.542	0	29	3383

Source: authors' elaboration.

Treatment and covariates

Here, we present the descriptive statistics for the main explanatory variable–the share of brothers–along with the other covariates we account for in our regression analyses. We express the share of brothers as the ratio of brothers-to-siblings. This transformation does not affect our identification assumption as the ratio of brothers to a given number of siblings would still be exogenous.

Based on the statistics presented in table 2.2, adolescents in our sample, on average, have about 1.73 brothers, 3.864 siblings, and the brothers-to-siblings ratio is about 0.44–less than half: but notice that we have more boys (53%) in our sample than girls which would lead to the lower-than half brothers-to-siblings ratio. We also check for the sex distribution of households in our sample by dividing the total boys in a household (including the YL child) to the total sibling size and find a ratio of 0.46 (also less than half).[15] About 61% of fathers and 79% of mothers are literate. The average age of our respondents is about 15 years. The average SWB of caregivers is about 5.[16] To curb the possibility of a strong correlation between the mother and the fathers' age, we re-code the variables such that we label younger mom and younger dad if their age falls below the median. About 49% of mothers and

[15]To check whether there is a systematic difference in the brothers-to-siblings ratio for any given number of siblings, we look at the summary statistics at each level of sibling size. The results show that, for example, the average brothers-to-siblings ratio at sibling size = 1 is 0.36; from 2-5 it is between 0.42-0.44; at sibling size 6, the ratio is 0.47; at 7 it becomes 0.43; at 9 it is almost 0.5; but at 10 it becomes 0.3.

[16]Subjective wellbeing of caregivers has also been measured using the 9-ladder survey instrument used to obtain the SWB of adolescents.

42% of fathers are younger than the median age of parents. On average, households in our sample have a dependency ratio of about 0.67—meaning that each working-age household member supports less than one person, on average. Households' average wealth index is 0.408, and about 76% of households own land. Approximately 19% of households are safety net beneficiaries. The majority of adolescents in our sample are Orthodox Christians (71%), followed by Muslims (16%). In terms of ethnic composition, about 28% are Amhara; about 21% Oromo; and approximately 23% are Tegaru. The most common shocks experienced by households are economic shocks encountered by 49% of households, environmental shocks experienced by about 32% of households, family shocks experienced by about 31% of households, and about 38% of respondents dwell in urban areas. Lastly, we present the summary of the birth order of the adolescents under investigation in appendix A.1. Based on the descriptive statistics reported in appendix A.1, our sample consists of adolescents with birth orders ranging from first to ninth. However, given the small proportion of adolescents after sixth order, in our regressions, we code birth orders sixth and above as 1; 0 otherwise.

Table 2.2: Descriptive Statistics: Treatment and covariates

Variable	Mean	Std. Dev.	Min.	Max.	N
Number of brothers	1.727	1.492	0	8	4592
Brothers-to-siblings ratio	0.438	0.307	0	1	4302
Number of siblings	3.864	2.243	0	14	4592
Father literate = 1	0.608	0.488	0	1	4592
Mother literate = 1	0.788	0.409	0	1	4592
Male child = 1	0.53	0.499	0	1	4592
Child's age in years	14.659	2.571	11.333	20	4576
Caregiver's SWB	4.98	1.566	1	9	3681
Younger mom = 1	0.488	0.5	0	1	4592
Younger dad = 1	0.423	0.494	0	1	4592
Dependency ratio	0.656	0.637	0	6	4498
Wealth index	0.408	0.178	0.006	0.924	4579
Land ownership	0.757	0.429	0	1	4570
Safety net = 1	0.187	0.39	0	1	4589
Orthodox = 1	0.711	0.453	0	1	4592
Muslim = 1	0.161	0.368	0	1	4592
Protestant = 1	0.107	0.31	0	1	4592
Catholic = 1	0.008	0.091	0	1	4592
Other religion = 1	0.012	0.107	0	1	4592
Amhara = 1	0.284	0.451	0	1	4592
Gurage = 1	0.076	0.265	0	1	4592
Hadya = 1	0.051	0.219	0	1	4592
Oromo = 1	0.208	0.406	0	1	4592
Sidama = 1	0.056	0.23	0	1	4592
Tigraway = 1	0.226	0.419	0	1	4592
Wolayta = 1	0.064	0.244	0	1	4592
Shock crime = 1	0.068	0.252	0	1	4592
Shock regulation = 1	0.022	0.147	0	1	4592
Shock economic = 1	0.493	0.5	0	1	4592
Shock environmental = 1	0.317	0.465	0	1	4592
Shock house = 1	0.006	0.075	0	1	4592
Shock family = 1	0.307	0.462	0	1	4592
Year = 2016	0.395	0.489	0	1	4592
Urban = 1	0.378	0.485	0	1	4590

Source: authors' elaboration.

2.3.4 *Empirical strategy*

Our identification strategy for the brothers' effect on adolescents' human capital development relies on the assumption that, for a given number of siblings, the gender assignment of siblings is determined by nature and is exogenous to the outcomes of adolescents under

investigation.[17] A similar identification strategy has been used by Zhou (2014) in his study of the effect of brothers on households' saving in China and Wang and Zhou (2018) in their study of the effect of brothers on happiness, also in China.[18]

We specify the following relationship to generate the main results.

$$HC_{hi} = \gamma Bro_i + \delta(Sib_i) + \alpha Order_i + \beta X_i + \gamma L_i + \epsilon_i \quad (1)$$

where, HC_{hi} is the human capital outcome indicator of outcome h attained by adolescent i, where h represents the mathematics and English language test scores, highest grade achieved, and HCI; Bro_i is the brothers-to-siblings ratio for adolescent i; Sib_i is the number of siblings of adolescent i; $Order_i$ is a dummy indicator for adolescent i's birth order; X_i denotes adolescent and household characteristics presented in table 2.2; L_i represents location (region and sentinel-site) fixed effects; ϵ_i is the stochastic error term; and, γ is our parameter of interest.

Our identification assumption relies on the idea that parents do not select the sex of their children either by sex-selective pregnancy termination or by following the fertility-stopping rule where parents stop fertility once the household reaches a desirable number of the "preferred" sex. In this case, the number of brothers is no longer determined by nature but endogenously by the parents. We argue below why we believe these assumptions hold in our study context.

Sex-selective pregnancy termination is unlikely among Ethiopian households because legal abortions, from 2004 on, are only allowed under specific conditions (such as if the pregnancy is considered risky for the mother's life; if the pregnancy resulted from rape or incest, and if there is fetal impairment). The law before 2004 was much stricter and allowed abortion only if the pregnancy was dangerous to the mother's health (Wada, 2008). Although there are illegal abortions undertaken by "traditional" methods, given that they have no access to ultrasound technology, they are unlikely to perform sex-selective abortions.

[17] Our measure of sibship consists of those who share either both parents or at least one parent.

[18] Other previous studies have used twins' sex composition or the sex of the second born to study outcomes on the first child. For example, Guo and Zhang (2020) uses the sex-composition of twins born to the one-child policy of China as their identification strategy to study parents' old-age care expectations from their female and male children and find that parents have higher old-age care expectations from their male children. A study by Brenøe (2021) uses the sex of the second-born sibling on the gender norms of the first-born and finds those first-born females with a second-born brother rather than sister hold more traditional gender norms. However, we are unable to use similar identification strategies for the following reasons. Firstly, our dataset does not come from a twins-targeted study. Secondly, since our sample respondents are randomly selected from a given household, they are not necessarily first-born. And since detailed data is only available for the project child, we cannot estimate the effects for first-born adolescents.

Also, the fertility-stopping rule is unlikely to apply to our households. Based on the variations in rituals that follow a child's birth, there is a good reason to suspect that parents in most Ethiopian communities may have a preference for sons.[19] To test whether the rituals have translated into a tangible son-targeting reproduction behavior among households in our sample, we adopt the following definition of the characteristics of son-targeting fertility behavior from the demography literature: "if a population practices son targeting fertility behavior, girls will be born into relatively larger families" (Basu and De Jong, 2010, P. 521). This is something we can test with our data, and we find that, in our sample, boys are born into a slightly larger sibship size, although this is not statistically significant (table 2.3 presents these results). Evidence from previous studies also confirms that, in sub-Saharan Africa, son-preference has not been an issue. For example, Rossi and Rouanet (2015), using data from 37 African countries, find that in sub-Saharan Africa, parents have a preference for child sex balance but find no evidence that shows preference to any particular sex. Additionally, the sex-ratio statistics also confirm that there is no reason to suspect a sex-selective reproduction in Ethiopia. The sex ratio at birth in Ethiopia is 1.03 male(s)/female while it is 1.11 males/females in China and India, the two countries with the "missing" women problem. Moreover, the population average sex ratio is 0.99 male(s)/female (CIA, 2019*b*).

Table 2.3: Testing for son-preference

	Mean	Std. Err.	N
Female	3.828	0.050	2,111
Male	3.877	0.045	2,360
Diff	-0.048	0.067	

Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Next, we present our analytical framework for the proposed mechanisms that could be driving the main effects. For this purpose, using the same identification assumption as in equation 1, we estimate the impact of having more brothers rather than sisters on the proposed mechanisms—physical and mental wellbeing and gender norms. We hypothesize that having more brothers rather than sisters would lead to better nutrition and mental wellbeing, which then could lead to higher educational outcomes. Similarly, we hypothesize

[19]For example, in northern Ethiopia, individuals who were around a woman that gave birth are banned from entering into the Church for 20 days if the child is a boy, and 40 days if the child is a girl. The reason is that child-birth is believed to be "unclean," and clearly, it is believed that the time it takes to be "clean" again takes much shorter when the newborn is a boy Selassie (1986). Moreover, in some communities, the number of "*elilta*"–a celebratory sound made by family and neighbors, to express their happiness for the birth of a child, also varies for boys and girls–where it is higher when the child is a boy.

that having more brothers rather than sisters would reduce the household workload for boys but increases it for girls, which then leads to higher educational outcomes for boys but lower educational outcomes for girls. Against this backdrop, we formulate the following relationship:

$$Mech_{ji} = \gamma Bro_i + \delta(Sib_i) + \theta Bro_i Xsex_i + \alpha Order_i + \beta X_i + \gamma L_i + \epsilon_i \quad (2)$$

where, $Mech_{ji}$ is an indicator showing the proposed mechanism j, where j represents the wellbeing, gender norms, and role model/tutoring mechanism indicators for adolescent i; Bro_i is the brothers-to-siblings ratios of adolescent i; $Bro_i Xsex_i$ is the interaction between the brothers-to-siblings ratios and adolescent i's sex; Sib_i is the number of siblings of adolescent i; $Order_i$ is a dummy indicator for adolescent i's birth order; X_i denotes adolescent and household characteristics presented in table 2.2; L_i represents location (region and sentinel-site) fixed effects; ϵ_i is the stochastic error term; and, γ and θ are the parameters of interest.

Lastly, we study the relationship between the brothers-to-siblings ratio, the proposed mechanisms, and the human capital outcomes by estimating the following regression equation.

$$HC_{hi} = \gamma Bro_i + \delta(Sib_i) + \zeta Mech_{ji} + \alpha Order_i + \beta X_i + \gamma L_i + \epsilon_i \quad (3)$$

where, HC_{hi} is the human capital outcome indicator h–representing adolescent i's highest grade achieved, mathematics test scores, and English language test scores; Bro_i is the brothers-to-siblings ratios of adolescent i; $Mech_{ji}$ represents mechanisms j (i.e. wellbeing, gender norms, and role model/tutoring mechanisms) of adolescent i; Sib_i is the number of siblings of adolescent i; $Order_i$ is a dummy indicator for adolescent i's birth order; X_i denotes adolescent and household characteristics presented in table 2.2; L_i represents location (region and sentinel-site) fixed effects; ϵ_i is the stochastic error term; and, γ is the parameters of interest.

2.4 RESULTS

In this section, we present and discuss the main results and mechanisms. We start with the main results that show the effect of siblings' sex composition on adolescents' human capital development. Next, we present and discuss the results that test the proposed mechanisms.

2.4.1 *Brothers and human capital*

In table 2.4, we present the results from pooled OLS estimations specified in equation 1 showing brothers' effect on the highest grade completed (columns 1 and 2), math skills (columns 3 and 4), English language skills (columns 5 and 6), and HCI (columns 7 and 8). In columns 1, 3, 5, and 7, we report the coefficient of the variable of interest–the brothers-to-siblings ratios, conditional on the number of siblings. In columns 2, 4, 6, and 8, we include parents' literacy to see if this attenuates the brothers' effect.

As can be seen from columns 1 and 2 of table 2.4, we find that a one-unit increase in the brothers-to-siblings ratio, on average, increases the highest grade completed by 0.279 years, controlling for parents' education (column 2 of the same table). In columns 3 to 6 of table 2.4, we present the pooled OLS estimates that show the effect of brothers on math and English language skills. Based on these results, we find that, on average, a unit increase in the brothers-to-siblings ratio increases math skills by about 2.64 percentage points. Similarly, we also find that brothers increase English language skills. After accounting for all relevant factors in column 6, we find that a unit increase in the brothers-to-siblings ratio, on average, increases adolescent's English language skills by about 1.94 percentage points. Lastly, the results from the aggregated measure of human capital show a positive and significant brothers' effect. Based on column 8, we find that a unit increase in the brothers-to-siblings ratio increases human capital by about 12% of a standard deviation, significant at the 1% level.

These results are in line with existing evidence that shows sibling's effects on educational outcomes. Our results conform to those in Butcher and Case (1994) where they find women who grew up with only brothers receive a higher level of education than women raised with any sisters. Our results are also, to an extent, similar to those in Joensen and Nielsen (2018) where they show that having an older brother who is enrolled in advanced math courses increases the younger brother's likelihood to choose an advanced math course. They also resemble the results in Gurantz et al. (2020), where they find younger siblings whose older siblings attained a passing score on the Advanced Placement (AP) exams to be more likely to take similar exams. On the other hand, our results contradict those in Morduch (2000) where they find that sisters rather than brothers increase grade achievement in Tanzania and those in Lei et al. (2017) where they also find a greater share of sisters rather than brothers to increase educational attainment in China. While evidence on the effect of brothers on linguistic skills is limited, for example, our results that show a positive brothers' effect on English language skills contradict those in a recent study by Jakiela et al. (2020) where they find that older sisters, rather than older brothers increase their younger siblings' vocabulary.

Result 1: Siblings' sex composition matters in adolescents' human capital development. On average, having more brothers than sisters leads to higher human capital both in terms of an aggregated HCI as well as disaggregated HC indicators–years of schooling, math skills, and English language skills.

Table 2.4: Brothers and human capital development

	Highest grade		Math skills		English skills		HCI	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES								
Brothers-to-siblings ratio	0.285***	0.279***	2.659***	2.638***	2.009**	1.940**	0.123***	0.121***
	(0.0915)	(0.0915)	(0.917)	(0.919)	(0.902)	(0.902)	(0.0370)	(0.0370)
Number of siblings	-0.0417**	-0.0432**	-0.294	-0.281	-0.445**	-0.453**	-0.0207***	-0.0208***
	(0.0195)	(0.0195)	(0.193)	(0.193)	(0.190)	(0.190)	(0.00765)	(0.00766)
Father literate = 1		0.0686		-0.189		0.631		0.0147
		(0.0722)		(0.657)		(0.691)		(0.0274)
Mother literate = 1		7.99e-05		1.644**		1.308		0.0530*
		(0.0810)		(0.764)		(0.800)		(0.0316)
Constant	-3.324**	-3.408**	-13.76	-13.78	-3.480	-4.205	-3.443***	-3.466***
	(1.403)	(1.407)	(13.25)	(13.29)	(11.95)	(11.91)	(0.522)	(0.523)
Observations	3,384	3,384	3,044	3,044	2,958	2,958	2,954	2,954
R-squared	0.545	0.546	0.346	0.347	0.550	0.551	0.506	0.506
Birth order	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses. Controls include all the adolescent and household covariates listed in table 2.2 as well as region and sentinel-site fixed effects. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

2.4.2 *Mechanisms*

This section examines potential mechanisms that might be driving the positive brothers' effect on their siblings' human capital development. As we outline in section 2.2, we hypothesize that the brothers' effect could be driven by its effect on wellbeing (both via parental investment decisions and direct contribution to the household resources), gender norms, or the role model/tutoring effect of brothers.

Brothers and wellbeing

Here we hypothesize that households with more boys tend to have a higher investment in children's human capital in one or both of the following two ways. First, in families with more "high-ability" children (i.e., boys), parents would invest more in boys. Since it would be difficult to exclude "low-ability" children from consumption, all children would benefit (we call this parental investment spillover effect). Second, in most developing countries' households, boys are more likely to participate in income-generating labor than girls. On the other hand, girls are more likely to take part in household chores, such as preparing food and cleaning the house, than working for a wage (Alvi and Dendir, 2011; Dammert, 2010). Therefore, households with more boys would have more resources from the paid work by male members (we call this a complementarity effect). Due to these two reasons, we expect that adolescents with more male siblings would have more resources and enjoy higher wellbeing—both physical and mental.[20]

Consecutively, higher levels of physical and mental wellbeing may create fertile ground for human capital development. For example, Acharya et al. (2019) find that poor nutrition negatively affects math and reading skills as well as grade achievement in India. Similarly, Mendez and Adair (1999) find a negative association between early childhood stunting and late-childhood cognitive performance among Filipino children. Similarly, studies show that SWB is positively associated with academic achievement (Ng et al., 2015; Lewis et al., 2011; Gilman and Huebner, 2006; Rode et al., 2005). If this is indeed the case, we expect brothers to positively affect the adolescents' physical and mental wellbeing than sisters, which will improve adolescents' intellectual development and educational achievement.

To test for the resource spillover and complementarity mechanisms, we first investigate the effect of having a greater share of brothers on adolescents' physical and mental wellbeing.

[20] Additionally, there is evidence that shows that siblings' sex composition affects the psychosocial outcomes of adolescents and children. For example, studies show that boys who grow up with many brothers are more likely to develop "a more failure-resistant form of self-esteem" ((Winch, 1965), cited in Conley (2000)). Specifically, a previous study by Wang and Zhou (2018) finds that, in China, having one brother instead of a sister increases the subjective wellbeing of their siblings.

Then, we investigate the relationship between physical and mental wellbeing and human capital outcomes. As we explain and describe in section 2.3.3, we use BMI-for-age as a proxy for physical wellbeing and subjective wellbeing as the proxy for mental wellbeing. We make the following argument to disentangle the spillover effect from the complementarity effect. If the brothers' effect is due to their contribution to household resources (complementing household resources), we would expect older brothers to be more important than younger brothers as older brothers are most likely to work on paid jobs. If the brothers' effect emanates from the parental investment spillovers, the number of brothers would be more crucial than the brothers' age. Thus, to examine which one of these mechanisms is at play, we use the sex of the eldest sibling and test whether having a brother as the eldest sibling rather than a sister would explain all or most of the brothers-to-siblings ratio' effects.

We start by presenting the brothers' effect on physical and mental wellbeing specified in equation 2 in table 2.5. In columns 1-4 of table 2.5, we present the effects on physical wellbeing–proxied by BMI-for-age. In the first column, we exclude the interaction term between the brothers-to-siblings ratio and adolescent's sex and parents' literacy. In column 2, we include the interaction term but exclude parental literacy. In column 3, we incorporate both the interaction term and parental literacy. In column 4, we include the eldest sibling's sex to test whether the brothers' effect is due to the brothers' contribution to household resources. In columns 5-8, we repeat a similar inclusion of variables and investigate the brothers' effect on mental wellbeing–proxied by adolescents' subjective wellbeing.

As can be seen from table 2.5, we find that a greater share of brothers indeed increases physical wellbeing, but only for boys. The positive and significant effect reported in the first column disappears when we control for the interaction between the brothers-to-siblings ratio and the adolescents' sex in column 2. However, the interaction term shows that there is a positive brothers effect on boys' BMI-for-age. On average, a unit increase in the brothers-to-siblings ratio leads to an approximately 0.197 standard deviations increase in boys' BMI-for-age (significant at 10%). These results remain the same in column 3, where we also account for parental literacy, and in column 4, after accounting for having a brother as the eldest sibling. These results hint that it might be the spillover from parental investment decisions that matter in improving boys' physical wellbeing rather than the brothers' contribution to household resources (this is because the inclusion of older brother would change the results if the effects were driven by brothers' contribution to household resources). Contrarily, we find no brothers' effect on adolescents' SWB. Based on the results presented in columns 4 (without an interaction term between the brothers-to-siblings ratio and adolescents' sex) and 5 (with the interaction term) of table 2.5, there seems to be a positive and significant brothers' effect on SWB. However, the effect disappears when we incorporate parents' literacy in

column 6. Interestingly, fathers' literacy comes out as a stronger predictor of adolescents' mental wellbeing than brothers. We speculate that this effect could be driven by parenting styles correlated to literacy, rather than brothers' complementarity to household resources. These results do not replicate those in Wang and Zhou (2018) where they find brothers to have a positive effect on the subjective wellbeing of their siblings in China.

> *Result 2:* Siblings' sex composition matters in adolescents' physical wellbeing but not on mental wellbeing. On average, having a greater share of brothers leads to higher BMI-for-age for boys, but not girls.

Table 2.5: Brothers and adolescents' physical and mental wellbeing

	BMI-for-age z-score				Child's SWB			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES								
Brothers-to-siblings ratio	0.172***	0.0710	0.0754	0.0435	0.156*	0.212*	0.193	0.146
	(0.0566)	(0.0830)	(0.0830)	(0.0936)	(0.0858)	(0.125)	(0.125)	(0.145)
Number of siblings	0.000298	0.00104	0.00160	0.00173	0.0201	0.0197	0.0146	0.0148
	(0.0118)	(0.0119)	(0.0119)	(0.0119)	(0.0178)	(0.0178)	(0.0178)	(0.0178)
Male child = 1	-0.311***	-0.395***	-0.395***	-0.395***	-0.0575	-0.0112	-0.0104	-0.0105
	(0.0355)	(0.0613)	(0.0614)	(0.0614)	(0.0528)	(0.0936)	(0.0933)	(0.0933)
Brothers X Male		0.189*	0.190*	0.191*		-0.105	-0.106	-0.105
		(0.113)	(0.113)	(0.113)		(0.170)	(0.170)	(0.170)
Father literate = 1			-0.0371	-0.0360			0.231***	0.233***
			(0.0425)	(0.0425)			(0.0654)	(0.0655)
Mother literate = 1			-0.0637	-0.0632			0.0169	0.0177
			(0.0462)	(0.0462)			(0.0754)	(0.0755)
Eldest brother = 1				0.0316				0.0468
				(0.0450)				(0.0691)
Constant	-1.367*	-1.400*	-1.342*	-1.360*	4.240***	4.259***	3.981***	3.954***
	(0.763)	(0.762)	(0.763)	(0.763)	(1.186)	(1.185)	(1.173)	(1.174)
Observations	3,374	3,374	3,374	3,374	3,374	3,374	3,374	3,374
R-squared	0.181	0.182	0.183	0.183	0.242	0.242	0.245	0.245
Birth order	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses. Controls include all the adolescent and household covariates listed in table 2.2 as well as region and sentinel-site fixed effects. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Brothers and gender norms

Another reason brothers could affect educational achievement could be through their effect on the gender norms. The gender norm in most developing countries is that boys participate more in income-generating labor and less in doing domestic chores than girls. A study by Alvi and Dendir (2011) shows that older boys in Ethiopia are more likely to participate in the paid labor market while girls tend to work domestically, regardless of the gender of their younger siblings. Similarly, Dammert (2010), in two Latin American countries, finds that older boys spend more time in both paid and domestic labor. In contrast, older girls spend more time in household labor compared to their younger counterparts. Given that females tend to run most domestic chores, having more brothers instead of sisters would increase girls' domestic workload and reduce their time available for studying. Conversely, for boys, having more brothers rather than sisters could mean that they have someone to share their household responsibilities with–possibly granting them additional time that they can spend studying, thereby increasing their educational achievements.

Therefore, we start our analysis by investigating whether household chores are gendered in our sample population. For this purpose, we use the information on time spent on household chores (such as cooking and cleaning) and household productive tasks (i.e., time spent on family farms and businesses) and study how brothers affect boys' and girls' time spent on the tasks mentioned above. As we show in columns 1 and 3 of table 2.6, in line with existing evidence, we find that, compared to girls, boys spend less time on household chores but spend more time on productive tasks. We find that boys, on average, spend about 1.2 fewer hours per day on household chores but spend about 1.5 more hours on productive tasks. As we show in column 5, overall, we find that boys spend 0.26 more hours working on household tasks than girls.

Table 2.6 presents the brothers' effect on household chores in columns 1-2; those that show the effect on productive tasks in columns 3-4; and those that show the effect on overall time spent on household tasks in columns 5-6. In column 1, we only look at the average main effect of brothers and find no statistically significant effect. However, in column 2, when we include the interaction term between the brothers-to-siblings ratio and adolescent's sex, we find that a unit increase in the brothers-to-siblings ratio reduces the domestic workload for boys while increasing it for girls. Based on the results reported in column 2, we find that a unit increase in the brothers-to-siblings ratio reduces boys' domestic workload by about 0.07 hours per day.

Next, we look at the brothers-to-siblings ratio effect on hours spent on productive household tasks, reported in columns 3-4 in table 2.6. Similarly, in column 3, excluding the interaction

term between the brothers-to-siblings ratio and adolescents' sex and parental literacy, we find no significant effect. However, when we include the interaction term in column 4, we find that our variable of interest increases boys' time spent on productive tasks. We find that, on average, a unit increase in the brothers-to-siblings ratio increases boys' time spent on productive tasks by about 0.065 hours per day. Columns 5 and 6 show that the total number of hours in any task is unaffected by the brothers-to-siblings ratio.

These results are consistent with some of the findings of existing studies in developed countries' contexts. For example, Brenøe (2021) finds that Danish women with younger brothers are more likely to conform to traditional gender norms than women with younger sisters. Her results also show that parents with mixed-sex children tend to practice a gender-specialized parenting style than parents with same-sex children. Our results also partly confirm those in Dahl et al. (2020) where they find, in Sweden, gender norms spillover across same-sex siblings but not across mixed-sex siblings. Our results are in line with the same-sex spillover of norms found in Dahl et al. (2020) as we could argue that brothers increase their male siblings' time spent on productive tasks because of a spillover effect as it could be the case that boys who work at the family business motivate/inspire their brothers to follow suit or induce competitive behavior. The existence of competition among siblings is documented in the literature. For example, a study by Peter et al. (2018) finds that boys who grew up with brothers earn more and tend to have better family formation outcomes driven by the competitive behavior among brothers.

Table 2.6: Brothers and gender norms

	Hours in chores		Hours in productive tasks		Total hours in tasks	
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Brothers-to-siblings ratio	0.0532	0.200*	-0.0993	-0.278**	-0.0450	-0.0756
	(0.0645)	(0.103)	(0.0946)	(0.116)	(0.102)	(0.134)
Number of siblings	-0.0187	-0.0199	0.0617***	0.0653***	0.0429*	0.0453**
	(0.0139)	(0.0139)	(0.0214)	(0.0215)	(0.0226)	(0.0228)
Male child = 1	-1.202***	-1.083***	1.466***	1.314***	0.261***	0.230**
	(0.0407)	(0.0703)	(0.0592)	(0.104)	(0.0637)	(0.111)
Brothers X Male		-0.271**		0.343*		0.0701
		(0.129)		(0.185)		(0.201)
Constant	1.225	1.284	2.866	2.899	4.137	4.232
	(1.166)	(1.168)	(2.586)	(2.562)	(3.231)	(3.218)
Observations	3,378	3,378	3,377	3,377	3,377	3,377
R-squared	0.345	0.346	0.375	0.375	0.308	0.308
Parental literacy	YES	YES	YES	YES	YES	YES
Birth order	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses. Controls include all the adolescent and household covariates listed in table 2.2 as well as region and sentinel-site fixed effects. All columns also control for sibling size. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Result 3: The total time spent performing any task is unaffected by the brothers-to-siblings ratio. However, having a greater share of brothers reinforces households' traditional gender norms: it decreases boys' time spent on household chores but increases their time spent on productive tasks—vice versa for girls.

Brothers as role models/tutors

In the previous sections, we study whether siblings' sex composition affects adolescents' physical and mental wellbeing and the households' gender norms and find that sibling sex composition matters and that having more brothers rather than sisters increases physical wellbeing and reinforces traditional gender norms. In this section, we zoom in on the role of brothers as role models/tutors. We hereby keep in mind that not all brothers would be equally important in affecting their siblings' human capital and that the eldest siblings would be more important. Our expectation is that if the brothers' effect is only purely through its effect on increasing parental investments, only the number of brothers and not the brothers' age should be important. However, suppose spillovers of parental investments drive the brothers' effect. In that case, we expect that eldest siblings with a greater share of brothers rather than sisters would acquire higher educational attainment, which in turn would spill over to their siblings in the form of role model/tutoring effects.

In column 1 of table 2.7, we present the results that show the effects of brothers-to-siblings ratio on the highest grade attained by the eldest sibling controlling for the eldest sibling's sex. In the second column, we also include an interaction term between brothers-to-siblings ratio and the eldest sibling's sex to test for the existence of resource rivalry between same-sex siblings. Based on the results in column 1, we find that, on average, a unit increase in the brothers-to-siblings ratio increases the eldest sibling's grade attainment by about 0.39 years (significant at 10%). In column 2, when we include an interaction term, the effects appear to be prominent if the eldest sibling is a female. Looking at the interaction term, we find those eldest males with a greater share of brothers have lower grade attainment, which can be interpreted as an indication of resource rivalry among male siblings and in line with the results of Morduch (2000).

Result 4: Having a greater share of brothers increases the eldest sibling's educational attainment, on average. However, there is suggestive evidence that it decreases it for male eldest sibling.

Table 2.7: Spillover mechanism

VARIABLES	(1) Eldest sibling's education	(2)
Brothers-to-siblings ratio	0.394*	0.795***
	(0.208)	(0.295)
Number of siblings	0.280***	0.265***
	(0.0343)	(0.0348)
Eldest brother = 1	-0.316***	0.120
	(0.120)	(0.240)
Brothers X Eldest male		-0.877**
		(0.438)
Constant	4.598**	4.412**
	(2.226)	(2.250)
Observations	2,654	2,654
R-squared	0.306	0.307
Parental literacy	YES	YES
Birth order	YES	YES
Controls	YES	YES

Robust standard errors in parentheses. Controls include all the adolescent and household covariates listed in table 2.2 as well as region and sentinel-site fixed effects. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

2.4.3 *Mediation analyses*

In table 2.8, we present the results of our mediation analysis that we specify in equation 3. Here we only focus on our aggregate measure of human capital–i.e., HCI. We, however, provide detailed analyses on the individual HC indicators in appendix A.2 which yield similar results. In column 1, we show the main effect to provide a reference point. In column 2, we test for the wellbeing mechanisms; in column 3, we test for gender norms mechanisms; and in column 4, we test for the spillover (role model/tutoring) mechanism.

First, we discuss the wellbeing mechanisms. Based on the results reported in column 2, we do not find evidence that the wellbeing mechanisms mediate the brothers' effect on human capital development. Even though we find no relationship between wellbeing and the aggregated human capital measure, the disaggregated analyses reported in appendix A.2 show some evidence that physical wellbeing affects the highest grade completed but not math and English language skills. Furthermore, we find some evidence that mental wellbeing has a positive relationship with both the highest grade completed and math skills, but not with English language skills.

Second, we look at the gender norms mechanism. Recall that in section 2.4.2 we find evidence that brothers reinforce traditional gender norms as we find that brothers reduce boys' time spent on household chores (traditionally female roles) but increase their time spent on productive tasks (traditionally male roles). Assuming that spending more time on household tasks reduces the time spent studying, we expect an inverse relationship between time spent on household tasks and human capital outcomes. Therefore, in our mediation analysis, we expect that, if the gender norms are at play, given that brothers reinforce traditional gender norms, we expect that the brothers' effect would be magnified when we account for the gender norms indicators.

However, based on results reported in column 3, we again find no evidence that gender norm is at play in mediating the brothers' effect on HC. As expected, time spent in chores and productive tasks (family businesses) is negatively and significantly correlated with the HCI (as well as all the three indicators of human capital development whereas, time spent in household chores is only significantly and negatively related to math skills (see A.2)). Based on the results in column 3, a unit increase in time spent on household chores is associated with about 0.022 standard deviations lower HCI that is significant at 5%. A unit increase in time spent on family businesses is associated with an HCI that is about 0.044 standard deviations lower and significant at 1%.

Lastly, looking at the results reported in column 4 of table 2.8, we find evidence that highly educated eldest siblings seem to explain the brothers' effect on HCI (as well as all the three human capital outcomes (see A.2)). This could be attributed to a role model/tutoring effect. However, we find no statistically significant interaction effect between the eldest sibling's sex and the eldest sibling's education level. This means that this role model/tutoring effect takes place regardless of the eldest siblings' sex, as long as their education level is high. We interpret this as an indication that it is the spillover of parental investment decisions that drive the positive brothers' effect on human capital development, not the sex of the siblings itself.

> *Result 5:* We find no evidence that the positive brothers' effect on adolescents' human capital is mediated by its effect on wellbeing or gender norms. However, we find evidence that the effect is driven by the eldest sibling's education.

Table 2.8: Mediation analysis for brothers' effect on human capital

VARIABLES	(1)	(2)	(3)	(4)
	HCI			
Brothers-to-siblings ratio	0.115***	0.114***	0.142***	0.0604
	(0.0370)	(0.0371)	(0.0438)	(0.0534)
BMI-for-age z-score		0.00196		
		(0.0113)		
Child's SWB		0.00936		
		(0.00726)		
Hours in chores			-0.0227**	
			(0.0106)	
Hours in productive tasks			-0.0435***	
			(0.00751)	
Brothers X Male			-0.0387	
			(0.0464)	
Eldest brother = 1				-0.0173
				(0.0513)
Eldest sibling's educ				0.0252***
				(0.00635)
Eldest male X Eldest educ.				0.00605
				(0.00889)
Constant	-3.512***	-3.565***	-3.316***	-4.084***
	(0.519)	(0.521)	(0.502)	(0.559)
Observations	2,954	2,946	2,954	2,312
R-squared	0.505	0.506	0.513	0.516
Parental literacy	YES	YES	YES	YES
Birth order	YES	YES	YES	YES
Controls	YES	YES	YES	YES

Robust standard errors in parentheses. Controls include all the adolescent and household covariates listed in table 2.2 as well as region and sentinel-site fixed effects. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

2.5 CONCLUSION

The family environment is where children spend most of their critical growth period and develop not only their character but also much of their skill set. Understanding the role of family environments and intra-household resource distribution in their development is therefore important to explain later life outcomes. In this paper, we focus on examining the role of siblings' sex ratio on human capital development and explore some mechanisms in a developing country context.

We show that adolescents with a greater share of brothers over the total siblings have higher human capital outcomes. Furthermore, we find evidence that a higher brothers-to-

siblings ratio increases boys' physical wellbeing, but this does not seem to be driving the positive human capital gains. We also find that a higher brothers-to-siblings ratio reinforces traditional gender norms—resulting in more house chores for girls and less for boys and more productive household tasks for boys and less for girls. This too, however, does not mediate the observed human capital outcomes. Instead, our results show that having a highly educated eldest sibling, regardless of their sex, seems to be important for adolescents' human capital development and explains away the brothers-to-siblings ratio effect. Taken together, these results suggest that the positive effects of the brothers-to-siblings ratio on human capital might be due to spillover effects from the high-investment decisions taken with regards to perceived high-ability children—i.e., boys. Future research may test this spillover argument more directly by using fine-grained and accurate data on investments in education and household consumption goods that may indirectly affect educational outcomes.

All in all, our study sheds new light on the complex dynamics of sexed intra-household resource distribution and their consequences on the human capital development of children, with implications that speak to both theory and policy. From a theoretical perspective, we find that decisions based on the expected return to investments are dominated by spillovers of parental investments, resulting in a positive relationship between the share of brothers and human capital outcomes. Especially in developing countries' contexts, the perception that girls have, on average, lower marginal returns than boys will be perpetuated until the investment gap in girls is closed—allowing girls to perform on an equal playing field. From a policy perspective, the finding that children born to families with more male siblings may benefit from higher investments in human capital regardless of their sex, and vice versa, highlights the importance of targeting interventions aimed at reducing this gap, especially for children born to families with a female-skewed sex ratio.

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A

APPENDIX: TABLES

Table A.1: Birth order

Birth order	Number	Per cent
First born	1,174	26
Second born	1,185	26
Third born	1,022	22
Fourth born	678	15
Fifth born	351	8
Sixth born	138	3
Seventh born	35	1
Eighth born	8	0
Ninth born	1	0
Total	4,592	100

Source: authors' elaboration.

Table A.2: Mediation analysis: brothers' effect on human capital

	Highest grade			Math skills			English skills		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES									
Brothers-to-siblings ratio	0.242***	0.402***	0.0571	2.725***	1.976*	1.284	1.733*	2.559**	2.133
	(0.0916)	(0.108)	(0.135)	(0.920)	(1.113)	(1.344)	(0.905)	(1.074)	(1.326)
BMI-for-age z-score	0.0583**			-0.0918			-0.0112		
	(0.0287)			(0.272)			(0.282)		
Child's SWB	0.0391**			0.331*			0.291		
	(0.0186)			(0.185)			(0.181)		
Hours in chores		-0.0419			-0.736***			-0.320	
		(0.0306)			(0.242)			(0.256)	
Hours in productive tasks		-0.180***			-0.912***			-0.641***	
		(0.0221)			(0.167)			(0.186)	
Brothers X Male		-0.245**			1.267			-1.214	
		(0.113)			(1.179)			(1.129)	
Eldest brother = 1			-0.107			0.683			-2.443*
			(0.127)			(1.256)			(1.313)
Eldest sibling's educ			0.0700***			0.488***			0.220
			(0.0149)			(0.151)			(0.168)
Eldest male X Eldest educ.			0.0325			-0.00475			0.311
			(0.0208)			(0.222)			(0.226)
Constant	-3.735***	-2.477*	-5.580***	-14.37	-11.00	-12.04	-8.038	-2.048	-17.49
	(1.387)	(1.297)	(1.580)	(13.13)	(13.16)	(15.49)	(12.29)	(11.63)	(14.45)
Observations	3,365	3,377	2,656	3,034	3,044	2,395	2,950	2,958	2,318
R-squared	0.544	0.563	0.554	0.349	0.354	0.357	0.551	0.552	0.546
Parental literacy	YES	YES	YES	YES	YES	YES	YES	YES	YES
Birth order	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses. Controls include all the adolescent and household covariates listed in table 2.2 as well as region and sentinel-site fixed effects. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

3

CASH TRANSFERS AND SOCIAL CAPITAL

Abstract

We examine the social capital implications of randomized conditional and unconditional cash transfer programs that target adolescent women and their households in Malawi. Our results show that the conditional cash transfer (CCT) program has more potent positive effects on social capital than the unconditional cash transfer (UCT) program. Further analyses reveal that adolescents with initial reciprocal beliefs drive the increase in social capital from the CCT. Surprisingly, we find that both programs reduce real-world collective action behaviour: voting at national or local elections. These results contribute to the current debate on whether CCTs or UCTs are better policy tools, adding the important dimension of social capital formation. At the same time, they caution that such transfers may erode the process of democratic participation if they are perceived to be detached from it.

3.1 INTRODUCTION

Social capital plays a critical role in spurring economic growth and development, among others by enabling collective action (Svendsen and Svendsen, 2003; Ostrom and Ahn, 2009; Ashraf et al., 2021; Algan and Cahuc, 2010). As Kenneth Arrow puts it, "It can be plausibly argued that much of the economic backwardness in the world can be explained by the lack of mutual confidence" (Arrow, 1972, Pp. 357). Further studies also support Arrow's argument on the role of social capital in the economy. For example, Knack and Keefer (1997), using cross-country data, show that higher social capital, proxied by generalized trust levels, is associated with higher economic achievement. Zak and Knack (2001) also reaffirm the positive relationship between trust and economic growth and show that low-income countries with high levels of trust are better placed to reap their advantages of backwardness

than their counterparts with low levels of trust.[1] In Africa, two complementary studies by Nunn (2008) and Nunn and Wantchekon (2011) show that the slave trade decreased economic growth through its effect on reducing trust among Africans.[2]

In this paper, we study whether cash transfers affect social capital, and examine whether their effect varies based on their degree of conditionality—a missing element in the existing debate on conditional vs. unconditional cash transfers. Additionally, we extend our analyses to examining the implications of the two cash transfer programs on a 'real-world' collective action behavior—voting.

Cash transfer programs have become popular policy tools among countries that aim to alleviate poverty and enable poor households to break the inter-generational poverty trap by encouraging investments in children's human capital. The two most widely used cash transfer formats are conditional cash transfer (CCT) and unconditional cash transfer (UCT). In the CCT format, the cash transfers are conditioned on certain desirable (at least from the provider's point of view) behavioral changes, such as sending children to school or visiting health care facilities. Contrarily, the UCT involves no conditions: beneficiaries are not required to change their behavior in exchange for the transfer they receive (Standing, 2014).

Even though the evaluation literature that examines the effects of cash transfer programs is rich, it mainly focuses on their intended impacts (primary outcomes).[3] Recently, there

[1] Advantage of backwardness is the idea that low-income countries have the opportunity to learn from the technologies and experiences of high-income countries and grow faster rather than engage in costly experiments that high-income countries in the lead have to go through.

[2] Trust also affects other intermediary factors that drive economic growth. For example, Guiso et al. (2004), by taking data from Italy, show that high trust increases credit availability and stock purchase and that these effects are pronounced in areas where formal institutions are weaker. Similarly, Engelhardt et al. (2021), using cross-national data, find that high levels of trust–both societal and governmental–reduces COVID-19 induced stock market volatility.

[3] For example, Mexico's PROGRESA (aka Oportunidades), one of the pioneering conditional cash transfer (CCT) programs improves health outcomes of children (Gertler, 2004; Hoddinott and Skoufias, 2004); increases educational outcomes, especially in post-primary school (Attanasio et al., 2012; Skoufias et al., 2001) and girls' educational outcomes (Schultz, 2004); reduces time spent in domestic work for both boys and girls (Skoufias et al., 2001), and increases consumption of ineligible villagers (Angelucci and De Giorgi, 2009). Other cash transfer programs have also been effective in improving the livelihoods of the poor. For example, Aizer et al. (2016) find that a Mothers' Pension program in the US improves children's health, education, and incomes in adulthood. Barham et al. (2013) find that a CCT program in Nicaragua increases boys' cognitive abilities. Harman et al. (2016) find that a CCT program in Turkey increases school attendance, improves test scores, and reduces pregnancy. Dietrich et al. (2020) find that CTs in Uganda increase school attendance and household income as well as improve children's health. And, Cirillo et al. (2021) present an extensive review of evidence on the effects of cash transfer programs on adolescents wellbeing. Another extensive review by Harman et al. (2016) also shows that cash transfers have encouraging effects on reducing poverty, increasing school attendance, and empowering women. The review shows less clear effects on learning and nutritional outcomes. Similarly, a recent extensive review by Tirivayi et al. (2021) also documents mostly positive effects of cash transfers on various outcomes.

is a rise in studies that evaluate the impacts of cash transfers on secondary outcomes, i.e., outcomes that are not intended to be affected by social protection programs.[4] To mention some examples, CCTs increase non-beneficiaries' consumption, transfers of gifts, and loans in Mexico (Barham et al., 2013); CT programs reduce HIV AIDS prevalence in Malawi (Baird et al., 2012); CCTs improve recipients' psychological wellbeing, also in Malawi (Baird, De Hoop and Özler, 2013; Angeles et al., 2019); CCT program leads individuals into a low-return migration in Indonesia (Bryan et al., 2021); CCT that aims to improve maternal health increases fertility in India (Nandi and Laxminarayan, 2016); and, social assistance program in Kyrgyzstan lowers subjective wellbeing (Gassmann et al., 2021).

There is also an emerging literature that specifically investigates the effects of various programs, interventions, and policies on social capital. For example, community reconstruction foreign aid increases cooperation in Liberia (Fearon et al., 2009); food aid crowds out informal risk-sharing in Ethiopia (Dercon and Krishnan, 2003); formal health insurance crowds out social capital in Uganda (Cecchi et al., 2016), and informal transfers in Ghana (Strupat and Klohn, 2018); weather index insurance reduces cooperation among Ethiopian farmers (Nigus et al., 2018); foreign aid increases trust by reducing inequality in Uganda (D'Onofrio and Maggio, 2015); and, CCT program increases trust in leaders in Tanzania (Evans et al., 2019). Given social capital's critical role in the economy, it is important to understand how programs such as cash transfers shape it. Importantly, to date we are unaware of studies that comparatively assess social capital implications of CCTs and UTCs within the same setting.

The debate over which one of the two cash transfer formats provides the least costly and most effective social protection to the poor remains active. Theoretically, for the *homo economicus*, the UCT would be favored as it grants the beneficiaries the autonomy to make their own priorities and allocate the money in such a way that maximizes their wellbeing/utility while at the same time involving a lower cost of running the program. However, for the boundedly rational *homo sapiens*, the CCT may be preferred as it may help draw beneficiaries towards making welfare-maximizing decisions, rather than relying solely on their "will" that could lead to sub-optimal allocations (for example, a myopic beneficiary might spend the money on clothing for immediate gratitude rather than on children's education for a delayed but higher returns). The CCT also has a political upside as it provides plausible justification for the government's redistributive expenditures to the middle-and-upper-class citizens. The

[4]Merton (1936) discusses the difficulty surrounding the anticipation of all outcomes that could be affected by what he calls "purposive social actions" i.e. policies. According to Merton (1936), the main reasons behind failure to anticipate the consequences of social actions are limited knowledge, errors in design and implementation, and "imperious immediacy of interest" (when a strong interest in the intended outcomes triumphs the actors' desire to consider unintended consequences). Additionally, evidence shows that policies and programs could affect outcomes that are not specifically targeted and that these effects could be desirable or undesirable (Klitgaard, 1997).

main drawback with CCTs, in addition to being paternalistic, is that they have an added cost in terms of monitoring compliance to the conditions (Gaarder, 2012; Standing, 2014).[5]

A few previous studies examine the impacts of social protection programs on social capital and political outcomes. One of the earliest quantitative studies observes higher cooperation (proxied by individuals' contribution in a public goods game) among Colombians in CCT recipient villages than their non-recipient counterparts (Attanasio et al., 2009). A follow-up study by Attanasio, Polania-Reyes and Pellerano (2015) also confirms the findings that CCT increases cooperation. Another study by Angelucci and De Giorgi (2009) finds that Mexico's PROGRESA increases transfers (in the form of gifts and loans) from beneficiaries to non-beneficiaries, indicating that the program contributes to the strengthening of social capital. Contrarily, Camacho (2014) finds no effect of a CCT program on social capital (proxied by membership in social organizations) in Peru. A qualitative study by MacAuslan and Riemenschneider (2011), on the other hand, shows that cash transfers negatively affect social relations in Zimbabwe and Malawi. They find that although the cash transfers improve intra-household social relations, they reduce inter-household relations induced by 'jealousy' arising from non-recipients. They find that some recipients even prefer a lower transfer towards them in order to include more beneficiaries in the program. Interestingly, they do not find the same negative inter-household effects from food transfer programs, which they argue, is due to the prevalent food-sharing norms that reduce adverse reactions among non-recipients. Similarly, Chong et al. (2009) find that welfare programs lead to lower interpersonal trust in four Latin American countries, which the authors argue, could be due to stigma (arising from both the self and others) associated with welfare programs.

Similarly, only few existing studies investigate the effects of cash transfers on political participation, and they mainly focus on the effect on the electoral success of political parties—incumbents vs. oppositions (Chen, 2013; Conover et al., 2020; Zucco Jr, 2013; Labonne, 2013; De La O, 2013, for example). In general they find that government driven conditional cash transfers, such as the Bolsa Familia in Brazil, tend to increase voters' engagement as well as favour incumbents. An exception to this is a study by Evans et al. (2019) where they look at the likelihood of voting and find no effect arising from a CCT program in Tanzania.

[5]Some studies have tried to obtain empirical insights on whether one form is superior to the other. One pioneering study by Baird et al. (2012) compares a CCT conditioned on school attendance to a UCT in Malawi. Using a randomized experiment, their study finds that while CCT surpasses UCT in increasing educational outcomes (school attendance and English proficiency), the UCT surpasses CCT in improving marriage and fertility outcomes of young women. Similarly, Attanasio, Oppedisano and Vera-Hernández (2015) show that CCT conditioned on health care outperforms UCT in increasing preventative healthcare uptake among Colombian beneficiaries. An excellent systematic review by Baird, Ferreira, Özler and Woolcock (2013) also finds that CCTs, especially when they have clear conditions that are coupled with strict monitoring, outperform UCTs, in increasing the uptake of desirable behavior (such as school enrollment), at least in the short run. Their review, however, finds no noticeable difference between CCTs and UCTs in fostering knowledge retention.

On the other hand, their results show that the cash transfer program do increase trust in elected leaders. However, their study too evaluates a locally-managed conditional transfer program as opposed to an NGO-managed program that our study evaluates, which may be perceived as more detached from the political and democratic process than government-sponsored ones. Moreover, virtually all these studies do not allow to contrast the effects of unconditional transfers, which our study does.

Our study contributes to the literature in the following ways. Firstly, there is little work that investigates the impacts of cash transfers on the recipients' social capital. Previous studies are primarily concentrated on conditional cash transfers in the Latin American context (Attanasio et al., 2009; Angelucci and De Giorgi, 2009; Camacho, 2014; Chong et al., 2009, for example).[6], while we investigate the effects in an African context. Additionally, while virtually all studies investigate adults, our experimental setup enables us to investigate the effects on adolescent women—recipients at a critical behavioral development age. Furthermore, we also investigate the effects of non-Governmental provision of cash transfers on recipients' real-world collective action behavior: voting. Lastly, unlike the previous studies that focus only on CCTs, we also investigate and contrast the effects of UCTs. By doing this, we aim to enhance our understanding of whether the conditionality in CCTs has a differential effect on important outcomes such as social capital, compared to an unconditional transfers.

To achieve our objectives, we use data that come from the "Schooling, Income, and Health Risks" study, which employs a randomized controlled cash transfer experiment in Malawi that aims to study the effects of cash transfers on adolescent women's schooling and health outcomes. Our intention-to-treat estimates show that the CCT program increases social capital but not the UCT. Further analyses reveal that individuals with initial reciprocal beliefs drive the increase social capital from the CCT program. Furthermore, our results reveal that both programs reduce altruistic real-world collective action behavior proxied by voting.

The remainder of this paper is organized as follows. The next section presents the theoretical framework and hypotheses. Section 3.3 presents the study design and estimation strategy. Section 4.4 presents and discusses the main results and explores potential explanations. Section 3.5 concludes.

[6]The study by MacAuslan and Riemenschneider (2011) provides insights from an African context; however, it is a descriptive qualitative study and therefore has limited generalizability.

3.2 THEORETICAL FRAMEWORK

In this paper, our primary objectives are 1) to study whether and how cash transfer programs affect social capital and whether the two widely used types of cash transfers have varying effects on social capital; 2) what/who drives such changes; and 3) to examine whether and how cash transfers affect 'real-world' collective action behavior (political participation).

We postulate that the way conditional transfers affect the recipients' social capital need not be identical to the way unconditioned transfers do. Recipients of UCTs, for example, might perceive the transfers as gifts. In contrast, recipients of CCTs might perceive it as an incentive for their "behavior" with respect to the conditions. As a result, UCTs might drive different sets of beliefs, such as altruism, whereas CCTs might be better placed to drive beliefs that embody expectations regarding the behavior of others, such as trust. This line of argument is based on the following conceptualization of trust "trust is the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor" (Mayer et al., 1995, P.712).

Another important element specific to the CCT is that the recipient has a clear understanding of the reasons why she is receiving the money. When individuals receive cash with no strings attached, anecdotal evidence suggests that it might raise suspicion about the motives and intentions. This might impede the development of trusting beliefs if not even erode them.[7] Motives are central to the components of trust identified by Mayer et al. (1995). According to Mayer et al. (1995), benevolence is one of the three components of trust and is conceptualized as "the extent to which a trustee is believed to want to do good to the trustor, aside from an egocentric profit motive." The fact that in the CCT, the recipient has a clear idea about the motives of the cash provider, compared to the UCT, where the motives are unclear, we expect that CCTs would have a stronger role in influencing trust than UCTs.

Finally, another reason to expect a difference in how the two types of transfers would affect different components of social capital is due to the fact that the conditions in the CCT programs often require the recipients to interact with other individuals (Attanasio et al., 2009).[8] It is also possible that cash transfers could reduce social capital due to possible resentments arising from non-beneficiaries. As Cameron and Shah (2014) show, mistargeting of a transfer program in Indonesia has resulted in the erosion of social capital (proxied by

[7] For example, a UCT program in Western Kenya created a belief among villagers that "they" are providing money because at some point they want to take away their children. See the video *https://www.bbc.com/news/av/world-africa-43646271*.

[8] The argument is that CCTs are usually conditioned on school attendance, visiting health care facilities, etc. which are activities that would expose beneficiaries to other individuals and this exposure might be more likely to affect certain types of social capital such as trust and cooperation.

individuals' participation in community groups) and an increase in crime. Interestingly, their study shows that the negative effect on social capital is driven by villages where the transfer included non-eligible individuals but not in villages where coverage of eligible households was lower, indicating that injustice aversion might lower social capital, especially if program implementation faces targeting problems. Such perception of mistargeting might be unavoidable in programs such as the one we are evaluating as it involves a random assignment of households to a transfer program with a selection criterion being the presence of unmarried adolescent women rather than wealth status ("deservingness") of households.

Based on the aforementioned arguments, the hypothesis that emerges is that the effects of both CCTs and UCTs on social capital could be positive or negative, but that CCTs can be expected to have a relatively more positive effect than UCTs.

Furthermore, we are also interested in studying whether beneficiaries with different characteristics and beliefs respond differently to the two formats of transfers. Specifically, we are interested in understanding whether the social capital of beneficiaries that are 'highly sociable,' that are wealthier, those who have reciprocal beliefs, and those who attend school would be more likely to respond to the cash transfers. If, for example, girls that are highly sociable to begin with, socialize more because they have more disposable money from the transfers, it could further strengthen their social capital. A similar argument also applies to wealth status as girls that are wealthier would most likely use the additional cash from the transfers to socialize more (rather than spend it on necessities), which, in turn, could increase their social capital. The reason behind these expectations is that social capital, like any other form of capital, would need some resources to be acquired and maintained (Glaeser et al., 2002). Similarly, since the condition in our CCT treatment is school attendance, the recipients would be more likely to go to school and be able to interact and socialize with their peers which could then increase their social capital.

As mentioned, we are also interested in studying whether girls with varying levels of initial reciprocal beliefs react differently to the cash transfer programs. In other words, we are interested in investigating whether respondents who have the belief that people, in general, can be expected to be helpful and with good intentions, would be more likely to develop trusting behavior when exposed to the CCT treatment. We hypothesize that respondents with initial reciprocal beliefs would find the cash transfers as "confirmations" to their beliefs that people are generally helpful and trustworthy as "others" have shown interest in not only providing them with extra cash but also have shown them that they have a clear motive that they care about their education. As Falk and Fischbacher (2006) and Cox et al. (2001) show, individuals' reciprocal behavior depends not only on the "consequences" of the actions of other parties but also the "intentions" behind. This is because previous studies show that

reciprocal beliefs are correlated with trust; for example, Altmann et al. (2008) find a positive relationship between positive reciprocity and trust. Inversely, Dohmen et al. (2008) find a negative correlation between negative reciprocity and trust. Our hypothesis here is that individuals who have a general reciprocal belief, i.e., a belief that people can help other people without expecting immediate return, could be more likely to be more trusting of others as a result of the fact that some people are providing them with cash to help them improve their living conditions and facilitate their education.

While we have hypothesized that the effects of CCT would be stronger on social capital, the effects of UCT could be stronger on the altruistic real-world collective action behavior—voting. The relationship between altruism and voting has been established by the political economy literature. The literature attempts to understand why individuals vote even though voting constitutes a high cost to the individual while knowing that the probability that this single vote would bring the desired gain to the voter is very low. Voters incur costs such as time, mental, and physical efforts to search and process information regarding alternative policies and get to the voting stations and cast their votes. Despite this, many individuals do vote, and one of the reasons identified by researchers is that voters are motivated by altruistic/prosocial behavior and that they are willing to take costly actions in exchange for desirable societal gains (Evren, 2012).[9] Empirical evidence also shows a strong relationship between altruistic behavior and voting as, for example, Fowler and Kam (2007) find a strong relationship between contributions in a dictator game and voting behavior. Similar studies by Jankowski (2007) and Fowler (2006) identify altruism as the main factor driving the decision to vote and that altruistic individuals are more likely to vote.

3.3 METHODOLOGY

Here, we describe the study setting and experimental design; explain and describe our variables; and, present our empirical strategy.

3.3.1 *Context: Malawi*

Malawi is a land-locked country located in southeastern Africa and is home to about 20 million people. The Malawian economy is primarily agrarian as agriculture employs 77% of its population. The employment share by the industry and service sectors are 4% and 19%, respectively. Like other African countries, about 67% of the Malawian population is

[9]The other reasons are expressive motive/group solidarity motive, ethical motive (although this is associated with the "warm-glow" dimension of altruistic behavior (Evren, 2012; Jankowski, 2019; Fowler and Kam, 2007).

below the age of 24 and has a youth dependency ratio of about 79%. Malawi is a low-income country with a per capita income of $1,060 and about 50% of its population living under the poverty line (CIA, 2021).

In order to lift its population out of poverty, the Malawian government, along with donors, has been implementing social assistance programs since 2000. A pioneering such program is the poverty alleviation program whereby the government-provided safety net to the poor to help with its structural transformation program (Slater and Tsoka, 2007). Afterward, a number of cash transfer programs have been implemented by NGOs and researchers. One such program is the "Schooling, Income, and Health Risks" (SIHR) cash transfer experiment conducted by researchers from The World Bank and other academic institutions with an objective to examine the roles of conditional and unconditional transfers in improving education and health outcomes of young women in the Zomba district of Malawi (Baird et al., 2012). This project also pioneers providing evidence to aid the debate on whether conditional or unconditional transfers are better for providing the least-cost social protection to the poor. Their analyses reveal that the two transfers yield positive effects on different outcomes: while CCT (conditioned on school attendance) outperforms UCT in educational outcomes, both in terms of decreasing dropout rate and increasing English language skills, UCT outperforms CCT in reducing teenage marriage and pregnancy (Baird et al., 2011).

3.3.2 *Study design*

The data for this study come from the "Schooling, Income, and Health Risks" study, a randomized cash transfer experiment implemented in Zomba District, Malawi.[10] The experiment targets young unmarried school-aged women (age 13 - 22 years old) and their households in 176 enumeration areas (EAs) covering both urban (29 EAs) and rural locations (147 EAs). The reason behind targeting young, school-age, unmarried women is because the main goal of the experiment was to study the effect of schooling cash transfers on HIV prevalence among young women (Baird et al., 2011). Treatment is assigned at the EA level, where half (88) of the EAs are assigned to treatment and half (88 EAs) to the control group. EAs in the treatment condition are further divided into 1) Dropoutgirls sample, which constitutes young school-aged women that have dropped out of school at baseline; 2)

[10]The experiment is conducted by: Berk Ozler, World Bank; Sarah Baird, George Washington University; Craig McIntosh, University of California San Diego; Ephraim Chirwa, University of Malawi. Malawi Schooling, Income, and Health Risk Impact Evaluation Household Survey (SIHRIER1-R3) 2007-2010. Ref round 1: MWI_2007_SIHR_v01_M_v01_A_PUF. Dataset downloaded from *https://microdata.worldbank.org/index.php/catalog/1005* on March, 2021. Ref round 2: MWI_2008_SIHRIE-R2_v01_M. Dataset downloaded from *https://microdata.worldbank.org/index.php/catalog/2338* on March, 2021. Ref round 3: Ref. MWI_2010_SIHRIE-R3_v01_M. Dataset downloaded from *https://microdata.worldbank.org/index.php/catalog/2339* on March, 2021.

Schoolgirls sample, which constitutes young school-aged women who are enrolled in school at baseline.

The Dropoutgirls sample is divided into those who receive a conditional cash transfer (CCT) (436 girls in 46 EAs) and those who do not receive any transfers (i.e., control groups) (453 girls in 88 EAs). The Schoolgirls sample, on the other hand, is divided into three groups where one group (506 girls in 46 EAs) receives a conditional cash transfer, the other group (283 girls in 27 EAs) receives unconditional cash transfer (UCT), and a third group (1,495 girls in 88 EAs) receives no transfers (control group). Therefore, the total sample size is 3173 girls. The condition in the CCT treatment arm is school attendance, where to be able to continue receiving the transfer, the girls are expected to attend school for at least 80% of the time. For months where attendance fell below 80%, payment is withheld, and payment resumes once the girl fulfills the attendance requirement [11]

Next, the treatment girls and their parents are randomly assigned to various amounts of transfers. Consequently, parents could receive either $4, $6, $8, and $10 per month, whereas the girls could receive either $1, $2, $3, $4, or $5 per month. The transfers lasted for two years, covering 2008 and 2009. Accordingly, the average monthly transfer to households amounted $10, which is equivalent to about 10% of households' consumption expenditure during the study period (Baird et al., 2011).[12]

Detailed data is collected both from the household head and the core respondent (the adolescent girl). The household-level data include information about household characteristics, assets, consumption, and shocks. The core respondent level data contain information on the adolescent's demographic characteristics, schooling status, health, sexual behavior, social networks, generalized trust, reciprocal beliefs, and political participation. The dataset consists of four waves. The first round (baseline) is collected in 2008. The second round (first follow-up) is collected in 2009, and the third follow-up data were collected in 2010, right after the completion of the cash transfer experiment. The fourth and last round of data was collected in 2012 to study the long-term impacts of the cash transfer program. Unfortunately, we are unable to use the last round of data in all of our analyses because information on generalized trust and gift-giving has not been collected in this round. Therefore, for these analyses, we use data coming from the first three rounds. Contrarily, information on voting behavior has only been collected in the fourth round, but since the survey instrument uses

[11]The experiment also includes control girls from experiment EAs to enable measurement of spillover effects. However, since we only focus our analysis on the unintended impact on recipients, we exclude these girls from our analyses.

[12]Initially, the program was intended for one year, and the same has been communicated to recipients. However, the project owners managed to secure additional funding and managed to extend it for one more year. The extension was once again communicated to beneficiaries in advance. The CCT also covers school fees–paid directly to the schools (Baird et al., 2011).

a retrospective question, it reflects behavior over the past five years prior to the survey period.[13]

3.3.3 *Variables and descriptive statistics*

The explanatory variables of interest are 1) an indicator for whether the respondent belongs to any of the cash transfers, regardless of the conditionally of the transfers (Treated sample); 2) an indicator for whether the respondent belongs to the conditional cash transfer arm; and 3) an indicator for whether the respondent belongs to the unconditional cash transfer arm.

Outcomes

One of our social capital indicators is the adolescent's generalized (interpersonal) trust beliefs. The primary challenge one faces when studying social capital is the difficulty associated with its conceptualization and measurement. Among many others, an earlier conceptualization of social capital by Robert Putnam presents it as "features of social life–networks, norms, and trust–that enable participants to act together more effectively to pursue shared objectives" (Putnam, 1995, pp 664). According to Robert Solow, for the concept of social capital to be meaningful, it has to be measured even if "inexactly" (cited in Knack and Keefer (1997)). As a result, attempts have been made to develop a measure of social capital even though the accuracy of the instruments is still debated. As part of the effort to measure social capital, a survey instrument has been developed by the General Social Survey (GSS) and is widely adopted by many other studies. The instrument asks respondents the following question: "Generally speaking, would you say that most people can be trusted or you can't trust most people?" The responses are either "People can be trusted." or "You can't trust most people." We code these responses into trust = 1 if the response is "People can be trusted"; 0, otherwise. Our dataset also contains information about adolescents' generalized trust generated using the same survey instrument.

Even though our measurement of trust is non-experimental, there is evidence that these measures of trust strongly correlate with experimentally measured trust (Aksoy et al., 2018; Johnson and Mislin, 2012). Knack (2001) also presents review of evidence that shows the survey instrument predicts quite well other types of trusting behavior such as returning lost wallets and immigrants holding trusting beliefs closer to the average in their source countries etc. It could also be that our non-experimental trust measure is even be better than

[13] Balance has been achieved along most of the baseline characteristics except for female-headed, age, and highest grade attended at baseline. The attrition rate is about 10%, and there is no evidence that attrition is systematic. For detailed discussion of this, see Baird et al. (2011).

its most commonly used experimental counterpart–i.e., the “trust (investment) game" for the following reasons.

The trust game works as follows: participants receive equal amounts of endowments, and they are anonymously paired with another participant such that one is the first mover or the “trustor" and the other a second-mover or the “trustee." The participants are instructed as follows. The trustor can send any amount of his endowment to the trustee, and that the amount will be tripled by the experimenter before it is passed on to the trustee. The trustee then has the choice to send any amount back to the trustor. From these games, the amount transferred by the trustor is used as a measure of his/her trust, and the amount returned by the trustee is used as a measure of his/her trustworthiness (Berg et al., 1995). However, as Cox (2004) argues, it is difficult to attribute the behavior observed in the trust game to just trust and trustworthiness as it is difficult to separate other motives such as altruism and inequality aversion. By using the responses to a survey question, we avoid such convolutions and be able to obtain a measure of the respondents' trusting beliefs. Based on the descriptive statistics presented in table 3.1, on average, about 31% of our respondents are trusting, which is slightly lower compared to the average trust in 29 high-income countries reported by Knack and Keefer (1997) which is about 36%.

Another social capital indicator we use is adolescents' gift-giving behavior. We are interested in studying gift-giving behavior because gifts can be seen both as a form of altruism, or as a basis to build social capital and establish reciprocal relations. As we show in table 3.1, about 16% of our respondents gave gifts for other individuals. In addition to these two variables, we construct a social capital index by standardizing and combining our two proxies of social capital. This index condenses the two proxies into a single easy to interpret measure, while at the same time addressing the potential concern that may arise from multiple hypothesis testing. When analyzing the potential moderating factors explaining changes in social capital induced by CCTs and UCTs we will only use this condensed index as our preferred proxy.

The final variable of interest is the adolescents' real-life collective action behavior proxied by voting. Even though the data is available only in the fourth round–the last round collected two years after the termination of the transfers, the survey uses a retrospective instrument about voting behavior in the past five years–covering the period where the transfer was ongoing. The instrument reads “ How many times have you voted in the past five years?" From this, we extract an indicator variable taking the value one if the adolescent has voted one and more times; zero, otherwise. As can be seen in table 3.1, almost 34% of our respondents have voted at least once.

Moderators

One of our hypothesis is that girls with reciprocal beliefs would be more likely to become more trusting in response to the CCT as it might strengthen their beliefs that people are generally helpful. For this purpose, we use data generated from the following survey instrument that is adopted from the GSS and ESS: “Most people in this village are willing to help if you need it. "The responses are “Strongly disagree"; “Disagree"; “Neither disagree nor agree"; “Agree"; “Strongly agree". From this, we generate a dummy indicator showing reciprocal = 1 if the responses are “Strongly agree" and “Agree"; 0, otherwise. As we present in table 3.1, about 38% of respondents in our sample have reciprocal beliefs. In our analyses, we also check for the robustness of our results by changing the treatment of the ‘Neither disagree nor agree" response into reciprocals.

We also hypothesize that the social capital of girls with higher initial sociability could be affected differently in response to the cash transfers. On the one hand, having more disposable income could further increase socialization and lead to stronger social capital. On the other hand, it could lead to stigma/jealousy from peers and could reduce the beneficiaries’ social capital. To test this, we construct a sociability index at baseline from the following indicators: 1) time spent with friends, obtained by asking “In the past month, how many times have you got together for food and drinks?" 2) Wedding attendance obtained by asking “How many times in the last 12 months have you been to a wedding?" and 3) Funeral attendance obtained by asking “How many times in the last 12 months have you been to a funeral?" To create the sociability index, we first standardize each variable so that they are on an identical scale such that they have a mean of zero and a standard deviation of one and then use a simple additive approach to construct our sociability index. Finally, to make interpretation more straightforward, we also standardize the sociability index to have a mean of zero and a standard deviation of one.

Similarly, we also look at whether girls from wealthier households would react differently to the two cash transfers by using households’ asset index as a proxy for wealth.

Another plausible explanation we examine is the idea that CCTs increase social capital because the conditions themselves (in our case, school attendance), often require the recipients to interact and socialize with other individuals (Attanasio et al., 2009; Attanasio, Polania-Reyes and Pellerano, 2015).[14] Therefore, we use data on school enrollment to test our hypothesis that the CCT could affect social capital through its effect in increasing the adolescents’ socialization with peers at school.

[14]The researchers who conducted the experiment we use for this paper document that the CCT increases school enrollment, attendance, and English language skills (Baird et al., 2011).

Controls

Additionally, we control for baseline age, household size, female headship, asset index, education, an indicator for mother is alive, an indicator for father is alive, and an indicator for whether the respondent lives in an urban area, respondents' time preferences, an indicator for whether the adolescent was sexually inactive, an indicator for whether the adolescent has never been pregnant, an indicator for the respondents' baseline gift-giving, an indicator for social network as a source of support, and an indicator for whether the adolescent believes other people would look out for her or take advantage of her. Table 3.1 presents the descriptive statistics for these variables at baseline. About 86% of our respondents are younger than eighteen years old and have, on average, about seven years of schooling. The average household spends about 456 Malawian kwacha on our respondents (adolescent girls). The average household has about six members with an average wealth index of 0.11. About 34% of households are headed by women. While about 65% of respondents have their mothers alive at baseline, only 41% of the respondents have their fathers alive. About 18% of the respondents come from urban areas. Our respondents have varying degrees of time preferences as can be seen from their discount rates ranging from zero (highly patient) to 39 (highly impatient) but have an average discount rate of about 0.8–on average, placing them on the patient side. While about 66% of our respondents never had sex, about 80% were never pregnant at baseline. About 17% of our respondents gave gifts at baseline and about 15% are politically active (proxied by attending political meetings). Lastly, about 87% of our respondents rely on their social networks to secure finance in times of need and about 80% believe that people would take advantage of them.[15]

[15]We also present the balance table for both conditional and unconditional treatment arms in appendix B.1. In the conditional treatment arm, trust, reciprocal beliefs, education, whether mother is alive, sexual inactivity, pregnancy, and social network are unbalanced. In the unconditional treatment arm, trust, female headship, education, asset index, urban dwelling, political participation are unbalanced. Notice however that the baseline trust is significantly lower in both treatment groups.

Table 3.1: Descriptive Statistics: baseline characteristics

Variable	Mean	Std. Dev.	Min.	Max.	N
Panel A: Outcomes					
People can be trusted = 1	0.313	0.464	0	1	3798
Gift = 1	0.166	0.372	0	1	3822
Voted = 1	0.341	0.474	0	1	2873
Panel B: Moderators					
People help = 1	0.376	0.485	0	1	3806
Sociability baseline	0.027	1.031	-1.319	8.590	11368
Asset index	0.11	2.52	-3.697	6.827	3790
Panel C: Controls					
Young = 1	0.857	0.35	0	1	3822
Household size	6.258	2.309	1	15	3790
Female headed = 1	0.338	0.473	0	1	3789
Education level	7.218	2.068	1	12	3795
Spending on girl	456.926	954.474	0	24940	3788
Mother alive	0.653	0.476	0	1	3787
Father alive	0.413	0.492	0	1	3788
Urban = 1	0.175	0.38	0	1	3796
Time preference	0.798	1.549	0	39	3807
Sexually inactive	0.658	0.474	0	1	3787
Ever been pregnant	0.119	0.324	0	1	3787
Majority tribe = 1	0.657	0.475	0	1	3822
People are selfish = 1	0.803	0.398	0	1	3808
Social network = 1	0.663	0.473	0	1	3783
Politics baseline	0.153	0.36	0	1	2874

Source: authors' elaboration.

3.3.4 *Estimation strategy*

Here, we present our estimation strategy we follow to identify the effects of the conditional and unconditional cash transfer programs on social capital and a 'real-world' collective action behavior proxied by voting. We also present the strategy we follow to explore some explanations.

Cash transfers and social capital

The random assignment of treatments provides us a straightforward identification. Therefore, we estimate the intention-to-treat (ITT) effects in an analysis of covariance (ANCOVA) framework (where we add the baseline values of the outcome variable to the standard linear

regression specification) to gain improvements in statistical power as discussed in McKenzie (2012). The ANCOVA models are specified as follows:

$$Outcome_{ji} = \gamma Treat_{ig} + \lambda Outcome_{jib} + \beta X_i + \epsilon_i \tag{4}$$

where $Outcome_{ji}$ stands for the outcome variables of interest represented by j of respondent i where j indicating generalized trust, gift-giving, and the social capital index. $Treat_{ig}$ represents individual i's assignment to the three treatment types we analyze sub-scripted by g, i.e, 1) an indicator for whether respondent i received an offer for either a CCT or UCT; 2) an indicator for whether respondent i received an offer for the CCT; and 3) an indicator for whether respondent i received an offer for the UCT, where g indicates the three treatment categories. $Outcome_{jib}$ represents the baseline (b) levels of the outcome variables (j) for respondent i; $gamma$ is the parameter of interest. Lastly, X_i's are baseline characteristics listed in table 3.1 and ϵ_i is the stochastic error term.

Furthermore, to study whether the effects are moderated by the initial reciprocal beliefs, initial sociability, and wealth, represented by subscript m in the following specification, we estimate the following specification.

$$Outcome_{ji} = \alpha Treat_{ig} + \lambda Outcome_{jib} + \tau Moderator_{mi} + \theta Treat_{ig} X Moderator_{mi} + \beta X_i + \epsilon_i \tag{5}$$

where $Moderator_{mi}$ stands for moderator m of respondent i; $TreatXModerator_{mi}$ shows the interaction between moderator m and treatment status; α_1 and θ are our parameters of interest.

We also investigate whether intrinsic features of the CCT embedded in the conditions are likely to drive its impact on social capital. Since the condition in our CCT experiment is that adolescent girls attend school, we examine whether the increase in school attendance mediates the effect in social capital arising from the CCT treatment. Consequently, we estimate ITT effects from the following model.

$$Outcome_{ji} = \omega CCT_i + \zeta School_i + \lambda Outcome_{jib} + \beta X_i + \epsilon_i \tag{6}$$

where $School_i$ is an indicator for school enrolment in a given term.

Cash transfers and 'real-world' collective action behavior

Since data on voting is available only in the last round of the survey, to estimate the ITT on the a 'real-world' collective action behavior, i.e., voting, we use the following LPM model.

$$Vote_i = \delta Treat_{ig} + \beta X_i + \epsilon_i \tag{7}$$

where $Vote_i$ indicates whether adolescent i has voted any number of times within five years prior to the survey period and δ is our parameter of interest.

3.4 RESULTS

In this section, we present the main results and explore potential explanations behind.

3.4.1 *Cash transfers and social capital*

We start our analyses by pooling the two forms of cash transfers–conditional and unconditional–and checking whether cash transfers affect our social capital indicators – generalized trust, gift-giving, and the composite social capital index. For this purpose, we generate a treatment indicator taking the value one if the respondent belongs to either the CCT or UCT arm; zero if the respondent is in the control group (receives no transfers). We show these results in columns 1, 4, and 7 of table 3.2. Next, we differentiate our analyses and measure the intention-to-treat effects of the CCT and UCT treatments separately against the control group. Similarly, we report the ITT estimates showing the effects of the CCT in columns 2, 5, and 8; and that of UCT in columns 3, 6, and 9. All columns control for other covariates listed in table 3.1. However, we also find similar results from the simple models where we only regress treatment statuses on the three outcome variables (see appendix B.2).

Based on the results presented in columns 1, 4, and 7 in table 3.2, we find that cash transfers increase all the two social capital outcomes and their aggregate index. After controlling for individual and household characteristics, we find that cash transfers increase the likelihood of trusting beliefs by about 3.7%; the likelihood of gift-giving by about 2.7%; and the composite social capital index by 0.10 standard deviations and significant at 1%. Our results from the disaggregated analyses show that only the CCT increases generalized trust, gift-giving, and the aggregate index. As shown in columns 2, 5, and 8 of table 3.2, CCT increases the likelihood of trusting beliefs by about 4.5%; the likelihood of gift-giving by about 3%; and the aggregate social capital index by 0.11 standard deviations also significant at 1%. We also find some evidence that UCT also increases social capital (by about 0.06 standard deviations) as we find a positive significant (at 10%) effect, but only on the aggregate social capital index. These results corroborate those reported in Attanasio et al. (2009) where they observe higher cooperation among beneficiaries of a CCT program in Colombia. Broadly, our results add evidence to the literature that looks at the interaction between social capital and institutions (Nigus et al., 2018; Cecchi et al., 2016; Fearon et al., 2009).

As we describe in section 4.2, another interesting feature of this experiment is that the transfer amounts are varied and randomly assigned to the respondents and their respective household heads. This gives us the opportunity to test whether the amount of money matters in shaping recipients' social capital. For this purpose, we look at the effects of

the transfer size that the adolescent received as well as the combined amount with that of the household head. Interestingly, we find no evidence that the amount of the transfer matters for social capital (see appendix B.3), contrary to existing studies that show a strong correlation between income and trust (Alesina and La Ferrara, 2000; Ananyev and Guriev, 2019).

> *Result 1:* Conditional cash transfer increases adolescent girls' generalized trust, gift-giving behavior and the aggregate social capital index whereas the unconditional cash transfer's effect is only visible on the social capital index.

Table 3.2: Cash transfers and social capital

	People can be trusted = 1			Gift = 1			Social capital index		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES									
Treated = 1	0.0365***			0.0272***			0.102***		
	(0.0113)			(0.00804)			(0.0222)		
Conditional = 1		0.0449***			0.0295***			0.114***	
		(0.0127)			(0.00900)			(0.0249)	
Unconditional = 1			0.00643			0.0162			0.0634*
			(0.0197)			(0.0129)			(0.0379)
Trust baseline = 1	0.0943***	0.0943***	0.0775***						
	(0.0120)	(0.0126)	(0.0156)						
Gift baseline = 1				0.0689***	0.0635***	0.0511***			
				(0.0106)	(0.0111)	(0.0131)			
SC index baseline							0.415***	0.413***	0.377***
							(0.00982)	(0.0103)	(0.0128)
Observations	5,896	5,361	3,344	5,919	5,382	3,359	5,907	5,372	3,352
R-squared	0.023	0.023	0.020	0.026	0.027	0.014	0.243	0.240	0.215
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors are in parentheses. Controls include all the adolescent and household covariates listed in table 3.1. Columns 2, 5, and 7 include an additional control variable that indicates whether the respondent belongs to the dropout sample. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Exploring potential explanations

Given that our results show that cash transfers increase social capital, we further investigate where these effects are coming from. Firstly, we explore whether the impact of the CTs on social capital is driven by the adolescents' initial reciprocal beliefs, wealth status, sociability index, and school attendance.

For this purpose, we prefer to present the moderation analyses on our preferred social capital indicator, i.e., the social capital index. Recall that the results in table 3.2 show that both the CCT and UCT lead to higher social capital albeit the effect from UCT is significant only at the 10%. Therefore, we conduct our moderation analyses on these two treatment indicators and present the results in table 3.3. The results in columns 1 and 2 show whether adolescents with initial reciprocal beliefs drive the increase in social capital. Columns 3 and 4 test whether adolescents from wealthier households would be more likely to reap the increase in social capital. Columns 5 and 6 present the results that show whether adolescents that are sociable would be more likely to gain higher social capital from the cash transfers. Lastly, columns 8 and 9 present the results showing whether adolescents that are enrolled in school would be the ones to acquire higher social capital.

Based on the results of these analyses, we find evidence that the entire positive effect of the CCT treatment indicator appears to be driven by those adolescents with initial reciprocal beliefs. Our results reported in column 1 show that respondents with initial reciprocal beliefs, on average, gain a social capital that is about 0.13 standard deviations higher than their counterparts in the control group (significant at 5%). In other words, the CCT increases social capital only among those individuals who hold generalized reciprocal beliefs to begin with.[16] Notice that in this analyses, the UCT's effect is no longer significant–making the results from 3.2 less robust. Similarly, none of the other proposed moderators seem to have significant moderation effects.

[16]We also check the robustness of these results by changing the way we code the reciprocal adolescents, now treating those who respond to "neither agree nor disagree" to the generalized reciprocity survey question as reciprocal. The results from this moderation analyses also reveal a similar story that the social capital gains from the CCT are driven by adolescents with reciprocal beliefs. We present these results in appendix B.6

Table 3.3: Cash transfers and social capital: moderators

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Social capital index							
Conditional = 1	0.0399		0.0772***		0.0755***		0.0505	
	(0.0291)		(0.0232)		(0.0233)		(0.0492)	
Conditional X Reciprocal = 1	0.102**							
	(0.0477)							
Unconditional = 1		0.0161		0.0317		0.0316		-0.0203
		(0.0452)		(0.0372)		(0.0357)		(0.137)
Unconditional X Reciprocal = 1		0.0437						
		(0.0727)						
Conditional X Wealth			0.00842					
			(0.00907)					
Unconditional X Wealth				0.00102				
				(0.0145)				
Conditional X Social					0.0127			
					(0.0223)			
Unconditional X Social						0.0136		
						(0.0329)		
Conditional X School = 1							0.0362	
							(0.0559)	
Unconditional X School = 1								0.0583
								(0.142)
SC index baseline	0.629***	0.629***	0.630***	0.629***	0.630***	0.630***	0.629***	0.629***
	(0.0131)	(0.0168)	(0.0131)	(0.0168)	(0.0132)	(0.0168)	(0.0132)	(0.0169)
Observations	5,360	3,343	5,361	3,344	5,344	3,330	5,344	3,330
R-squared	0.319	0.312	0.319	0.312	0.319	0.312	0.319	0.312
Controls	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors are in parentheses. Controls include all the adolescent and household covariates listed in table 3.1 and baseline social capital index, trust and gift-giving behavior. Significance: *** p<0.01, ** p<0.05, * p<0.1. Columns 1 and 2 show the mediation role of reciprocal beliefs. Columns 3 and 4 test the moderation effects of wealth. Columns 5 and 6 show the moderation effects of sociability index. And, columns 7 and 8 show the moderation effects of school attendance. Source: authors' elaboration.

Result 2: Adolescents with initial reciprocal beliefs drive the increase in social capital from the conditional cash transfer treatment. We find no such effect arising from wealth status, adolescents' sociability, or increased socialization in school.

3.4.2 *Cash transfers and real-world collective action*

Next, we examine whether the effects of CCT and UCT are different on real-world collective action behavior—voting. We present these results in table 3.4. Similar to our previous analyses, we first show the results for the pooled treatment status (columns 1 and 2), followed by the disaggregated analyses that look at the effects of CCT (columns 3 and 4) and UCT (columns 5 and 6), where the first columns show results without additional controls and the subsequent ones with additional controls.

Table 3.4 presents interesting and surprising results. Interesting because, at face value, we find that all forms of transfers reduce the adolescents' voting likelihood. As column 2 shows, assignment to either one of the transfer programs reduces the likelihood of voting by about 4%, significant at 1%. The disaggregated analyses also show roughly similar effects, where the likelihood of voting is about 5% lower in the CCT program (significant at 1%) and about 4% in the UCT program, significant at 10%. These results are interesting on their own as they provide novel insight into the effects of non-governmental social protection programs on young women's political participation. These results are surprising because, contrary to our expectation that the transfers, and especially the UCT, would increase altruistic behavior such as voting, the results reveal that they actually reduce it (although the result for UTC is admittedly less robust).

One plausible explanation for our results could be that the CTs may reduce beneficiaries' interest in local politics and the democratic process, especially when the CT provider is a non-governmental organization. This could explain why previous studies investigating government led programs (e.g. in Brazil) found increased voting, while we find the opposite. In fact, our results resemble those in a previous study by Boulding (2010) in Bolivia, which finds that the expansion of NGOs predicts higher incidents of anti-government sentiment. However, this interpretation is purely speculative at this stage. As Evans et al. (2019) find, information about the program, such as the provider and the selection criteria, leads to higher trust in local leaders. Therefore, exploring the effects of donor-funded cash transfer pilot programs on local politics is an interesting and relevant research avenue for future work.

Result 3: Both conditional and unconditional cash transfers reduce adolescents' propensity to vote.

Table 3.4: Cash transfers and voting

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Voted = 1					
Treated = 1	-0.0280**	-0.0399***				
	(0.0129)	(0.0119)				
Conditional = 1			-0.0585***	-0.0514***		
			(0.0141)	(0.0131)		
Unconditional = 1					-0.0424**	-0.0362*
					(0.0210)	(0.0195)
Constant	0.354***	0.441***	0.299***	0.368***	0.296***	0.0701
	(0.00817)	(0.0594)	(0.00848)	(0.0662)	(0.00886)	(0.0916)
Observations	5,608	5,385	5,088	4,884	3,180	3,072
R-squared	0.001	0.210	0.052	0.218	0.001	0.193
Controls	NO	YES	NO	YES	NO	YES

Robust standard errors are in parentheses. Controls include all the adolescent and household covariates listed in table 3.1 and an additional indicator for whether the adolescent girls take part in political meetings. Column 3 and 4 includes an additional control variable that indicates whether the respondent belongs to the dropout sample. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

3.5 CONCLUSION

Given the critical role social capital plays for economic development, it is important to understand how development programs shape it. In this study, we investigate whether the two widely implemented programs – conditional and unconditional cash transfers – affect social capital and examine whether their effect varies on different proxies of social capital arising from the variation in their delivery formats. Furthermore, we investigate their effects on a real-world collective action behavior—voting. We also examine various potential explanations.

The two cash transfer formats are currently under extensive debate among academics and policymakers regarding their effectiveness in providing least-cost social protection to the poor. Since conditional transfers require the beneficiaries to adhere to certain behaviors that are deemed important for beneficiaries, they are expected to be more effective at improving welfare. However, they are criticized for being paternalistic and requiring higher running costs associated with monitoring of adherence to the conditions. Contrarily, unconditional transfers involve no such requirements, making them cheaper and more liberal. Given that both formats have specific advantages and disadvantages, the debate continues as to which one is optimal for the individual and the state alike.

With this study, we contribute some evidence to the debate on whether CCTs or UCTs are better policy tools by scrutinizing the effects of the two forms of cash transfers on important but potentially unintended outcomes – social capital and voting – both of which have the potential to further the process of economic development. To achieve our objectives, we use data from a randomized cash transfer experiment that targets young women and their households in Malawi and estimate intention-to-treat effects. Our results show that CCT has stronger positive effects on social capital than UCT. Additional analyses reveal that the social capital gain from CCT arises from respondents with initial reciprocal beliefs.

Interestingly, our results also reveal that both types of transfers significantly reduce voting tendency—meaning that they lead to lower real-world collective action behavior among recipients. The decline in voting likelihood should caution policymakers to the fact that such programs could have a crowding out effect for the political participation in African countries. We speculate that either the non-governmental nature of the cash transfer program – which might have exacerbated a sense of external locus of control among participants, diminishing the effectiveness of voting in their eyes – or the low trust in elected politicians that typically pervades African countries such as Malawi, may have had a role to play. However, our study was not geared to test why or under what circumstances such outcomes may take place, something that will definitively need further investigation.

With an important caveat associated with our measurements of social capital in mind, we indicate that policymakers could reap a positive externality in the form of higher social capital by implementing CCT programs rather than UCTs. It would be relevant if future research could validate these comparative findings in other contexts – and perhaps with incentive-compatible methods – and further investigate the implications of non-governmental social protection programs (pilot experiments) on beneficiaries' participation in collective actions such as voting and participation in local politics. It would also be very useful if future research could find a way to quantify the social capital gains and conduct a cost-benefit analysis.

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B

APPENDIX: TABLES

Table B.1: Balance table: baseline characteristics

	Conditional			Unconditional		
	(1)	(2)	(3)	(4)	(5)	(6)
	Control	Treated	Diff	Control	Treated	Diff
Trust baseline = 1	0.338	0.283	-0.054***	0.342	0.278	-0.064**
	(0.473)	(0.451)	(0.019)	(0.474)	(0.449)	(0.031)
Gift baseline	0.169	0.174	0.005	0.159	0.134	-0.024
	(0.375)	(0.379)	(0.015)	(0.365)	(0.342)	(0.023)
Reciprocal baseline = 1	0.395	0.346	-0.049**	0.402	0.384	-0.018
	(0.489)	(0.476)	(0.019)	(0.490)	(0.487)	(0.032)
Young = 1	0.853	0.827	-0.026*	0.914	0.926	0.011
	(0.354)	(0.378)	(0.014)	(0.280)	(0.263)	(0.018)
Household size	6.259	6.187	-0.072	6.309	6.562	0.253*
	(2.330)	(2.409)	(0.094)	(2.301)	(2.188)	(0.148)
Female headed = 1	0.359	0.337	-0.022	0.341	0.290	-0.051*
	(0.480)	(0.473)	(0.019)	(0.474)	(0.454)	(0.031)
Education level	7.253	6.714	-0.539***	7.566	7.841	0.275***
	(2.061)	(2.344)	(0.086)	(1.632)	(1.669)	(0.106)
Spending on girl	433.743	413.407	-20.337	495.282	550.142	54.861
	(866.385)	(1,131.778)	(38.195)	(943.344)	(889.817)	(60.803)
Asset index	0.017	-0.094	-0.111	0.239	0.893	0.654***
	(2.460)	(2.587)	(0.099)	(2.465)	(2.453)	(0.160)
Mother alive	0.654	0.613	-0.041**	0.663	0.655	-0.009
	(0.476)	(0.487)	(0.019)	(0.473)	(0.476)	(0.031)
Father alive	0.406	0.388	-0.017	0.420	0.423	0.004
	(0.491)	(0.488)	(0.019)	(0.494)	(0.495)	(0.032)
Urban = 1	0.158	0.178	0.020	0.148	0.230	0.082***
	(0.365)	(0.383)	(0.015)	(0.355)	(0.421)	(0.024)
Time preference	0.795	0.746	-0.050	0.776	0.925	0.150
	(1.543)	(1.286)	(0.058)	(1.591)	(2.194)	(0.111)
Sexually inactive	0.663	0.531	-0.132***	0.771	0.786	0.015
	(0.473)	(0.499)	(0.019)	(0.420)	(0.411)	(0.027)
Ever been pregnant	0.118	0.210	0.093***	0.021	0.025	0.004
	(0.322)	(0.408)	(0.014)	(0.143)	(0.156)	(0.009)
Majority tribe = 1	0.664	0.662	-0.001	0.652	0.625	-0.027
	(0.473)	(0.473)	(0.019)	(0.476)	(0.485)	(0.031)
People are selfish = 1	0.798	0.821	0.022	0.796	0.826	0.029
	(0.401)	(0.384)	(0.016)	(0.403)	(0.380)	(0.026)
Social network = 1	0.659	0.605	-0.054***	0.703	0.722	0.020
	(0.474)	(0.489)	(0.019)	(0.457)	(0.449)	(0.030)
Politics baseline	0.157	0.164	0.007	0.147	0.104	-0.043*
	(0.364)	(0.371)	(0.015)	(0.354)	(0.306)	(0.023)
Sociability baseline	0.023	0.052	0.029	0.007	0.029	0.022
	(1.052)	(1.033)	(0.042)	(1.057)	(1.084)	(0.069)
Observations	1,948	942	2,890	1,495	283	1,778

Source: authors' elaboration.

Table B.2: Cash transfers and social capital: No controls

	People can be trusted = 1			Gift = 1			Social capital index		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES									
Treated = 1	0.0313***			0.0246***			0.102***		
	(0.0113)			(0.00937)			(0.0220)		
Conditional = 1		0.0419***			0.0349***			0.116***	
		(0.0123)			(0.0103)			(0.0241)	
Unconditional = 1			-0.00352			0.00944			0.0657*
			(0.0196)			(0.0154)			(0.0375)
Trust baseline = 1	0.104***	0.103***	0.0887***						
	(0.0118)	(0.0124)	(0.0152)						
Gift baseline = 1				0.0708***	0.0662***	0.0476***			
				(0.0122)	(0.0128)	(0.0155)			
SC index baseline							0.417***	0.413***	0.378***
							(0.00967)	(0.0102)	(0.0125)
Observations	5,909	5,374	3,349	6,346	5,780	3,556	5,940	5,401	3,364
R-squared	0.014	0.014	0.010	0.006	0.007	0.003	0.240	0.237	0.214
Controls	NO	NO	NO	NO	NO	NO	NO	NO	NO

Standard errors are in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Table B.3: Amount of cash transfer and social capital

VARIABLES	(1) People can be trusted = 1	(2)	(3) Gift = 1	(4)	(5) Social capital index	(6)
Individual amount	-8.37e-06		-1.39e-05		-3.97e-05	
	(4.77e-05)		(3.40e-05)		(0.000107)	
Combined amount		-1.36e-05		-9.17e-06		-4.08e-05
		(1.52e-05)		(1.14e-05)		(3.49e-05)
Observations	2,096	2,096	2,101	2,101	2,096	2,096
R-squared	0.030	0.030	0.056	0.057	0.041	0.042
Controls	YES	YES	YES	YES	YES	YES

Robust standard errors are in parentheses. The results are from OLS regression. Controls include all the adolescent and household covariates listed in table 4.1. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Table B.4: Cash transfers and social capital index: moderators

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Social capital index								
Treated = 1	0.0325			0.0639***			0.0637***		
	(0.0266)			(0.0211)			(0.0211)		
Treated X Reciprocal = 1	0.0875**								
	(0.0434)								
Conditional = 1		0.0399			0.0772***			0.0758***	
		(0.0291)			(0.0232)			(0.0232)	
Conditional X Reciprocal = 1		0.102**							
		(0.0477)							
Unconditional = 1			0.0161			0.0317			0.0319
			(0.0452)			(0.0372)			(0.0356)
Unconditional X Reciprocal = 1			0.0437						
			(0.0727)						
Treated X Wealth				0.00586					
				(0.00830)					
Conditional X Wealth					0.00842				
					(0.00907)				
Unconditional X Wealth						0.00102			
						(0.0145)			
Treated X Social							0.0273		
							(0.0313)		
Conditional X Social								0.0320	
								(0.0357)	
Unconditional X Social									0.0294
									(0.0516)
Observations	5,895	5,360	3,343	5,896	5,361	3,344	5,896	5,361	3,344
R-squared	0.320	0.319	0.312	0.320	0.319	0.312	0.320	0.319	0.312
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors are in parentheses. Controls include all the adolescent and household covariates listed in table 4.1 and baseline social capital index, trust and gift-giving behavior. Significance: *** p<0.01, ** p<0.05, * p<0.1. Columns 1-3 show the mediation role of reciprocal beliefs. Columns 4 to 6 test the moderation effects of wealth. And, columns 7-9 show the moderation effects of sociability index. Source: authors' elaboration.

Table B.5: Cash transfers, school attendance, and social capital

VARIABLES	(1) People can be trusted = 1	(2) Gift = 1	(3) Social capital index
Conditional = 1	0.0474***	0.0353***	0.119***
	(0.0126)	(0.00891)	(0.0247)
In school = 1	-0.00566	-0.0306***	-0.0202
	(0.0149)	(0.0105)	(0.0292)
Trust baseline = 1	0.0942***		
	(0.0126)		
Gift baseline = 1		0.0625***	
		(0.0111)	
SC index baseline			0.412***
			(0.0103)
Observations	5,361	5,382	5,372
R-squared	0.023	0.028	0.240
Controls	YES	YES	YES

Standard errors are in parentheses. Controls include all the adolescent and household covariates listed in table 4.1. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Table B.6: Cash transfer and social capital: alternative measure of reciprocal beliefs

VARIABLES	(1) Social capital index	(2)
Conditional = 1	0.0332	
	(0.0299)	
Unconditional = 1		0.0207
		(0.0461)
Conditional X Reciprocal	0.111**	
	(0.0470)	
Unconditional X Reciprocal		0.0305
		(0.0720)
Reciprocal baseline = 1	0.00143	0.0170
	(0.0274)	(0.0298)
SC index baseline	0.629***	0.629***
	(0.0131)	(0.0168)
Observations	5,360	3,343
R-squared	0.320	0.312
Controls	YES	YES

Standard errors are in parentheses. Controls include all the adolescent and household covariates listed in table 4.1. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

4

OVERCONFIDENCE, TRUST, AND INFORMATION-SEEKING AMONG SMALLHOLDER FARMERS

Abstract

We investigate the role of overconfidence and trust in farmers' information-seeking behavior using a lab-in-the-field experiment in Ethiopia. Our results show that overconfidence is widespread among farmers in our sample, predicts less information-seeking, and is associated with an efficiency loss. Moreover, we find that farmers tend to seek more information from extension agents than peer farmers and that information-seeking increases when the source is perceived as more knowledgeable. When aiming to increase the adoption of productivity-enhancing practices, farmers' overconfidence in their own information set and their trust in the quality of information shared should not be overlooked.

4.1 INTRODUCTION

Enhancing agricultural productivity is an important strategy for poverty alleviation and economic development in Sub-Sahara Africa (Gollin et al., 2002). Information and knowledge are fundamental drivers to adopt productivity-enhancing technologies and practices, and hence many developing countries' governments have implemented programs that aim to facilitate access to information for farmers—often through some form of agricultural extension service (Cole and Fernando, 2012; Foster, Andrew D, and Mark R, Rosenzweig, 2010; Godtland et al., 2004; Foster and Rosenzweig, 1995; Ryan and Gross, 1950). Ethiopia is a prime example where the national government has intensively engaged in agricultural extension for years, making it the largest agricultural extension service (AES) provider in Africa (Berhane et al., 2018).

[0]The chapter is based on:
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Despite its long-standing tradition and a large scholarly literature on AES, evidence on its effectiveness remains inconclusive. For example, Krishnan and Patnam (2013) find that the Ethiopian AES is more effective at initializing technology adoption, but for broader adoption, they find peer learning more effective. Dercon et al. (2009) also study its effect on poverty reduction and find some evidence that it reduces headcount poverty in rural Ethiopia. On the other hand, Gebresilasse (2020) finds that the Ethiopian AES affects productivity only when combined with road access. Similarly, recent studies in different contexts also show weak evidence to the effectiveness of AES in driving technology adoption and increasing agricultural productivity (Pan et al., 2018; Cerdán-Infantes et al., 2008, for example), and Birkhaeuser et al. (1991) provides a comprehensive review of earlier non-experimental studies on the effectiveness of AES, finding that its effect is ambiguous and overall weak.

Recently, researchers have started to investigate potential supply-side barriers to effective AES, in both an experimental and non-experimental fashion. Several studies, for example, document the diffusion process of agricultural information (Beaman and Dillon, 2018; Aker, 2011; Conley and Udry, 2010; Ryan and Gross, 1950); the impact of agricultural information on technology adoption, productivity, and poverty reduction (Pan et al., 2018; Dercon et al., 2009; Owens et al., 2003; Birkhaeuser et al., 1991; Feder and Slade, 1986); and, the impact of various incentivized interventions to disseminate agricultural information (Fafchamps et al., 2020; Shikuku et al., 2019; BenYishay and Mobarak, 2018; Kondylis et al., 2017).

By contrast, there is much less known about possible demand-side barriers related to agricultural extension. A handful of studies try to understand the learning process (Genius et al., 2014; Conley and Christopher, 2001; Foster and Rosenzweig, 1995), while others investigate how granting framers control over the quality of agricultural information-providers through feedback mechanisms increases demand for information (Jones and Kondylis, 2018); the role of signaling and shame in relation to information-seeking (Chandrasekhar et al., 2019); and the influence of trust on learning from extension agents (Buck and Alwang, 2011). Our study complements this research and investigates two topics that we deem particularly relevant for understanding constraints in the context of farmer's information-seeking behavior—overconfidence bias and trust in information quality, as well as their possible interaction.

Specifically, we argue that if farmers believe that they have adequate information and knowledge, they may search for less information and may undervalue information from external sources like AES. There is well-established literature that shows that individuals tend to be overconfident in various aspects. For example, individuals are found to be overconfident in their driving skills (Svenson, 1981; Matthews and Moran, 1986); in their agricultural production decisions (Barsbai et al., 2021); in their health (Huang and Luo, 2015);

in their financial decisions (Barber and Odean, 2001); in prescription decisions (Baumann et al., 1991); and, in their likelihood of gym attendance (DellaVigna and Malmendier, 2006). Yet individuals could also be underconfident, as confidence depends on the ability required by the task at hand as in Kruger (1999), who finds individuals to be overconfident in low-ability tasks and underconfident in high-ability tasks, and Moore and Cain (2007) reporting that individuals tend to be overconfident in simpler tasks, but underconfident in difficult tasks. Yet none of the studies above link overconfidence to information-seeking behavior. There are two studies that do and are most closely related to ours, though in a very different and non-agricultural context: a study by Kramer (2016) shows that confident individuals seek less financial advice, but finds no relationship between overconfidence and financial advice-seeking. The second study by Porto and Xiao (2016) finds that overconfident individuals seek less financial advice on saving, investment, and mortgage but seek more advice on debt counseling and tax planning.

Another plausible constraint to information-seeking behavior is trust in the information source. Evidence from the organizational management literature demonstrates that people discriminate among information sources and by perceived quality (Nicolaou et al., 2013; Nicolaou and McKnight, 2006; O'Reilly III, 1982). Thus if farmers are suspicious of the motives or the expertise of their information sources, they may seek less information from them. Distrust in AES can for example be caused by extracurricular political assignments governmental extension agents have, as documented by Berhanu and Poulton (2014) for Ethiopia.

In this paper, we examine both issues – overconfidence and trust – in a lab-in-the-field experiment among a sample of Ethiopian farmers. Specifically, we investigate whether farmers are overconfident with respect to knowledge about agriculture and whether such endogenous behavioural features predict their information-seeking behavior. In addition, we study whether providing randomized positive or ambiguous nudges about the quality of the information and the trustworthiness of its source affects information-seeking and whether these impacts co-vary with levels of overconfidence. Lastly, we are interested in potential efficiency losses that result from overconfidence and (or) low trust through their effects on information-seeking behavior.

Our lab-in-the-field experiment employs two incentivized "exam-based" tasks. One "familiar" task involves farmers solving multiple-choice questions on familiar agricultural topics (questions covering the most common farming activities in the study area). In a second, "unfamiliar" task, we require these same farmers to solve multiple-choice questions from Raven's matrices test. During these tasks, farmers can seek help from designated extension agents or peer farmer advisors (henceforth, information sources). We randomly assign

farmers to either extension agents or peer farmers as information sources. The number of times the participant farmer reaches out to his or her information source is our key outcome variable in the experiment. We have a number of additional treatment arms to help us understand the role of perceived quality of sources and trust and its potential interaction with overconfidence.

Our results show that the majority (76-83%) of farmers are overconfident and that overconfidence seems to be a behavioral feature observed across tasks with varying levels of familiarity to the sample farmers. Furthermore, we find that overconfidence predicts lower information-seeking and that, on average, farmers seek more information from extension agents than their peers. Concerning our sub treatments, we report that farmers seek more information from perceived high-quality sources and that a positive trust nudge leads to higher information-seeking. We find little support for the idea that overconfident farmers react differently to informational treatments related to the information source's perceived quality or nudges on its trustworthiness. Lastly, we also show that overconfidence is associated with an efficiency loss, while trust leads to an efficiency gain.

The remainder of the paper is organized as follows. The next section presents the experimental design and data. Section 4.3 presents the empirical strategies. Section 4.4 presents and discusses the empirical results. Section 4.5 concludes.

4.2 EXPERIMENTAL DESIGN AND DATA

This section starts with some brief background information about the study area and then proceeds to describe the experimental design. Next, we discuss the experiment and survey instruments we use to collect additional data. The section concludes by presenting the summary statistics.

4.2.1 *Context*

Ethiopia is the second-most populous country located in the horn of Africa, with its economy heavily reliant on small-scale rain-fed agriculture—employing more than 70% of its population (CIA, 2020). Agriculture comprises about 31% of the Ethiopian GDP, thereby exceeding the manufacturing sector's contribution, which was 27% in 2018 (WorldBank, 2020). Recognizing the importance of the agriculture sector, the Ethiopian government has been implementing the Agricultural Development-Led Industrialization (ADLI) policy as its primary growth and transformation strategy since 1991. Increasing agricultural productivity through the adoption of improved agricultural technologies is a core objective

of the ADLI strategy, and since 1991, the Ethiopian government adopted and implemented the participatory demonstration and training extension system (PADETES) as its national extension policy, with free services expanding over the years, making the Ethiopian extension service one of the largest in the world, with a relatively small extension agent to farmer ratio (21 agents per 10,000 farmers)(Berhane et al., 2018). The latest available information shows that each *kebele* has at least three EAs with specializations in crops, livestock, and natural resources (MOA, 2017).[1]

4.2.2 *Experimental design*

Our experiment involves farmers participating in two exam-based tasks—one covering "familiar" (i.e., agricultural) topics to farmers and another we consider "unfamiliar." The familiar task requires farmers to solve ten multiple-choice questions that are based on the most common agricultural activities in the study area. More specifically, the questions cover topics regarding wheat and sheep production (see appendix E for the questions used in this task).[2] The unfamiliar task involves solving ten multiple-choice questions from Raven's matrices test. To run our experiment, we used facilities such as, farmers' training centers, schools, and village administration compounds–based on availability and proximity to the *Gots*–and we run one session per *Got*.[3] In our regression analyses, we cluster standard errors at the *Got* level to account for session/*Got* specific characteristics.

In both tasks, farmers in the treatment groups have two options when solving the questions. One option is that they solve all questions by themselves. Another option is that they seek advice from their information sources for any of the questions.[4] We set up two information sources–extension agent and peer farmer sources. Farmers in the treatment group were randomly assigned to either one of these sources. Farmers earned 5 Birr for every question

[1] *kebele* is an administrative unit next to district.

[2] Eighty-nine percent of farmers in our sample hold sheep. In the main rainy season of 2020, 27% of plots in our sample were used for wheat, 26% for barely 32% for legumes, and the remaining for other crops such as teff and lentils. The farmers practice crop rotation between legumes and the other cereals.

[3] *Gots* are administrative units next to Villages.

[4] We use advisors from a different village than the participant farmers to minimize the effect of prior personal knowledge between advisors and participants. Additionally, to avoid interpersonal interaction between the participant farmers and advisors, which might create an image concern for participant farmers, communication between farmers and advisors was mediated by enumerators. Previous studies show that social distance between advisor and seeker and an associated image concerns affect advice seeking. For example, Chandrasekhar et al. (2019) find an 81% decline in the likelihood of advice-seeking when the advisor is from the same caste because the seeker feels shame about appearing less able in the eyes of the co-caste advisor than a stranger. Image concerns also affect behavior in other domains, such as the "Acting Wife" findings of Bursztyn et al. (2017) where they observe single women posing less ambitious in their career when being observed by male classmates and the "Acting White" hypothesis, which states that Black Americans invest less in their education due to fear of rejection from their group members (Fryer Jr and Torelli, 2010; Austen-Smith and Fryer Jr, 2005).

they solved correctly and incurred a cost of 1 Birr for every question they refer to their sources.[5] The reason behind our incentive structures is to mimic the real-world return and cost of information. We expect that, in the real world, the more information a farmer has, the higher his/her returns will be: for example, a farmer with up to date information about profitable varieties or a farmer who is informed about what products are on-demand and what products are being produced by other farmers would be more likely to make better allocation decisions and generate better profits. Similarly, information acquisition in the real world is not costless. For example, a farmer has to pay for transportation and spend valuable time traveling to the extension office or to a nearby market to ask about new technologies and assess the supply and demand of produces.[6]

To obtain a measure of over(under)confidence, we elicit farmers' expected performance by asking them to estimate how many questions they expect to solve correctly and compare it with their actual performance.[7] Previous studies measure overconfidence in various ways. One method is by asking respondents to estimate the probability of getting specific events (Weinstein, 1980) or getting the right answer to a question (Lichtenstein and Fischhoff, 1977). Another method is by asking the confidence interval such that the correct answer lays between the upper and lower bound with some confidence level (Menkhoff et al., 2013; Gilovich et al., 1993). A third option is to ask how well they have done compared to other participants (Menkhoff et al., 2013). And lastly, people have used survey questions to elicit perceived skills in specific domains (Koellinger et al., 2007).[8] Using the probability and confidence interval approaches, we considered infeasible in our setting given the high cognitive burden it could plausibly cause to our mostly less-educated respondents. To simplify, we instead directly ask farmers about their expected performance before they solve the questions. Our measurement is closely related to the one used by Camerer and Lovallo (1999) where they ask participants to estimate the number of market entrants and look at its relationship with participants' own market entry decisions in a lab setting. Before asking about their expected performance, we show them two examples of the questions

[5]Birr is Ethiopian currency where 1 USD is exchanged for about 29 Birr in November 2019. During the survey period, the wage for a daily laborer in the study area ranged between 80 to 120 Birr, and daily laborers often work for 9 to 10 hours. If we assume an average wage of 100 Birr, 5 Birr would be approximately equivalent to the wage of 30 minutes of labor.

[6]The reason behind the constant cost of seeking is that when we designed the experiment, we were imagining a scenario where each outsourcing would represent a separate information-seeking effort. For example, in the real world, a farmer would one day go to the extension officer to discuss solutions to a new disease or pest, and another day he/she might go there to ask for the agronomy of improved seed. In this case, each round of seeking would constitute an information-seeking cost that is more or less independent from the other. However, we acknowledge that some real-world scenarios could have been better addressed with a different design.

[7]Expected performance is elicited before we provide information about their information sources.

[8]See Moore and Cain (2007) for a review of the different forms of overconfidence and respective measurements.

so that they get an idea of what kind of questions to expect. By doing this, we mimic the fact that in the real world, individuals would have to rely on incomplete information to assess whether the task is within the scope of their abilities. We incentivize the expectation elicitation such that if their expected performance and actual performance are equal, they get a 15 Birr phone credit as a prize. By incentivizing the expectation elicitation, we address an important limitation in the existing literature on overconfidence that relies heavily on unincentivized expectation elicitation. When unincentivized, expectation elicitation could lead to a "careless" estimation of performance by participants–leading to biased inference (Hoelzl and Rustichini, 2005).[9]

Treatment arms

Farmers in the treatment group are randomly assigned to one of three additional (sub)treatment arms - see figure 4.1 for a graphical illustration of the treatment arms. The first split refers to the type of information source - farmers are either assigned to an extension agent or a peer farmer as an information source. The farmers in the training treatment arm receive information that their information sources have been trained.[10] This allows us to investigate whether the quality of information matters for farmers' information-seeking. However, this treatment does not allow us to disentangle the increase in "trust" about the quality of the information received from actual increases in quality due to the training (which sophisticated participants could elicit from the information received from their sources). For this reason, our last sub-treatment pertains to farmers receiving high or low-quality nudges about the ability of the information source without actually changing their ability. Ability is one of three important characteristics of trustworthiness underlined by Mayer et al. (1995), and while trust in information sources is impossible to randomize, we believe that a trust nudge increases salience with respect to trust in the advisor, and as such, may help us understand its role in farmers' decision-making. In the "high-trust" nudge, we present sources as highly

[9]On the other hand, one might argue that by incentivizing the expectation elicitation, we might have led farmers into behaving in such a way that they start providing wrong answers, on purpose, once they feel like they have answered correctly as many questions as they expected to answer to win the prize. Although we cannot completely rule out this possibility, we suspect that this kind of behavior could not have been dominant as only 10% of farmers in our sample have answered exactly as many questions as they expected. Also, we can argue that only a proportion of these 10% farmers could have intentionally tampered with their answers for the sake of the prize. Secondly, even if a farmer behaves this way, the consequence would be that the farmer would appear as calibrated rather than being underconfident. Meaning that if a farmer expects to solve five questions correctly and starts providing wrong answers once he/she thinks he/she has solved five questions correctly, the farmer would appear as calibrated rather than underconfident–the farmer's true state of confidence. This is because if the farmer had not started tampering with the answers, he/she would have answered more than five questions correctly, which would have made him/her underconfident. In our main analysis, we label farmers as overconfident if their overconfidence scores are above the median and non-overconfident; otherwise, therefore, such farmers would belong in their "rightful" category.

[10]Information sources in the training treatment arm received training on wheat agronomy and sheep fattening by extension agents from the district agriculture and rural development office.

able to solving the experimental tasks, whereas, in the "low-trust" nudge, we present sources as having an ambiguous ability to solving the tasks. Specifically, the high-trust nudge in the high-quality source reads: "The designated advisor has taken training on the topic related to the questions and is well equipped to have the correct answers." The low-trust nudge in the high-quality source reads: "The designated advisor has taken training on topics related to the questions. Notwithstanding the training received on topics related to the questions, they may or may not know the correct answers to all the questions." The high-trust nudge in the low-quality source reads: "The designated advisor is well equipped as you are, and maybe highly likely to help you solve the questions." The low-trust nudge in the low-quality source reads: "Note that the designated advisor may or may not know the correct answers to all the questions" (see the appendix E the complete experimental protocol).[11]

Additional data and descriptive statistics

We collect additional data on various behavioral and socio-economic variables to account as much as we can for variables that could possibly correlate with our variable of interest: overconfidence. A cross-cultural study by Meisel et al. (2016), for example, shows that risk preference correlates positively with overconfidence in two cultures–China and the US. We, therefore, collect data on farmers' risk preferences using the investment game developed by Gneezy and Potters (1997), where farmers decide whether to invest some or all of their show-up fee (which is 30 Birr) in a lottery with a 50% chance of doubling their investment and 50% chance of halving it. We also collect a measure of generalized trust as more trusting farmers may also be the more overconfident ones. We also adopt the survey instrument from the General Social Survey (GSS) to measure generalized trust.[12] Next, we measure farmers' locus of control by using the instrument used in Bernard et al. (2008).[13]

[11]Notice that we have a pure control group where farmers can solve the questions only by themselves and hence it is not used in the main analyses involving information seeking. The main reason we decided to have a pure control group when we were designing the experiment was to avoid the risk of running into some unanticipated bias that may require a scenario where we would need pure control to test/justify. We, however, use the observations from the pure control group as well in our analyses of gauging overconfidence and establishing whether it is a task-specific behavior or a personality trait. We also use it to test whether those with external information sources score better than those without. The results presented in appendix C.1 confirm that farmers with external sources, on average, score higher than those without.

[12]We ask participants the following question: *"Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?"* The responses are either (1) Most people can be trusted or (2) You can't be too careful in dealing with people."

[13]Locus of control indicates individuals' beliefs in the relationship between the causes and outcomes in their lives. If an individual believes that outcomes are the results of his/her own actions, he/she is considered to be internally controlled. However, if an individual believes that he/she has no full control over what happens to his/her life and believes that luck or fate determines outcomes in life, the individual is considered to be externally controlled (Rotter, 1966). To that end, participants respond to the following question: *Which one of the following statements do you agree the most?* The responses are either (1) Each person is primarily responsible for his/her success or failure in life (internally controlled). Or, (2) One's success or failure in life is a matter of his/her destiny (externally controlled).

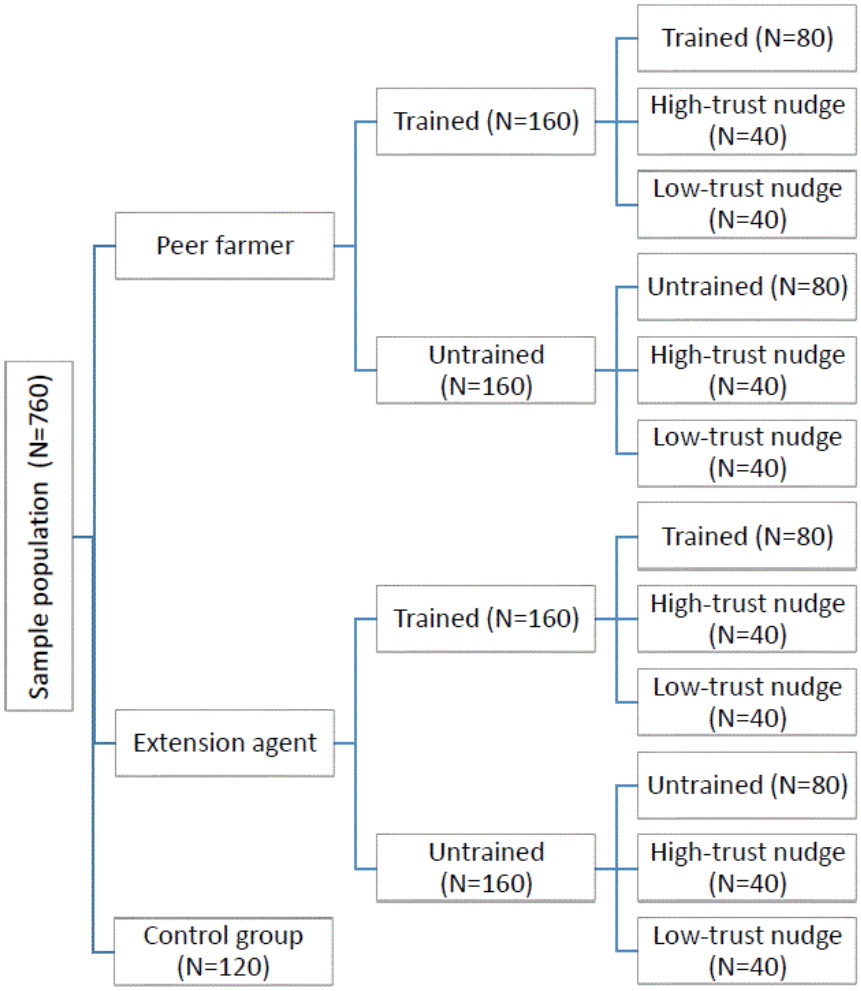

Figure 4.1: Treatment arms and respective sample sizes

Lastly we obtain information on standard economic and demographic variables that have been associated with overconfidence including sex (Forbes, 2005; Barber and Odean, 2001) age (Bhandari and Deaves, 2006), family size, education, farm size, farm experience, and livestock holding,(Gervais and Odean, 2001) which we convert into tropical livestock units (TLU), and social capital (proxied by *Iquib* membership).[14]

Table 4.1 presents the summary statistics. Our sample constitutes 760 farmers from 40 *Gots* in 10 Villages.[15] The average age in our sample is 43 years, and 90% of our participants are males.[16] On average, our respondents have three years of formal education. Fifty percent

[14] *Iquib* is an informal saving group

[15] We randomly selected households and requested them to send the household member who is mainly responsible for the farming activities and would be most knowledgeable; this was important because one of the tasks involve solving agriculture related questions.

[16] We miss data on age for one individual.

of our respondents have *Iquib* membership. Sample farmers have 1.3 *timads* of land, 5.5 tropical livestock units (TLU), and 21 years of farming experience.[17] Seventy-seven percent of farmers have an internal locus of control, and 25% are trusting towards others. Lastly, the index for relative risk-loving in our sample is 0.718.[18]

Table 4.1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Age	43.316	13.245	18	77	759
Male=1	0.901	0.298	0	1	760
Formal education	3.162	3.685	0	15	760
Iqub membership=1	0.508	0.5	0	1	760
Internally controlled=1	0.771	0.42	0	1	760
Farm size	1.272	0.779	0	5	760
Farming experience	20.934	12.912	0	60	760
Tropical Livestock Units	5.537	3.161	0	20.98	760
Trusting=1	0.251	0.434	0	1	760
Risk loving	0.718	0.264	0	1	760

Source: authors' elaboration.

[17] Timad is the local unit for land size. Four timads are equivalent to 1 hectare.

[18] We calculate the risk-loving index as the proportion of the endowment farmers invest in the lottery relative to the total endowment. This results in $0 \leq risk - loving \leq 1$. Therefore a value closer to zero indicates lower risk-loving propensity and *vice versa*.

4.3 EMPIRICAL STRATEGY

4.3.1 *Overconfidence, information quality, trust, and information-seeking*

Our objectives here are 1) to examine whether overconfidence predicts farmers' information-seeking behavior ; 2) to examine the impact of information quality on information-seeking; 3) to examine the impact of trust in information-seeking; 4) to investigate whether the impacts of information quality and trust are heterogeneous by overconfidence. For this purpose, we estimate the following linear models.[19]

$$Seeking_i = \alpha + \rho OC_i + \beta X_i + \epsilon_i \tag{10}$$

$$Seeking_i = \alpha + \pi Treat_{ki} + \zeta Treat_{ki} XOC_i + \beta X_i + \epsilon_i \tag{11}$$

where $Seeking_i$ the number of questions farmer i referred to the advisor. OC_i is farmer i's level of overconfidence (representing both a dummy split of overconfidence at the median – what we call relative overconfidence (OC_R) – and, the continuous overconfidence Z-scores).[20] $Treat_{ki}$ shows whether farmer i belongs to treatment k, where k stands for quality

[19]We measure information-seeking by the number of questions that farmers referred to advisors. This means that our outcome variable is a count variable with a Poisson distribution. Hence, to check the robustness of our results, we also use a negative binomial regression (NBR) to analyze the relationship between overconfidence, information quality, trust, and information-seeking. The advantage of the NBR over Poisson regression is that it relaxes the equidispersion (equality of the conditional mean and variance) assumption of the Poisson regression.

Let O_i be the number of questions referred by a farmer i; X_i be a vector of explanatory variables corresponding to the farmer i. The vector includes the overconfidence indicator which takes a value of one if a farmer i's overconfidence score is higher than the median, and zero otherwise; a treatment indicator for information quality; and, a treatment indicator for high-trust nudge. The vector also includes interaction terms and other controls including age, , sex, formal education, *Iqub* membership, risk preference, generalized trust, locus of control, farm size, farming experience, livestock ownership (TLUs), and a dummy indicator for task familiarity. β is the parameter associated with the explanatory variables; and, α is the constant. Assuming O_i follows a Poisson distribution, the expected value of O_i given X_i is:

$$\lambda_i = Var[O_i|X_i] = E(O_i|X_i) = exp^{(\alpha + x'\beta)} \tag{8}$$

However, since NBR allows for the inclusion of a stochastic error term (ε_i) to relax the equidispersion assumption, equation 14 becomes;

$$E[O_i|X_i, \varepsilon_i] = exp^{(\alpha + x'\beta + \varepsilon_i)} = h_i \lambda_i \tag{9}$$

where $h_i = exp^{\varepsilon_i}$ and is assumed to have gamma distribution with mean of 1 and variance $1/\theta = k$. Hence, the NBR estimates the conditional mean $E[O_i|X_i] = \lambda_i$ (similar to the Poisson model) while allowing for overdispersion such that the variance becomes $Var[O_i|X_i] = \lambda_i[1 + (1/\theta)\lambda_i]$; where θ is the parameter of overdispersion (for the full derivation, see Greene (2008).)

[20]In our regression analyses, we favour a dummy split at the median as this maximizes the power of our analysis. This was an ex-ante decision, as we could not anticipate which share of respondents would be

and trust treatments. $Treat_{ki}XOC_i$ is an interaction between the quality and trust treatments and overconfidence level and ρ, π, and ζ are the parameters of interest.

Given that one of our variables of interest, i.e., overconfidence, is an endogenous personality feature, it is difficult to conduct a causal analysis. However, it would still be useful for policymakers to know whether such features predict economically relevant decisions such as information seeking.[21] For this purpose, we start with an OLS regression specified in equation 10. Next, we use random forest (RF) algorithm – a supervised machine learning method – to improve our prediction accuracy and to examine the relative importance of overconfidence vis-a-vis other factors in predicting farmers' information-seeking behavior. The RF algorithm is a widely used method as it is one of the best-performing machine learning algorithms that combine good out-of-sample fits along with shorter running time (Varian, 2014; Hastie et al., 2009; Caruana and Niculescu-Mizil, 2006). The RF method works by constructing many trees using randomly selected subsets of the variables (predictors) and the data and averaging across them.

Following Schonlau and Zou (2020)'s recommendation to assign a larger proportion of the data to the training set in cases where the sample size is relatively small, we split our data such that 60% is used for training and 40% for validation. We then tune the hyper-parameters – the number of iterations (number of sub-trees) and the number of variables to investigate at each split – in order to find the model that yields the highest testing accuracy (or to find the model that has the lowest out-of-bag (OOB) error). According to Hastie et al. (2009), the OOB error estimate is similar to that of K-fold cross-validation used in other machine learning methods, such as the least absolute shrinkage and selection operator (LASSO). Therefore, RFs can be fit in one go, with cross-validation being performed along the way, where, in our case, following Schonlau and Zou (2020), the RF algorithm learns by randomly selecting 75% of the training data at a time and repeats the same resampling, with replacement, until the OOB error stabilizes. Afterward, we terminate the training, test its performance against the test dataset, and generate the variable importance plot.

overconfident, and thus could not conduct ex-ante power calculations. In the event that a very small (or very large) number of respondents would have been overconfident this may have yielded a strongly under-powered analysis.

[21] Take the following silly example. In Ethiopia, the electric power goes off often when it is going to rain (from preventative action taken by the power company or technical problems due to wind, etc.). Obviously, the power blackout does not cause rain (although many kids in Ethiopia believe that it does). However, since it helps predict rain, when the power goes off, people start collecting laundry and other things and get them inside—showing that predictability of rain from power outages helps households to take relevant actions. Therefore, we argue that it would be worthwhile to know whether overconfidence predicts information-seeking behavior to be able to take actions that could improve information uptake of overconfident individuals.

4.3.2 *Efficiency implications of overconfidence and trust*

The final component of our empirical strategy seeks to examine whether there is an efficiency loss due to overconfidence that arises from seeking less information. Additionally, we test whether trust and extension agents improves efficiency. For this purpose, we use the Stochastic Frontier Analysis (SFA) approach. In our specific case, the output is the log of the total scores, labeled as $lnscore_i$, in equation 12. The factors of production (inputs) are the two factors that contribute to the total score i.e. farmers (questions attempted by the farmers), and sources (questions attempted by the sources). The factors of production are also log-transformed and labeled as $lninputs_{ji}$ in equation 12. Next, following Wang and Schmidt (2002), we simultaneously estimate equations 12 and 13 to calculate the inefficiency (if there is any) in our sample and, test how it is affected by overconfidence, extension agents, and trust.

$$lnscore_{ij} = \alpha + \gamma^{'} lninputs_{ji} + (v_i - \mu_i) \tag{12}$$

$$\mu_i = \beta_1 OC_i + \beta_2 trust_i + \beta_3 source_i + \tau X_i + \gamma_v \tag{13}$$

where μ_i is the technical inefficiency with an exponential distribution, that is, $\mu_i \sim \varepsilon(\sigma_\mu)$; v_i is the stochastic error term; $\gamma^{'}$ is elasticity of the respective inputs; i is the i^{th} farmer; j is the j^{th} input (that is, questions attempted by the farmers and the sources). OC_i is an indicator for the relative overconfidence of farmer i, where farmer i is overconfident if his/her overconfidence score is above the median, and 0 for otherwise; $trust_i$ is an indicator variable taking he value of 1 if farmer i belongs to the high-trust nudge treatment arm; $source_i$ is an indicator which takes the value of 1 if farmer i belongs to the extension agent treatment group, and 0 for otherwise; $\beta_1 - \beta_3$ are the parameters of interest. X_i are a set of covariates including age, sex, formal education, *Iqub* membership, risk preference, generalized trust, locus of control, farm size, farming experience, livestock ownership in TLUs, an indicator for trained source, and an indicator for task familiarity. γ_v are village fixed effects.

4.4 RESULTS

In this section, we present and discuss the results from the statistical and econometric analyses. We first start by showing the extent of overconfidence in our sample and its relationship with information seeking. Next, we present and discuss the results that show the effects of information quality and trust in information sources in information seeking. We conclude this section by showing the efficiency implications of overconfidence and trust.

4.4.1 *Overconfidence*

Our first objective is to gauge the extent of overconfidence across two tasks with varying levels of familiarity to the participant farmers. As we point out in the introduction, the literature provides inconclusive evidence on whether individuals are overconfident across various task domains. Here, we intend to test whether overconfidence varies by task familiarity. For this purpose, we create a measure of overconfidence by subtracting the actual score of a farmer from his/her expected performance in the two tasks, following the definition of overconfidence by Moore and Cain, which states that "overconfidence is the overestimation of one's actual ability, performance, level of control, or chance of success." (Moore and Cain, 2007, P.502).[22] Next, to formally test the hypothesis, we generate an indicator variable that equals one if the expected performance is higher than the actual performance; zero, otherwise, and test whether the mean overconfidence in the two tasks is equal. Mathematically;

$$I_{ij} = \begin{cases} 1 \; if & Expected\ score_i^{own} > Actual\ score_i^{own} \\ 0 & Otherwise \end{cases}$$

$$Overconfidence_j = \sum_{i=1}^{N} (W_i I_{ij}) \tag{14}$$

Where $Overconfidence_j$ is sample overconfidence in task j; I_{ij} is the indicator of overconfidence of individual i in task j, and W_i is the weight such that $W_i = 1/N$, where N is the sample size.

We start by illustrating the distribution of the overconfidence scores in the unfamiliar and familiar tasks in figure 4.2. The distribution visibly shows that a large proportion of our respondents overestimate their performances in both tasks.

The results from the statistical analyses also confirm that most farmers are overconfident in both tasks and that overconfidence is higher in the familiar task. The results in row 1 of table 4.2 show that, in the familiar task, 83% of farmers in our sample are overconfident, and this percentage is significantly higher than half of the farmers, which would have been the case if overconfidence is normally distributed in our sample population. The second row presents the extent of overconfidence in the unfamiliar task, which is about 76%. This is also significantly higher than half of the sample population. Consistent with our expectation, overconfidence is higher in the familiar task by about 7.4 percentage points and is statistically significant at 1%, as shown in the third row of table 4.2. These results are in line with those reported by West and Stanovich (1997), who also find that about 88% of their

[22] See appendix 1 and 2 for the distribution of actual and perceived ability.

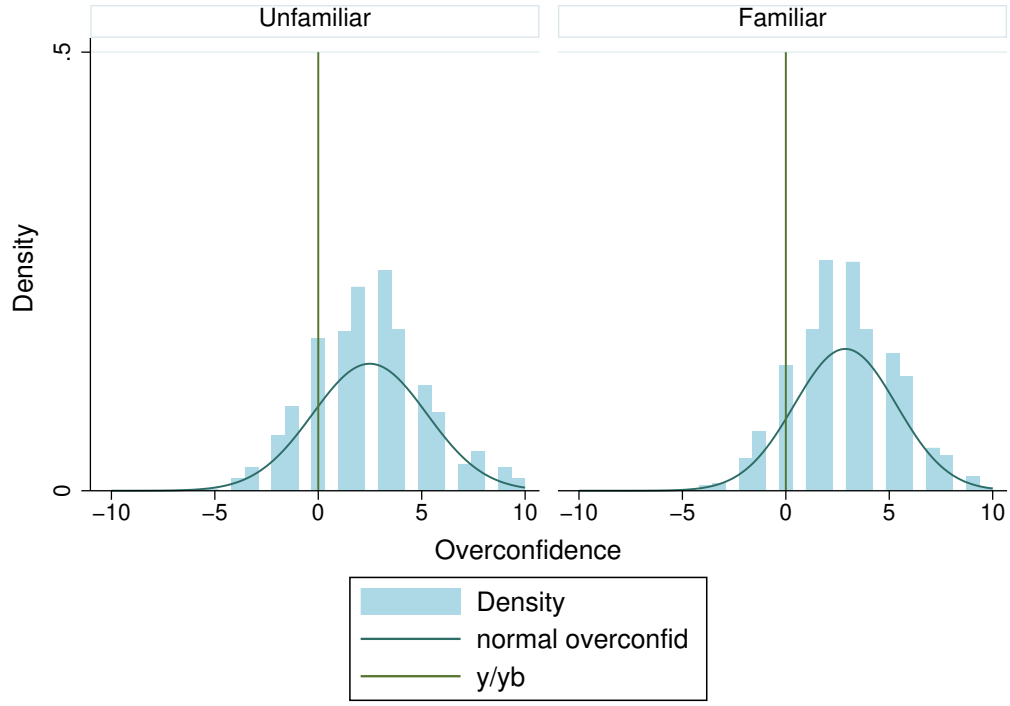

Figure 4.2: Distribution of overconfidence in the unfamiliar and familiar tasks
Note: The values in the X-axis show the raw values of overconfidence obtained by subtracting actual performance from expected performance and take values $-10 \leq overconfidence \leq 10$. Hence, negative values indicate underestimation and positive values indicate overestimation.

student subjects were overconfident in a knowledge-based task (where their participants solve general knowledge questions) whereas, in a motor-skill task (where participants play a penny slide game), 77% of their sample were overconfident. Similarly, Fellner and Krügel (2012), also find similar persistence of overconfidence across different tasks with higher overconfidence in a knowledge-test task than a forecasting task. These studies show that overconfidence tends to manifest over various task domains as well as vary across tasks.[23]

[23]One might argue that farmers appear overconfident not because they have biased beliefs about their ability but because they have biased beliefs about the difficulty of the tasks (they could be optimistic about the task being easy) and expect to solve many of the questions correctly. Given that the questions are farm-related, this type of optimism might be likely in the familiar task as farmers could be optimistic that the questions would be easy and expect they would solve many correctly. However, the fact that farmers are also overconfident in the unfamiliar task is an indication that farmers have biased beliefs in their ability to solve the tasks. In the unfamiliar task, we have little reason to suspect that farmers would be optimistic about the task being easy as they already have seen the example questions and would know that the task is new to them and would be difficult for them to believe that the questions would be easy.

Another reason farmers might overestimate their expectations could be due to image concerns. Given that farmers were responding to enumerators rather than filling the questionnaire by themselves, in private, farmers with social image concerns might provide higher estimates to appear knowledgeable to the enumerator. However, given that modesty is a more desirable behavior in the study area, if farmers are motivated by the social desirability bias, we would expect them to underestimate to appear modest.[24]

Table 4.2: Overconfidence on varying levels of task familiarity

	Mean	SD	Chi-square	N
Overconfidence=1; familiar task	0.831***	0.374	334.23	760
Overconfidence=1; unfamiliar task	0.757***	0.428	202.19	760
Diff	0.074 ***	0.540		

Note: A farmer is labelled overconfident (taking the value 1) if his expected performance is higher than his actual performance; 0 otherwise. The Chi-square tests whether the percentages of overconfident and non-overconfident farmers in our sample are equal (50%, 50%); the Chi-square test result enables us to reject the equality of percentages hypothesis at less than 1%. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Result 1: Most farmers are overconfident in both familiar and unfamiliar tasks and overconfidence is significantly higher in the familiar task.

4.4.2 *Persistence of overconfidence across tasks*

Our second objective is to investigate whether overconfidence is a behavioral feature or task-specific behavior. To do so, we examine the extent to which overconfidence in the familiar task correlates with overconfidence in the unfamiliar task by estimating the following OLS regression.

$$OCunfam_i = \alpha + \varphi OCfam_i + \beta X_i + \gamma_v + \varepsilon_i \tag{15}$$

where $OCunfam_i$ is overconfidence of farmer i in the unfamiliar task, calculated as the difference between expected and actual performance in the unfamiliar task and standardized using Z-scores; $OCfam_i$ is overconfidence of farmer i in the familiar task, similarly calculated as the difference between expected and actual performance in the familiar task and standardized using Z-scores; φ is the coefficient of interest; X_i represent a set of controls including age, sex, formal education, *Iqub* membership, risk preference, generalized trust, locus of control, farm size, farming experience, and livestock ownership in TLUs; β is the coefficients associated with the control variables; γ_v represent village fixed effects; and, ε_i is the stochastic error term.

Table 4.3 presents the results of the OLS regression specified in equation 15. The results show a positive relationship between overconfidence in the familiar task and overconfidence in the unfamiliar task. We find that an increase in overconfidence in the familiar task by one standard deviation is associated with an increase of 0.33 standard deviations in

overconfidence in the unfamiliar task. These results are significant at 1% and are robust to the inclusion of controls and village fixed effects.

Table 4.3: Overconfidence between familiar and unfamiliar tasks

	(OLS)	
VARIABLES	Overconfidence: familiar task	
Overconfidence: unfamiliar task	0.324***	0.331***
	(0.0406)	(0.0379)
Constant	1.556***	3.210
	(0.132)	(4.999)
Observations	760	759
R-squared	0.084	0.123
Controls	NO	YES
Village FE	NO	YES

Notes: Robust standard errors, clustered at the respondent and *Got* level (N=40) are in parentheses. Controls are: Age, Sex, Education, Iqub membership, Locus of control, Farm size, Farm experience, Livestock ownership (in TLUs), Trust, and Risk loving propensity. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Result 2: Overconfidence appears to be a behavioural feature rather than a task specific behavior.

These results are consistent with the literature on overconfidence. For example, Fellner and Krügel (2012) find a strong correlation (a correlation coefficient of 0.5) between overconfidence in a knowledge-based task and overconfidence in a forecasting task (the analogy is that the overconfidence of an individual tends to persist in various task domains). Werner De Bondt and Richard Thaler summarize the overconfidence literature by stating that it is "perhaps the most robust finding in the psychology of judgment is that people are overconfident" (De Bondt and Thaler, 1995, P.389). Our results corroborate this finding by showing that smallholder farmers are not immune to overconfidence bias, whether in tasks that are familiar to them or fairly unfamiliar.

Why is overconfidence so rampant? Existing literature offers various theories. The status-enhancement theory (also known as signaling-value theory) argues that overconfidence occurs when individuals signal higher ability to attain higher social status (Burks et al., 2013; Kennedy et al., 2013; Bénabou and Tirole, 2002). Another theory is the consumption-value theory, which states that individuals generate utility simply by thinking about themselves favorably (Bénabou and Tirole, 2002). The motivation-value theory argues that a positive

evaluation of the self, as opposed to an accurate evaluation, serves as a motivating factor for present-biased individuals to take on and accomplish difficult tasks (Bénabou and Tirole, 2002; Blanton et al., 2001; Akerlof and Dickens, 1982). Lastly, the information asymmetry theory argues that overconfidence arises because individuals have imperfect information about their ability (Moore and Healy, 2008).[26]

Owing to the established evidence that farmers exhibit overconfidence in both types of tasks, in the analyses that follow, we pool the data across the two tasks and control for the effects of task familiarity in the regressions instead of repeating the analyses for the two tasks separately.[27]

4.4.3 *Overconfidence and information-seeking*

In this section, we present the results that show the relationship between overconfidence and information-seeking. On average, information-seeking in our sample is equivalent to 1.344 questions referred to sources, with a standard deviation of 1.627. Figure 4.3 shows the distribution of information-seeking by the overconfidence indicator and over the data pooled across the two tasks. From here on, we use the dummy variable for the overconfidence indicator as it is easier to use for graphical illustration and interpretation. However, we also repeat our analyses by using the continuous overconfidence Z-scores for robustness checks.[28]

Table 4.4 presents the results from OLS regressions where columns 1 to 3 show the results from the dummy overconfidence indicator and columns 4 to 6 show those from the con-

[26]Given that the aim of our study is to investigate the extent of overconfidence in our study sample population and how it affects information seeking, we do not have the right experimental set-up to generate the data one may require to test which one of these theories best apply for the observed overconfidence among farmers in the experimental tasks. However, we can to some extent, rule out the role of the information asymmetry theory as we provide a couple of examples before we elicit their expected performance (see appendix E). We argue that this would provide farmers with some information on the type of task to expect and enables them to assess the questions against their ability (knowledge). Future research may investigate which one of these theories best explains farmers' overconfidence—especially if there is a reason to believe that it could be different for farmers than other subject pools covered by the psychology literature.

[27]In appendix C.2, we present the determinants of overconfidence. The results show that Wealth (proxied by farm size), risk-loving propensity, social capital (proxied by Idir membership), and trust positively correlate with overconfidence.

[28]The previous studies by Kramer (2016) and Porto and Xiao (2016) also use a dummy variable for overconfidence. Kramer (2016) constructs OC as a dummy variable where if the respondent's perceived financial literacy is in the highest possible category (which is measured by asking respondents how good they think their financial literacy is on a scale of 1 to 4) while ranking below the median in the measured financial literacy score, the respondent is coded as overconfident; non-overconfident, otherwise. Similarly, Porto and Xiao (2016) label a respondent as overconfident if his/her perceived financial knowledge is greater than the average (measured on a scale of 1 to 7) but scores less than the average in the financial knowledge test, non-overconfident, otherwise.

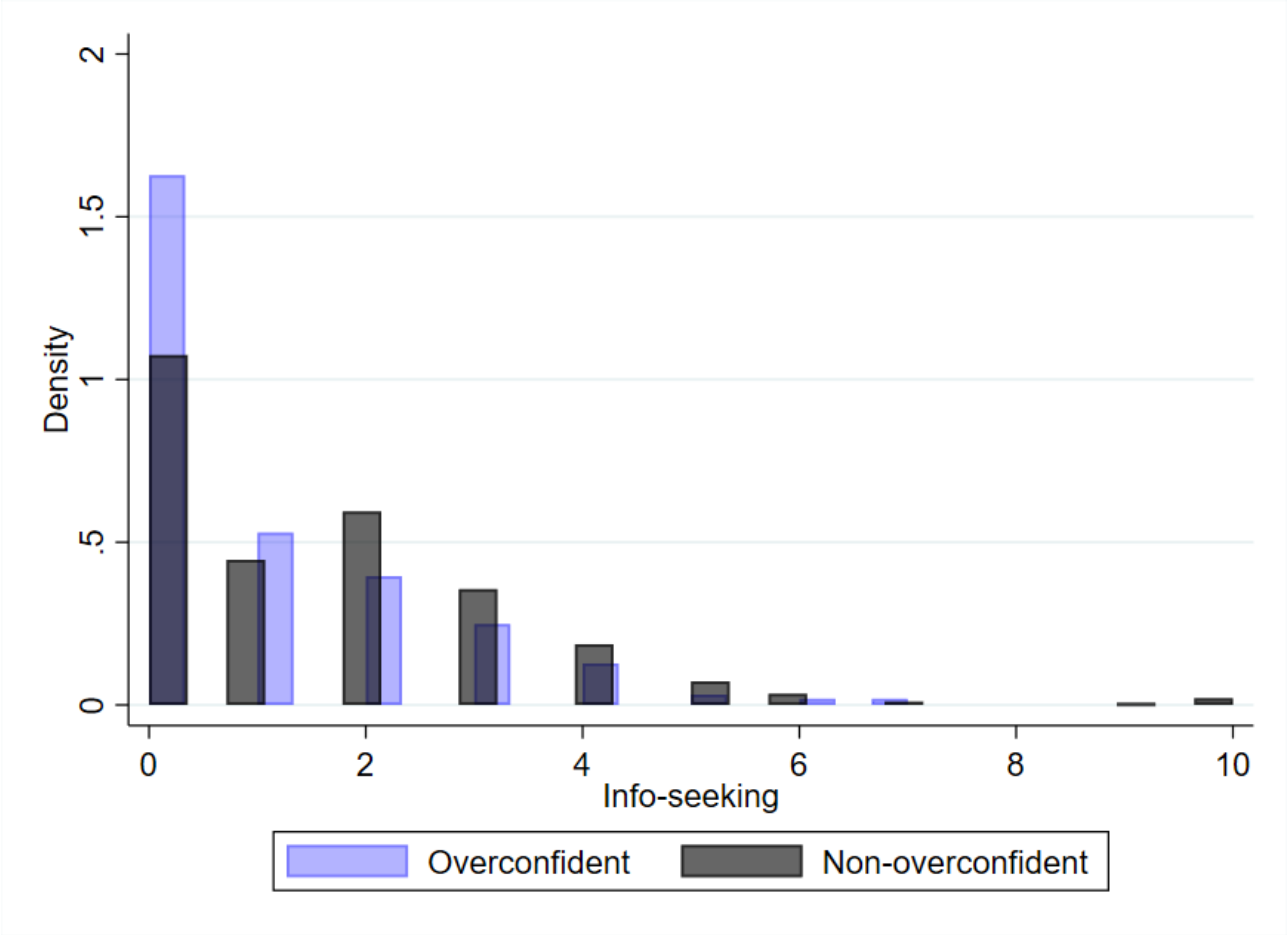

Figure 4.3: The distribution of information-seeking pooled across the two tasks
The average information-seeking is 1.344 questions with a standard deviation of 1.627. The minimum seeking is 0 and the maximum 10. The number of observations is 1,280. A farmer is overconfident if his/her overconfidence score exceeds the median; non-overconfident, otherwise.

tinuous overconfidence Z-scores. We start out with simple regression in which we only look at the relationship between overconfidence and information seeking in the first and fourth columns of both regressions. Next, in the second and fifth columns, we include actual performance, extension-agent source, and the interaction between overconfidence and extension-agent source. In the last columns of the two regressions, we include a set of controls and village fixed effects. Notice that even though our models explain a small fraction of the variance in information seeking, predictive power improves when we add more predictors where the R-squared increases from 0.027 in the simple model to 0.15 and 0.19 in columns 2 and 3, respectively, where the models include more predictors.

The results in columns 3 and 6 of table 4.4, show that after controlling for various factors and village fixed effects, overconfidence is associated with a decrease in information-seeking by about 0.8 units when we use the dummy indicator and by about 0.4 standard deviations

when we use Z-scores and both are statistically significant at 1%. Given that our outcome is a count variable, to probe the robustness of our results, we also use negative binomial regressions and find similar results (see appendix C.3). Furthermore, we restrict the sample to farmers that show consistent overconfidence across the two tasks and repeat the analyses using the dummy and continuous measures of overconfidence using OLS and negative binomial regressions. Similarly, the results from this sub-sample also reveal a negative relationship between overconfidence and information-seeking (see appendix C.4 and C.5). These results are consistent with the results reported by Porto and Xiao (2016) who also find that overconfidence is associated with lower financial advice seeking in certain areas of finance, and those reported by Barber and Odean (2001) who find that overconfidence leads to excessive trading of financial assets and loss of net returns, and those in Barsbai et al. (2021) who find that overconfidence leads to higher risk-taking arising from an overestimation of returns of risky choices. They also resemble the results reported by Camerer and Lovallo (1999) who find that overconfidence affects behavior in a market entry decision as overconfidence leads to excess market entry, which in turn results in entrepreneurial failure.

Additionally, we find a negative relationship between actual performance and information-seeking. Based on the results in column 6 of table 4.4, after controlling for other factors and village fixed effects, a one-unit increase in actual performance is associated with about 0.31 units fewer information-seeking (significant at 1%). These results are analogous to those reported by Yaniv (2004) who finds that higher knowledge leads to higher discounting of advice. But, our results contradict those reported by Kramer (2016) who does not find a relationship between objectively measured financial knowledge and financial advice seeking.

The other variable considered in our analysis is the type of information source and its interaction with overconfidence. As discussed in the experimental design, farmers are randomly assigned to either an extension agent or peer farmers. As can be seen from column 6 in table 4.4, after controlling for various factors and village fixed effects, information-seeking from extension agents is about 0.4 units higher than seeking from peer farmers (significant at 5%). Moreover, the results from the OLS regression provide suggestive evidence that overconfident farmers seem to seek less from extension agents. However, these results do not hold in the NBR regressions presented in appendix C.3.

We now turn to the results of the RF analysis. As we show in appendix 3, the OOB and validation error start to stabilize at around 350 iterations and reach the smallest level, around 500 iterations. Similarly, appendix 4 shows that the randomly selected number of variables to use at every split that minimize the validation error is four. Therefore, to run our final model, we use 500 iterations and four randomly selected variables at each step, which gives

Table 4.4: Does overconfidence predict information-seeking behavior?

	Dummy OC			Continuous OC		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Information seeking					
OC_R	-0.551***	-0.797***	-0.847***			
	(0.141)	(0.141)	(0.136)			
Overconfidence				-0.269***	-0.372***	-0.379***
				(0.0626)	(0.0635)	(0.0631)
Actual performance		-0.304***	-0.307***			
		(0.0294)	(0.0250)			
Actual performance					-1.073***	-1.034***
					(0.106)	(0.0915)
Extension agent		0.528***	0.419***		0.493***	0.409***
		(0.144)	(0.151)		(0.105)	(0.111)
OC_R X Extension agent		-0.405**	-0.335*			
		(0.179)	(0.176)			
OC X Extension agent					-0.264***	-0.241***
					(0.0821)	(0.0794)
Constant	1.547***	2.488***	1.965***	1.354***	1.394***	0.911**
	(0.0973)	(0.178)	(0.374)	(0.0665)	(0.0826)	(0.380)
Observations	1,280	1,280	1,278	1,280	1,280	1,278
R-squared	0.027	0.146	0.194	0.028	0.124	0.169
RMSE	1.606	1.506	1.470	1.605	1.525	1.492
Controls	NO	NO	YES	NO	NO	YES
Village FE	NO	NO	YES	NO	NO	YES

Robust standard errors, clustered at the respondent and *Got* level (N=40) are in parentheses. Data are pooled across the two tasks. The outcome variable is information-seeking measured as the number of questions a farmer referred to his/her advisor, such that $0 \leq seeking \leq 10$. OC_R is the relative overconfidence indicator taking the value one if the overconfidence score is above the median; zero otherwise. Continuous OC is the Z-scores of the difference between actual and perceived performance. Controls are: Age, Sex, Education, Iqub membership, Locus of control, Farm size, Farm experience, Livestock ownership (in TLUs), Trust, Risk loving propensity, and an indicator for task familiarity. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

us an OOB error of 1.157 (lower than the root mean squared errors (RMSE) obtained from the OLS regressions presented in table 4.4 indicating that RF performs better for in-sample prediction) and a validation error equals to 1.482. Lastly, in figure 4.4, we illustrate that overconfidence is the most important predictor of information seeking. Notice that actual performance is the second most important predictor of information-seeking behavior.We also compare these results with an OLS model where we also use the same 60 - 40 split of the data to train and validate, respectively. As expected, OLS does not perform as well as RF as the training RMSE (which equals 1.512) is higher than the OOB from RF (which is 1.157). Interestingly, we find the validation RMSE to be 1.482 — similar to that of the RF.

Result 4: Overconfidence predicts lower information-seeking. Information-seeking is higher when the source is an extension agent rather than a peer farmer.

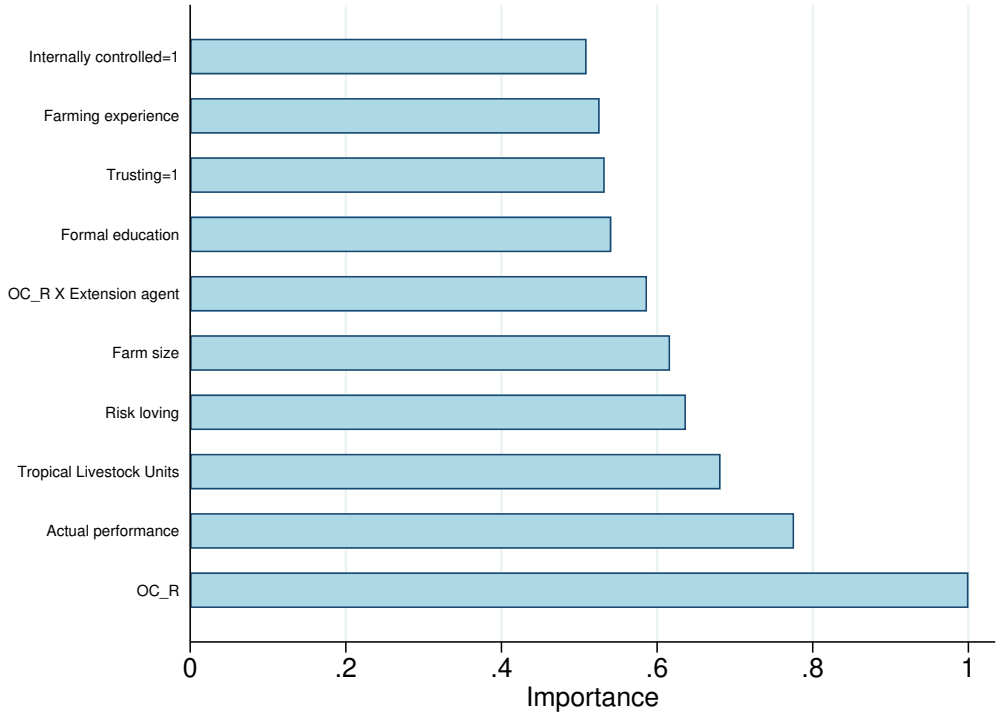

Figure 4.4: Variable Importance Score of Predictors

4.4.4 *Information quality, trust, and information-seeking*

In this section, we study the effects of information quality and trust on farmers' information seeking behavior and study their interaction with overconfidence. Recall that the results presented in section 4.4.3 show a negative and significant relationship between overconfidence and information-seeking. In this section, we examine whether increasing the quality and trustworthiness of information sources attenuates the negative relationship between overconfidence and information-seeking. We do so by examining the interaction effects between overconfidence and an exogenously introduced information quality variation on information-seeking; and, an interaction between overconfidence and exogenously introduced variation in trust.

We start our discussion by defining trust. Various strands of the literature conceptualize trust in various ways. The widely accepted definition of trust is that it is "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" (Mayer et al., 1995, P.712). According to Mayer et al. (1995) trustworthiness has three vital characteristics; ability, benevolence, and integrity. Ability is "that group of skills, competencies, and characteristics that enable a party to influence within some specific domain. Benevolence is "the extent to which a trustee is believed to

want to do good to the trustor, aside from an egocentric profit motive." And, integrity is "the trustor's perception that the trustee adheres to a set of principles that the trustor finds acceptable." Even though all components of trust are important, in this paper, we primarily focus on the "ability" component as it is more relevant to our research question. To identify the effect of trust, we employ two exogenous sources of variation. First, we vary the ability of the sources by providing training (we call this "information quality treatment"). Second, to tease out a pure trust effect, we vary the way we present their ability through a simple nudge. As discussed in section 4.2, we randomly assign farmers to either high-quality or low-quality sources.

In table 4.5, we present the OLS results from information quality treatment in columns 1 to 3 and the results from the trust nudge treatment in columns 4 to 6. Similar to section 4.4.3, the proxy for information-seeking is the number of questions referred by farmers to sources. Although we show results from OLS regressions here, we present results from negative binomial regressions in the appendix to account for the count nature of our outcome variable and test the robustness of our results. Similarly, we first display the results from a regression where we only include the high-quality treatment indicator in column 1 and the high trust indicator only in column 4. Then we introduce a triple interaction term along with the corresponding two-way interaction terms in columns 2 and 5 and include other controls and village fixed effects in columns 3 and 6.

According to the results in column 4 of table 4.5, we find that farmers in the high-quality sources seek considerably more information than those in the low-quality sources. The results in column 1 show that information-seeking among farmers in the high-quality sources treatment arm is about 0.65 units higher than it is among farmers in the low-quality sources treatment arm and is significant at 1%. These results support the study by Borgatti and Cross (2003), which provides theoretical and qualitative evidence that shows that information-seeking happens when the seeker knows what the source knows and positively values the knowledge that the source has. In this section, we provide causal evidence that, indeed, knowing what the source knows, i.e., knowing that the source is trained, leads to higher information-seeking and that individuals strongly value information quality. In columns 2 and 3 of the same table, we also include two-way and three-way interactions between overconfidence and information quality and overconfidence, extension-agent source, and information quality, respectively to examine whether information quality would attenuate the negative association between overconfidence and seeking information from extension-agent sources; we find that it does not. We also find similar main results from the analyses that use the continuous overconfidence measure (Z-scores of the difference between actual and perceived performance) and report the results in appendix C.7 and C.8.

So far, our results have shown the importance of information quality in relaxing demand-side constraints in information-seeking. However, it doesn't allow us to identify if the main mechanism of such change in perceptions is an actual increase in the quality of the information received or if it is driven mostly by an increase in trust. To tease this out, we present the effect of a pure trust nudge on information-seeking and test whether its effect varies according to the level of overconfidence. For the high-trust nudge, we present sources as having a high (unambiguous) ability, and for the low-trust nudge, we present sources as having an ambiguous ability to solving the experimental tasks.

Columns 4 to 6 of table 4.5 presents the results. Similarly, we present the results from OLS here and NBR results in appendix C.6, which provide similar results. We first show the effect of high trust in columns 4; next, we only include the triple interaction term along with the two-way interactions in columns 5; and lastly, in columns 6, we include other sets of controls and village fixed effects. The results show that high trust leads to higher information-seeking. Based on column 4, we find that information-seeking in the high-trust nudge treatment is about 0.6 units higher than in the low-trust nudge treatment (significant at 1%). Even though there is some evidence that highly overconfident farmers respond less to the trust nudge, the three-way interaction of overconfidence, extension agent treatment arm, and trust is not statistically significant, i.e., the effect of trust on information-seeking from the extension agent does not vary according to the level of overconfidence. The results remain the same with the continuous overconfidence measure (see appendix C.6).

These results are in line with the literature that looks at the correlation between trust and information-seeking, which is mostly concentrated in the organizational management and information technology fields. For example, Lachance and Tang (2012) find that trust is an important factor that explains individuals' financial advice-seeking behavior. Burke and Hung (2016) also find that trust is an important predictor of investors' financial advice-seeking from professional financial advisors. Similarly, Madamba and Utkus (2017) also finds a strong relationship between investors' trust in financial advisors and their financial advice-seeking behavior. Zhang et al. (2019) also find a positive correlation between trust and seeking health information from internet sources.

Trust and conveying a simple message of the quality of the information provided can therefore play an important role in increasing demand for information. But is the entire effect of information quality explained by trust nudging? To answer this, we test whether the coefficients of the effects of information quality (column 1 of table 4.5) and trust (column 4 of the same table) are equal. By doing so, we test whether the increase in information-seeking due to improvements in information quality reported in the preceding section could be attributed solely to the trust-nudging effect of informing farmers that their source had been

trained or if additional information-seeking stemmed from actual quality improvements. We test if $\beta_q - \beta_t = 0$ where β_q stands for the coefficient of information quality and β_t for the coefficient of trust. The Chi-square test for equality of the coefficients results in chi2(1) = 0.05 $(Prob > chi2 = 0.8293)$. In words, we cannot reject the null hypothesis that the two coefficients are the same. More specifically, this means that, while trust is a fundamental driver of information-seeking, its increase in the high-quality treatment is at least partially arising from the pure effect of improving information quality.

Result 5: Both information quality and trust lead to higher information-seeking. However, there is no evidence that the effect varies with overconfidence.

Table 4.5: Information quality, trust, and information seeking

	Quality			Trust		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Information seeking					
High quality	0.647***	0.523***	0.567***			
	(0.153)	(0.181)	(0.200)			
High trust				0.581***	0.679***	0.697***
				(0.111)	(0.138)	(0.148)
Extension agent		0.533**	0.385		0.528***	0.358**
		(0.251)	(0.277)		(0.156)	(0.154)
OC_R		-0.531***	-0.933***		0.0807	-0.432**
		(0.168)	(0.174)		(0.184)	(0.160)
OC_R X High quality		0.0825	-0.0313			
		(0.279)	(0.278)			
OC_R X High trust					-0.718**	-0.663*
					(0.282)	(0.330)
Constant	1.053***	1.062***	1.537**	1.022***	0.761***	1.162***
	(0.0933)	(0.131)	(0.686)	(0.0762)	(0.152)	(0.423)
Observations	640	640	638	640	640	640
R-squared	0.034	0.106	0.281	0.037	0.085	0.241
Controls	NO	NO	YES	NO	NO	YES
Village FE	NO	NO	YES	NO	NO	YES

Robust standard errors, clustered at the respondent and *Got* level (N=40) are in parentheses. Data are pooled across the two tasks and across high quality and low quality sources. The outcome variable is information-seeking measured as the number of questions a farmer referred to his/her advisor, such that $0 \leq seeking \leq 10$. Controls are: Actual performance, Age, Sex, Education, Iqub membership, Locus of control, Farm size, Farm experience, Livestock ownership (in TLUs), Trust, Risk loving propensity, an indicator for trained source, an indicator for task familiarity, and the following interaction terms: Extension agent X High trust, OC_R X Extension agent, and OC_R X High trust X Extension agent. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

4.4.5 *Efficiency implications of overconfidence and trust*

In the preceding sections, we show that overconfidence is associated with less information-seeking and that trust leads to higher information-seeking. We also find greater seeking of information from extension agents, on average. In this section, we show the efficiency implications by; examining whether overconfidence induced less information-seeking results in an efficiency loss and examining whether trust leads to an efficiency gain. We also study whether the effect of trust varies for the more overconfident farmers in the extension agent treatment. For this purpose, we use stochastic frontier analysis described in section 4.3.2. As discussed in section 4.3.2, for ease of interpretation, we use a dummy variable for overconfidence, which takes the value of one if overconfidence is greater than the median, zero for otherwise. Additionally, we repeat the analysis using the standardized overconfidence measure and obtain similar results in terms of the direction of the relationship and statistical significance (see appendix C.9). For the purpose of this SFA efficiency analysis, we assume that a maximum feasible output exists (in terms of log of correct test answers), given a vector of inputs (i.e., the log of the number of questions attempted by the farmer and by the source) and a stochastic component. This allows the estimation of a technical efficiency parameter – i.e., the ratio of observed output to the estimated maximum feasible output or the distance to a production possibility frontier – and the implications of overconfidence and trust on this estimated average (in)efficiency.

The results are presented in table 4.6. Since our interest is to see the relationship between efficiency and the variables of interest—overconfidence, trust, and extension agents, we present the results from the second stage of the SFA. The results in column 7 of table 4.6 show that inefficiency exists in our sample: efficiency averages at about 47%, indicating that output is, on average short of about 53% from the possible frontier of correct answers. The average efficiency in the larger sample is about 56% (column 1 of table 4.6 and 68% after accounting for other controls and village fixed effects (appendix C.9).

Our results show that overconfidence increases inefficiency significantly, even after controlling for various factors and village fixed effects.[29] Column 6 of table 4.6 shows that overconfidence increases inefficiency by 1.149 units (significant at 1%).

On the other hand, trust and extension agents decrease inefficiency. Interestingly, the efficiency gain resulting from high-trust becomes apparent only after we control for overconfidence in column 4 and remains statistically significant after controlling for extension agent source in column 6 and other controls in column 7. The results show that farmers in the

[29]The sign should be interpreted as “distance" from the frontier, such that a positive sign indicates that it increases the distance from the frontier — meaning that it decreases efficiency.

high-trust treatment have an inefficiency that is lower by 0.434 units (significant at the 5%). With respect to extension agents, we find some evidence that it also decreases inefficiency (see columns 3, 5, and 6). However, it loses its significance when we control for a set of covariates and village fixed effects in column 7.

Result 6: Overconfidence is associated with lower efficiency, whereas trust leads to an efficiency gain.

Table 4.6: Overconfidence, trust, and inefficiency

VARIABLES	**2nd stage (lnsig2u)**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
OC_R	0.329***			1.123***	1.013***	1.267***	1.149***
	(0.0971)			(0.162)	(0.120)	(0.168)	(0.345)
High trust		-0.131		-0.617***		-0.470***	-0.434**
		(0.112)		(0.126)		(0.136)	(0.192)
Extension agent			-0.561***		-1.153***	-0.405***	-0.286
			(0.0883)		(0.112)	(0.137)	(0.201)
Constant	2.121***	2.251***	2.084***	2.206***	2.076***	2.206***	2.206***
	(0.0306)	(4.98e-05)	(0.0273)	(2.50e-06)	(0.0233)	(2.24e-06)	(1.96e-06)
Observations	1,280	640	1,280	640	1,280	640	640
Controls	NO	NO	NO	NO	NO	NO	YES
Village FE	NO	NO	NO	NO	NO	NO	YES
Mean efficiency	0.559	0.467	0.583	0.468	0.468	0.468	0.468
	(0.228)	(0.219)	(0.227)	(0.220)	(0.220)	(0.220)	(0.220)

Standard errors in parentheses. Data are pooled across the two tasks. OC_R is the relative overconfidence indicator taking the value one if the overconfidence score is above median and zero otherwise. Controls are: Age, , Sex, Education, Iqub membership, Locus of control, Farm size, Farm experience, Livestock ownership (in TLUs), Trust, Risk loving propensity, an indicator for a trained source, and an indicator for task familiarity. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

4.5 CONCLUSION

Understanding the information-seeking behavior of smallholder farmers is crucial to designing policies that can effectively increase their utilization of new knowledge, practices, and technology. However, most of the existing research focuses on understanding the supply-side factors for agricultural knowledge and technology dissemination, and more recently, searching for ways to increase the effectiveness of various agricultural knowledge transmission channels. In this study, we focus on the demand-side factors that could affect agricultural knowledge acquisition from a behavioral angle. Specifically, by using a lab-in-the-field

experiment, we examine the role of overconfidence bias and its interaction with information quality and trust in affecting farmers' information-seeking behavior. We also investigate their implications for efficiency.

Our results show that a large proportion of farmers are overconfident in their own information and skill-set and that overconfidence strongly predicts less information-seeking. This, we find, has substantial implications for the achievement of "optimal" and efficient outcomes in two laboratory tasks. While laboratory tasks can only partially mimic "real-life" behavior – a known and undeniable shortcoming – our experiments were played with the very agents that engage in information-sharing in the field–smallholder farmers and extension agents. We speculate that similar efficiency losses could be at play in the transmission of information under extension services. Future research might extend our results by searching for ways to introduce exogenous variation in overconfidence and testing policy options that could be used to nudge overconfident farmers into taking up information. For example, one can investigate whether providing feedback on performance about halfway through the tasks would calibrate farmers' beliefs about their ability and improve their information-seeking behavior.

Additionally, we find that farmers seek more information from sources that they perceive as high-quality and trustworthy and that trust improves efficiency outcomes. Our results also reveal that farmers seek more information from extension agents than peer farmers – a sign that extension agents are perceived as a worthy source of information, on average – and that overconfident farmers do not deviate significantly in this regard.

Policymakers aiming to increase the effectiveness of agricultural extension services need to take such behavioral underpinnings into account when delivering information. While interventions aimed at increasing the quality of information (e.g., through periodic training of extension agents) and the trust bestowed by farmers upon extension agents (e.g., through information campaigns) are easy to envisage and implement, a path to addressing overconfidence is somewhat less clear. New studies may examine whether bringing overconfidence bias and its consequences to the attention of farmers could serve as a starting point, for example, by testing whether providing feedback on performance would lead farmers into seeking more information. This is left for future work.

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C

APPENDIX: TABLES

Table C.1: Performance difference between control and treatment groups

	Mean	Std. Err.	N
Treatment	4.259	0.056	1280
Control	3.833	0.106	240
Diff	0.426***	0.137	

Significance: *** p<0.01, ** p<0.05, * p<0.1. This table tests whether farmers who have access to advisors perform better than their counterparts without access to advisors. Source: authors' elaboration.

Table C.2: Determinants of overconfidence

VARIABLES	(1) OLS	(2) OLS	(3) Logit	(4) Logit
Farm size	0.133***	0.132***	0.189**	0.179*
	(0.0456)	(0.0429)	(0.0940)	(0.0951)
Risk loving	-0.196*	-0.188*	-0.416*	-0.393*
	(0.108)	(0.109)	(0.223)	(0.228)
Age	-0.00152	5.68e-05	-0.00420	-0.000433
	(0.00502)	(0.00515)	(0.0104)	(0.0104)
Male=1	0.0704	0.0345	0.118	0.0131
	(0.115)	(0.118)	(0.236)	(0.243)
Formal education	0.00295	0.00697	0.0211	0.0307*
	(0.00821)	(0.00885)	(0.0158)	(0.0176)
Iqub membership	0.0600	0.104	0.133	0.257**
	(0.0596)	(0.0638)	(0.119)	(0.130)
Internally controlled=1	0.0669	0.0577	0.0847	0.0612
	(0.0802)	(0.0802)	(0.156)	(0.163)
Farming experience	0.00267	0.00179	0.00218	-0.000104
	(0.00507)	(0.00505)	(0.00984)	(0.00992)
Tropical Livestock Units	-0.00539	0.000559	-0.00510	0.00827
	(0.0103)	(0.0107)	(0.0216)	(0.0244)
Trusting=1	0.0788	0.0641	0.289**	0.254**
	(0.0624)	(0.0610)	(0.132)	(0.121)
Constant	-0.236	-0.351	-0.877*	-1.214**
	(0.239)	(0.254)	(0.486)	(0.526)
Observations	1,518	1,518	1,518	1,518
R-squared	0.022	0.034		
Task familiarity	YES	YES	YES	YES
Village FE	NO	YES	NO	YES

Notes: Robust standard errors, clustered at the respondent and *Got* level (N=40) are in parentheses. Data are pooled across the two tasks. The dependent variable used in columns 1 and 2 is the standardized overconfidence scores. The dependent variable used in columns 3 and 4 is a dummy indicator for overconfidence whereby it takes 1 if overconfidence is greater than the median; 0, otherwise. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Table C.3: Overconfidence and information-seeking: Negative binomial regression

	Dummy OC			Continuous OC		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Information seeking					
OC_R	-0.441***	-0.700***	-0.733***			
	(0.0762)	(0.103)	(0.103)			
Overconfidence				-0.234***	-0.322***	-0.323***
				(0.0362)	(0.0517)	(0.0534)
Actual ability		-0.243***	-0.249***			
		(0.0190)	(0.0191)			
Actual performance					-0.871***	-0.841***
					(0.0895)	(0.0883)
Extension agent		0.301***	0.207**		0.306***	0.222***
		(0.0815)	(0.0826)		(0.0753)	(0.0776)
OC_R X Extension agent		-0.167	-0.100			
		(0.139)	(0.141)			
OC X Extension					-0.168**	-0.146*
					(0.0727)	(0.0749)
Constant	0.436***	1.151***	0.773***	0.281***	0.286***	-0.168
	(0.0447)	(0.0913)	(0.293)	(0.0402)	(0.0548)	(0.291)
Observations	1,280	1,280	1,278	1,280	1,280	1,278
Controls	NO	NO	YES	NO	NO	YES
Village FE	NO	NO	YES	NO	NO	YES

Robust standard errors, clustered at the respondent and *Got* level (N=40) are in parentheses. Data are pooled across the two tasks. The outcome variable is information-seeking measured as the number of questions a farmer referred to his/her advisor, such that $0 \leq seeking \leq 10$. OC_R is the overconfidence indicator taking the value one if the overconfidence score is above the median; zero otherwise. Continuous OC is the Z-scores of the difference between actual and perceived performance. Controls are: Age, Sex, Education, Iqub membership, Locus of control, Farm size, Farm experience, Livestock ownership (in TLUs), Trust, Risk loving propensity, and an indicator for task familiarity. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Table C.4: Overconfidence and information-seeking: Consistent overconfidence sample, OLS

	Dummy OC			Continuous OC		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Information seeking					
OC_R	-0.616***	-0.707***	-0.712***			
	(0.138)	(0.145)	(0.146)			
Overconfidence				-0.395***	-0.348***	-0.314***
				(0.0733)	(0.0711)	(0.0726)
Actual performance		-0.314***	-0.329***			
		(0.0333)	(0.0286)			
Actual performance					-0.954***	-0.935***
					(0.113)	(0.0899)
Extension-source=1		0.495***	0.402**		0.497***	0.429***
		(0.155)	(0.175)		(0.122)	(0.136)
OC_R X Extension agent		-0.469**	-0.424**			
		(0.182)	(0.190)			
OC X Extension agent					-0.354***	-0.368***
					(0.114)	(0.121)
Constant	1.544***	2.425***	2.009***	1.386***	1.353***	1.062***
	(0.105)	(0.182)	(0.390)	(0.0770)	(0.0851)	(0.391)
Observations	914	914	914	914	914	914
R-squared	0.038	0.143	0.203	0.052	0.130	0.185
Controls	NO	NO	YES	NO	NO	YES
Village FE	NO	NO	YES	NO	NO	YES

Robust standard errors, clustered at the respondent and *Got* level (N=40) are in parentheses. Data are pooled across the two tasks. The sample is restricted to those farmers that exhibit overconfidence in both tasks. The outcome variable is information-seeking measured as the number of questions a farmer referred to his/her advisor, such that $0 \leq seeking \leq 10$. OC_R is the overconfidence indicator taking the value one if the overconfidence score is above median and zero otherwise. Continuous OC is the Z-scores of the difference between actual and perceived performance. Controls are: Age, Sex, Education, Iqub membership, Locus of control, Farm size, Farm experience, Livestock ownership (in TLUs), Trust, Risk loving propensity, actual performance, and an indicator for task familiarity. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Table C.5: Overconfidence and information-seeking: Consistent overconfidence sample, Negative binomial regression

	Dummy OC			Continuous OC		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Information seeking					
OC_R	-0.509***	-0.690***	-0.704***			
	(0.117)	(0.137)	(0.138)			
Overconfidence				-0.355***	-0.324***	-0.295***
				(0.0659)	(0.0737)	(0.0727)
Actual performance		-0.271***	-0.289***			
		(0.0263)	(0.0246)			
Actual performance					-0.860***	-0.833***
					(0.118)	(0.108)
Extension-source=1		0.273***	0.173		0.308***	0.216**
		(0.0950)	(0.114)		(0.0831)	(0.0953)
OC_R X Extension agent		-0.228	-0.160			
		(0.145)	(0.158)			
OC X Extension agent					-0.262**	-0.258**
					(0.104)	(0.111)
Constant	0.435***	1.191***	0.889***	0.296***	0.271***	0.0391
	(0.0677)	(0.124)	(0.342)	(0.0523)	(0.0671)	(0.348)
Observations	914	914	914	914	914	914
Controls	NO	NO	YES	NO	NO	YES
Village FE	NO	NO	YES	NO	NO	YES

Robust standard errors, clustered at the respondent and *Got* level (N=40) are in parentheses. The outcome variable is information-seeking measured as the number of questions a farmer referred to his/her advisor, such that $0 \leq seeking \leq 10$. OC_R is the overconfidence indicator taking the value one if the overconfidence score is above median and zero otherwise. Overconfidence is measured by the standardized Z-scores of the difference between expected and actual performance. Controls are: Actual performance, Age, Sex, Education, Iqub membership, Locus of control, Farm size, Farm experience, Livestock ownership (in TLUs), Trust, Risk loving propensity, and an indicator for task familiarity. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Table C.6: Information quality, trust, and information seeking: Dummy OC, Negative binomial regression

	Quality			Trust		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Information seeking					
High quality	0.479***	0.400***	0.387**			
	(0.105)	(0.134)	(0.161)			
High trust				0.450***	0.486***	0.458***
				(0.0823)	(0.0887)	(0.0912)
Extension-source=1		0.407**	0.253		0.377***	0.248**
		(0.182)	(0.213)		(0.0982)	(0.100)
OC_R		-0.693***	-0.972***		0.0362	-0.379**
		(0.241)	(0.211)		(0.186)	(0.153)
OC_R X High quality		0.360	0.246			
		(0.289)	(0.283)			
OC_R X High trust					-0.530*	-0.423
					(0.285)	(0.306)
Constant	0.0518	0.0606	0.495	0.0216	-0.149	0.0642
	(0.0885)	(0.123)	(0.513)	(0.0745)	(0.128)	(0.310)
Observations	640	640	638	640	640	640
Controls	NO	NO	YES	NO	NO	YES
Village FE	NO	NO	YES	NO	NO	YES

Robust standard errors, clustered at the respondent and *Got* level (N=40) are in parentheses. Data are pooled across the two tasks and across high quality and low quality sources. The outcome variable is information-seeking measured as the number of questions a farmer referred to his/her advisor, such that $0 \leq seeking \leq 10$. Controls are: Actual performance, Age, Sex, Education, Iqub membership, Locus of control, Farm size, Farm experience, Livestock ownership (in TLUs), Trust, Risk loving propensity, an indicator for trained source, an indicator for task familiarity, and the following interaction terms: Extension agent X High trust, OC_R X Extension agent, and OC_R X High trust X Extension agent. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Table C.7: Information quality, trust, and information seeking: Continuous OC, OLS

	Quality			Trust		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Information seeking					
High quality	0.647***	0.565***	0.686***			
	(0.153)	(0.131)	(0.159)			
High trust				0.581***	0.575***	0.568***
				(0.111)	(0.117)	(0.105)
Extension-source=1		0.499**	0.518**		0.407***	0.384***
		(0.190)	(0.206)		(0.113)	(0.110)
Overconfidence		-0.314***	-0.513***		-0.0597	-0.422***
		(0.0832)	(0.0990)		(0.0774)	(0.0910)
OC X High quality		0.147	0.125			
		(0.146)	(0.164)			
OC X High trust					-0.0323	0.0510
					(0.118)	(0.111)
Constant	1.053***	0.869***	-0.107	1.022***	0.747***	0.588
	(0.0933)	(0.0959)	(0.722)	(0.0762)	(0.153)	(0.430)
Observations	640	640	638	640	640	640
R-squared	0.034	0.115	0.238	0.037	0.085	0.252
Controls	NO	NO	YES	NO	NO	YES
Village FE	NO	NO	YES	NO	NO	YES

Robust standard errors, clustered at the respondent and *Got* level (N=40) are in parentheses. Data are pooled across the two tasks and across high quality and low quality sources. The outcome variable is information-seeking measured as the number of questions a farmer referred to his/her advisor, such that $0 \leq seeking \leq 10$. Controls are: Actual performance, Age, Sex, Education, Iqub membership, Locus of control, Farm size, Farm experience, Livestock ownership (in TLUs), Trust, Risk loving propensity, an indicator for trained source, an indicator for task familiarity, and the following interaction terms: Extension agent X High trust, OC X Extension agent, and OC X High trust X Extension agent. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Table C.8: Information quality, trust, and information seeking: Continuous OC, Negative binomial regression

	Quality			Trust		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Information seeking					
High quality	0.479***	0.564***	0.616***			
	(0.105)	(0.116)	(0.133)			
High trust				0.450***	0.457***	0.442***
				(0.0823)	(0.0835)	(0.0794)
Extension-source=1		0.472***	0.449**		0.284***	0.255***
		(0.167)	(0.190)		(0.0853)	(0.0803)
Overconfidence		-0.418***	-0.571***		-0.0564	-0.362***
		(0.0946)	(0.104)		(0.0848)	(0.0927)
OC X High quality		0.299**	0.307**			
		(0.126)	(0.144)			
OC X High trust					-0.0293	0.0563
					(0.109)	(0.115)
Constant	0.0518	-0.210*	-0.984*	0.0216	-0.189	-0.528
	(0.0885)	(0.110)	(0.539)	(0.0745)	(0.128)	(0.334)
Observations	640	640	638	640	640	640
Controls	NO	NO	YES	NO	NO	YES
Village FE	NO	NO	YES	NO	NO	YES

Robust standard errors, clustered at the respondent and *Got* level (N=40) are in parentheses. Data are pooled across the two tasks and across high quality and low quality sources. The outcome variable is information-seeking measured as the number of questions a farmer referred to his/her advisor, such that $0 \leq seeking \leq 10$. Controls are: Actual performance, Age, Sex, Education, Iqub membership, Locus of control, Farm size, Farm experience, Livestock ownership (in TLUs), Trust, Risk loving propensity, an indicator for trained source, an indicator for task familiarity, and the following interaction terms: Extension agent X High trust, OC X Extension agent, and OC X High trust X Extension agent. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

Table C.9: Overconfidence and inefficiency

	SFA			
	1st stage	2nd stage	1st stage	2nd stage
	(1)	(3)	(4)	(6)
VARIABLES	log Total score	lnsig2u	log Total score	lnsig2u
log Source	0.00861***		0.0117***	
	(0.00169)		(0.00152)	
log Farmer	-0.0214*		-0.0269***	
	(0.0115)		(0.00846)	
Overconfidence		1.068***		1.499***
		(0.0748)		(0.0779)
Constant	2.098***		1.926***	
	(0.0254)		(0.0228)	
Observations	1,280	1,280	1,278	1,278
Controls	NO	NO	YES	YES
Village FE	NO	NO	YES	YES
Wald chi2(2)	35.63		81.15	
Mean efficiency		0.566		0.675
		(0.232)		(0.229)

Standard errors in parentheses. Data are pooled across the two tasks. Notes: The measure of overconfidence here is the standardized overconfidence scores. Controls are: Age, Sex, Education, Iqub membership, Locus of control, Farm size, Farm experience, Livestock ownership (in TLUs), Trust, Risk loving propensity, and an indicator for task familiarity. Significance: *** p<0.01, ** p<0.05, * p<0.1. Source: authors' elaboration.

D

APPENDIX: FIGURES

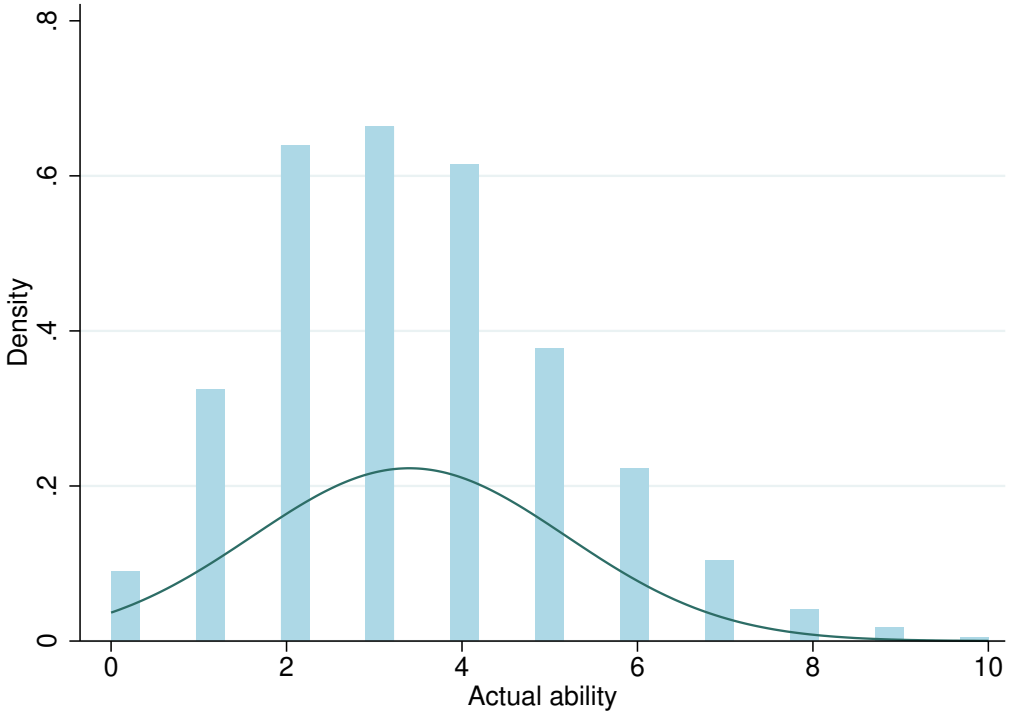


Figure 1: The distribution of actual performance pooled across the two tasks
The average score, pooled across the two tasks is 3.5 with a standard deviation of 1.8. The minimum score is 0 and the maximum is 10. The number of observations is 1,520.

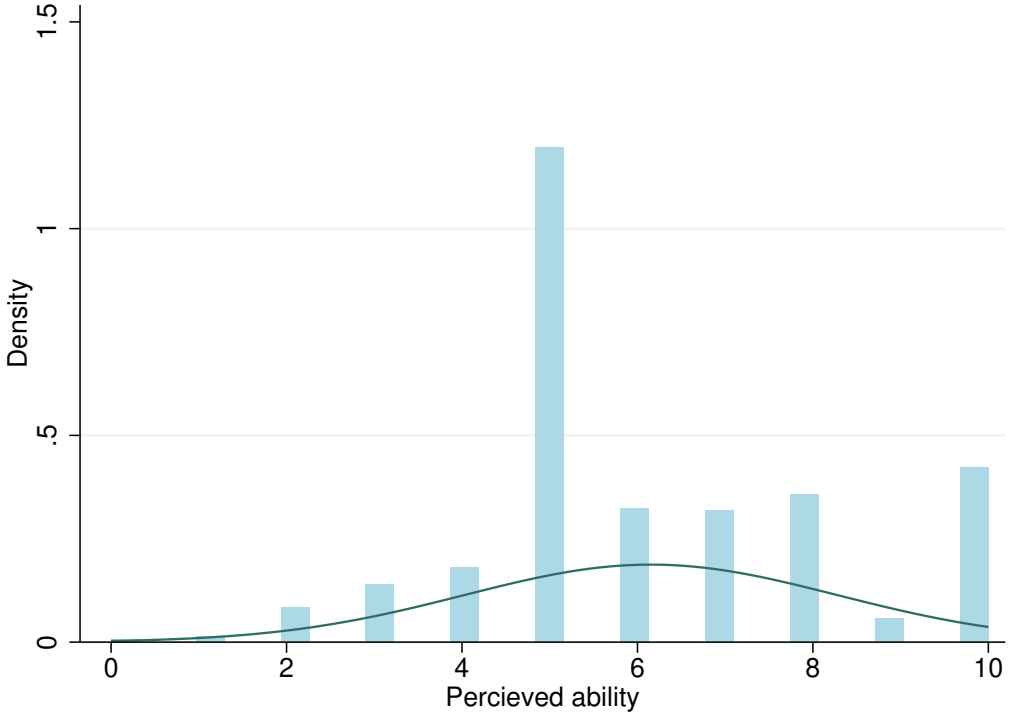


Figure 2: The distribution of perceived performance

The average perceived performance, pooled across the two tasks is 6.152 with a standard deviation of 2.128. Minimum perceived performance is 0 and the maximum is 10. And, the number of observations is 1,520.

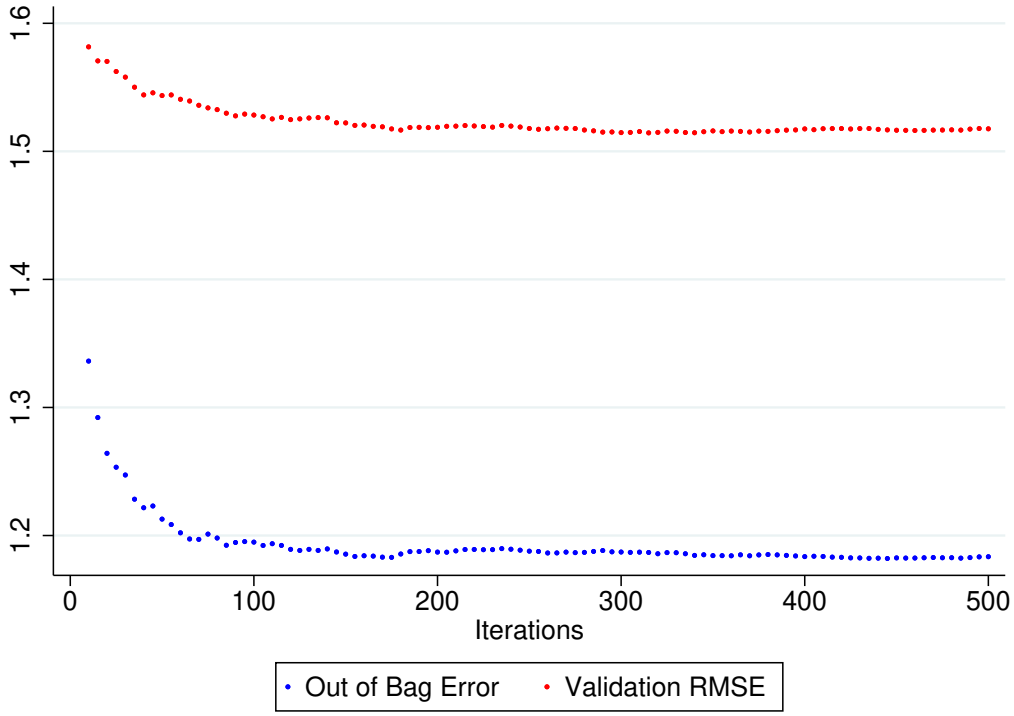


Figure 3: Out of Bag Error and Validation RMSE vs. Iterations Plot

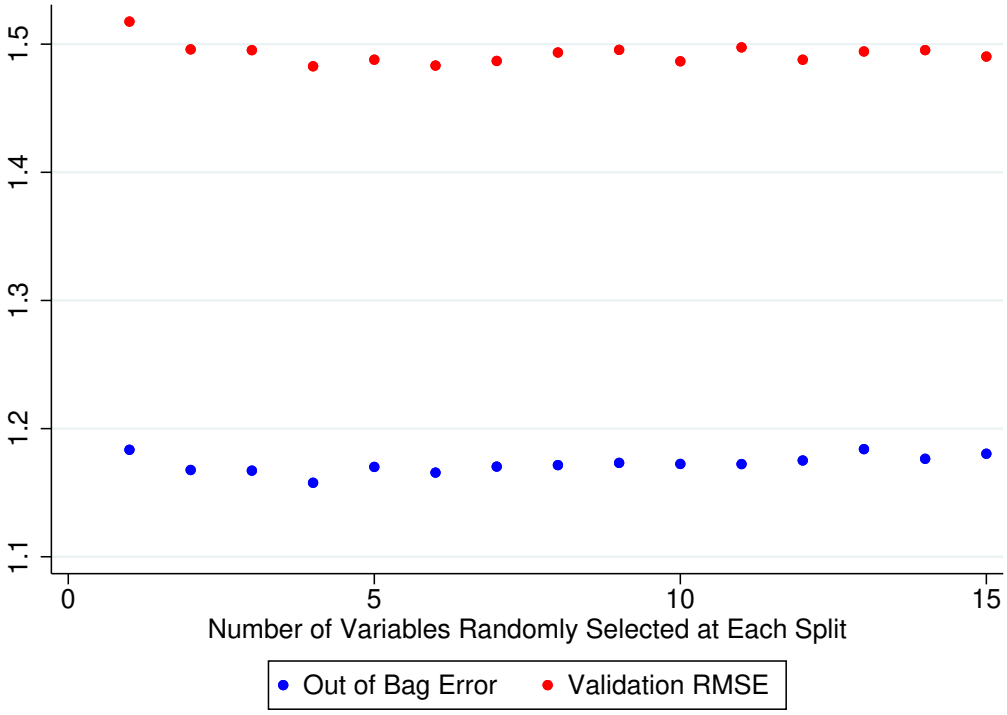


Figure 4: Out of Bag Error and Validation Error vs. Number of Variables Plot

5

CONCLUSION

Every society aspires to improve the wellbeing of its population. Regardless, while some societies have managed to meet their aspiration, the vast majority still have a long way to go. As part of the quest for improved wellbeing, policymakers and researchers have been working to figure out what works and what does not, both at the global and local levels. This dissertation contributes to this greater effort by investigating three important micro-level development topics that revolve around the formation and consequences of human and social capital. While the first chapter studies the formation of human capital by focusing on the role siblings' sex composition on adolescents' human capital development, the second chapter studies the formation/evolution of social capital in response to cash transfer programs, and the last chapter investigates the effects of social capital i.e., trust, on farmers' information-seeking behavior.

This section summarizes the dissertation's main findings, highlights the main policy contributions, and concludes by discussing the limitations and the avenues for future research.

5.1 MAIN FINDINGS

Chapter 2 of this dissertation studies the family environments' role on adolescents' human capital development by taking Ethiopia as its case study. Using data that come from the Young Lives project, it shows that having a greater share of brothers rather than sisters increases human capital outcomes. The chapter also investigates whether the brothers' effects are mediated by their effects on wellbeing (physical and mental), gender norms, and by driving different parental investment behavior. The results from the mediation analyses show that even though a greater share of brothers improves boys' physical wellbeing and perpetuates traditional gender norms, they do not appear to mediate the human capital gains. Instead, the results suggest that spillovers of parental investment decisions, in the

form of role model/tutoring by the eldest sibling, appear to drive the positive brothers' effects.

Chapter 3 examines the impacts of conditional and unconditional cash transfer programs on adolescent women's social capital (proxied by interpersonal trust and gift-giving behavior) and a 'real-world' collective action behavior (proxied by voting). It uses data that come from a randomized experiment conducted in Malawi. The chapter shows that the conditional cash transfer program increases adolescent women's social capital. Contrarily, it shows that both conditional and unconditional cash transfers reduce the likelihood of voting among beneficiaries. Since the cash transfers evaluated in this chapter are NGO-provided transfers, we speculate that it could be lowering the beneficiaries' interest in local politics. Further analyses test whether these effects are driven by adolescent women's reciprocal beliefs, sociability, and wealth. The results from these analyses reveal that adolescents with initial reciprocal beliefs drive the gains in social capital arising from the conditional cash transfer treatment. On the other hand, none of these factors appear to be moderating the decline in the likelihood to vote.

Chapter 4 investigates demand-side factors that affect farmers' information-seeking behavior. Using data from a lab-in-the-field experiment in Ethiopia, it shows that farmers' overconfidence and their trust in the ability of their information sources affect their information-seeking behavior. Interestingly, this chapter shows that a large proportion of farmers are overconfident, i.e., they hold exaggerated beliefs regarding their abilities, and that overconfidence strongly predicts less information seeking from external sources. Additionally, farmers seek more information from high-quality sources and sources they trust. The chapter also examines the efficiency implications of these factors and finds that while overconfidence reduces efficiency, trust increases it.

5.2 POLICY IMPLICATIONS

The main policy implication of chapter 2 is that the family environment plays an important role in individuals' human capital development and that the existing gender gap in the labor market seems to perpetuate further inequality in human capital investment in boys and girls at the household level. Given that the existing labor market rewards men more than women, parents tend to invest more in their male children to reap higher returns to their investments. Fortunately, based on the results, these investments seem to spill over to girls. However, one can imagine that children with more sisters than brothers would be at a disadvantage. This needs policy attention that addresses the gender gap in the existing labor market as well as households' investment decisions.

The main policy implication from chapter 3 is that cash transfers have positive and negative secondary/unintended effects and that these effects need to be taken into account when designing programs. The chapter also provides input to the existing policy debate on whether conditional or unconditional cash transfers serve as better policy tools. Since the results from the chapter show that while both decrease political participation, the conditional cash transfer increases social capital (proxied by interpersonal trust and gift-giving), policymakers may promote social capital by adopting conditional transfers.

Lastly, the policy lesson that comes from chapter 4 is that demand-side factors, such as overconfidence and trust in the ability of information sources, matter in farmers' information-seeking behavior. Therefore, policymakers need to work towards increasing both the quality (trustworthiness) of information delivery services, such as the agricultural extension services, and look out for behavioral constraints that might hinder demand for such services.

5.3 LIMITATIONS AND FUTURE RESEARCH

The main limitation of chapter 2 is that, despite attempting to test for various potential mechanisms and providing some suggestive evidence, it fails to pinpoint the exact mechanism driving the positive brothers' effects on human capital. Future research could attempt to figure this out by collecting detailed data on households' investment patterns (both in terms of physical resources and time allocation), motivations, and siblings' interactions. Furthermore, future research could engage in experimenting with informational campaigns and role model interventions to see whether it would increase parental investments in households that have a larger share of female children.

Similarly, chapter 3, due to data limitations, fails to pinpoint the exact mechanisms driving the decline in political participation as a result of both conditional and unconditional cash transfers. Future research could further investigate why political participation declines in response to cash transfers and whether the type of the provider matters. This could, for example, be done by using a randomized experiment where some villages receive cash transfers from government body and others from an NGO and see how the recipients' political participation evolves. Understanding the role of NGOs in the political atmosphere is crucial given the large concentration of NGOs in many African countries.

Lastly, future research could build on the results obtained from the lab-in-the-field experiment presented in chapter 4 of this dissertation, for example, by examining the same questions in the "natural" setting. Moreover, future research could also expand on the findings by examining ways that could help us battle the overconfidence bias. For example, one could examine whether providing frequent feedback on performance would help farmers

update their beliefs regarding their abilities and become less overconfident and consequently seek more information from external sources.

E

APPENDIX: EXPERIMENTAL PROTOCOL

Experimental protocol: Overconfidence, Trust, and Information-seeking among Smallholder Farmers: Experimental Evidence from Ethiopia

(Online appendix)

General instructions

Welcome and thank you very much for coming.

We invited you today to take part in four activities. In the first activity, you will be solving farming related questions where you will be earning 5 birr for every correctly solved question. In the second activity, you will be solving image-based questions where you also will earn 5 birr per correctly solved question. In the third activity, you will decide whether to play a lottery. After that, I will ask you some other questions such as your age, education, farm size, agricultural production, etc. Please be informed that for the last activity, you will not be paid per questions answered. Instead, you will receive 30 birr in total. Your total earnings will depend on the number of correctly solved questions and the outcome of the lottery winning.

Specific instructions

1. **Procedures in the Control group**

   Activity 1: Framed test (familiar task)

- The enumerator uses the following instructions for the control group:
    1. You will be solving 10 farming-related multiple-choice questions on your own. The questions are related to the agricultural activities commonly practiced by farmers in this district.
    2. I will be reading the questions and the choices for you. Feel free to ask me to re-read them for you until you understand the question and the choices very well.
    3. I will record the answer you give me and the computer [enumerator shows the tablet to the farmer] will check if it is the correct answer.
    4. As you know, for each correct answer, you will earn 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. If you answer 6 questions, you will earn 30 birr.
    5. Now, I will show you two examples so that you have an idea what kinds of questions to expect (COMMON TO ALL TREATMENT ARMS):

Example 1: Which wheat disease is the most prevalent in your village? [some of the names in the choices are in the local language]

a. Scald
b. Aremamo
c. Yellow rust
d. All three are prevalent

Example 2: Which one of the following is the best sheep breed for fattening in your agro-ecology? [the names in the choices are in the local language]

a. Washera
b. Farta
c. Menz
d. Horro

Box 1: Exercise questions for the familiar task

6. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly].

- The enumerator starts administering the test by reading the questions and the choices and records the answers.

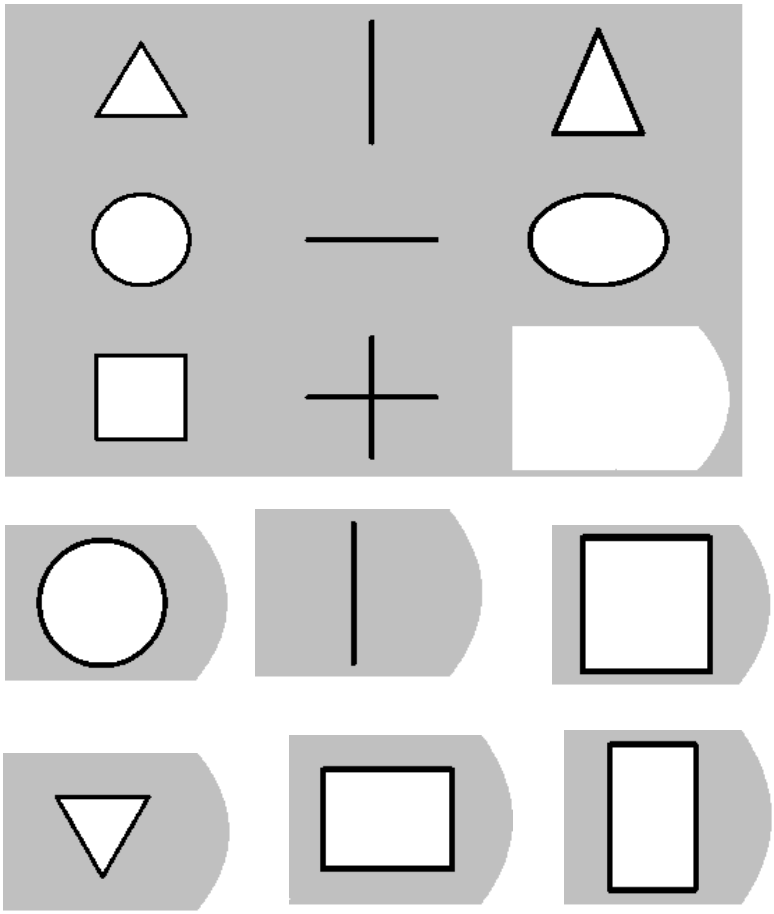
Activity 2: Cognitive ability test (unfamiliar task)

- The enumerator proceeds to the Raven Matrices test and uses the following instructions;
    1. Now, you will solve the general cognitive ability questions [These are image-based questions].
    2. These questions do not require reading and writing skills.
    3. Now, I will show you 2 examples of this test.
    4. Have a look at the shapes in the boxes on top. Do you see how related they are to each other? Can you find the answer that goes in the empty box so the shapes

in the bottom row will relate to each other in the same way as the shapes in the top row?

- The enumerator shows the following two examples (COMMON TO ALL TREATMENT ARMS).

  Example 1:



Example 2:

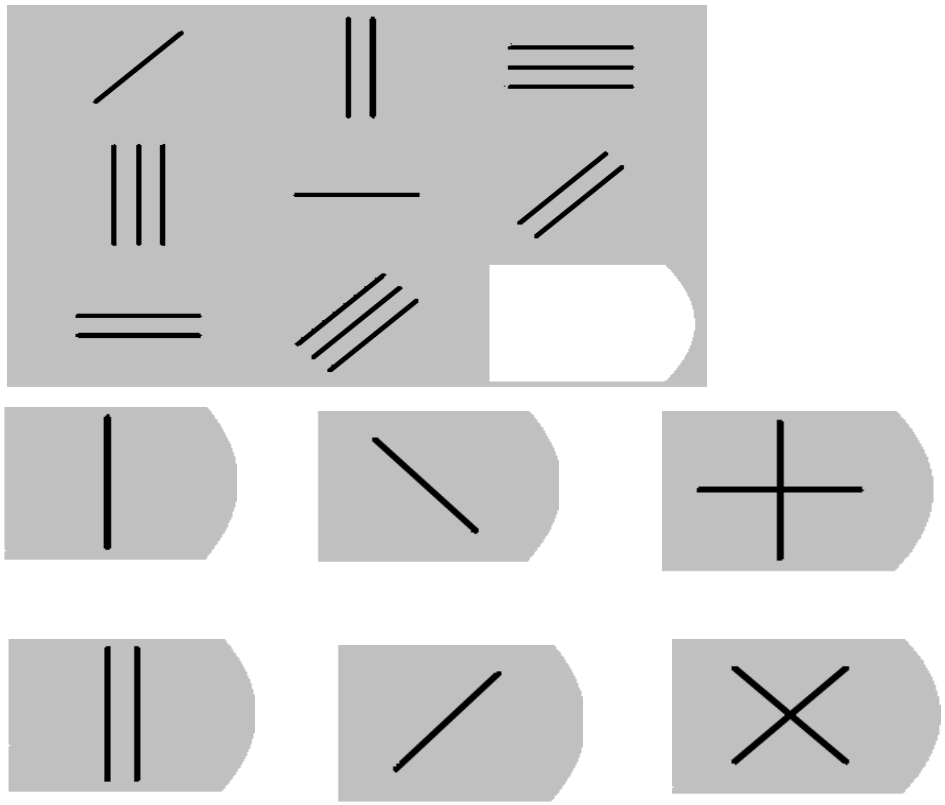


Figure 1: Exercise Raven's Matrices (unfamiliar task)

5. Same as in the first activity, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. For example, if you solve only 6 correctly, you will earn 30 birr.
6. Now, you will begin the actual activity. Before we proceed, could you tell me how many of these questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- The enumerator starts to show the matrices to the farmer.
- The enumerator records the answer and proceeds with the third activity—the survey.

****

2. Procedures in peer-farmer advisor treatment arms

2.1. Untrained peer advisors (UPA)

Activity 1: Framed test

- The enumerator will read the following instructions:
    1. You will be solving 10 farming-related multiple-choice questions. The questions are related to the agricultural activities commonly practiced by farmers in this woreda.
    2. I will be reading the questions and the choices for you. Feel free to ask me to re-read them for you until you understand the question and the choices very well.
    3. I will record the answer you give me and the computer [enumerator shows the tablet to the farmer] will check if it is the correct answer.
    4. As you know, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. If you solve only 6, you will earn 30 birr.
    5. Now, I will show you two examples so that you have an idea what kinds of questions to expect [enumerator shows the two exercise questions presented in box 1.]
    6. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]
- At this stage, the enumerator in UPA treatment group provides additional information to the farmer about the option to seek advice (answers) from a designated advisor. He will read the following instruction;

    We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is a farmer from [name] village. Note that for every question you refer to your advisor, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to you advisor, I will contact your advisor using my cell phone.

    7. Now, together with your advisor, how many of these questions do you expect to solve correctly? _____

- The enumerator starts administering the test by reading the questions and the choices and records the answers.

Activity 2: Cognitive ability test

- The enumerator proceeds to the Raven Matrices test and uses the following instructions;
    1. Now, you will solve the cognitive ability questions.
    2. These questions do not require reading and writing skills.
    3. Now, I will show you 2 examples of this test
    4. Have a look at the shapes in the boxes on top. Do you see how related they are to each other? Can you find the answer that goes in the empty box so the shapes in the bottom row will relate to each other in the same way as the shapes in the top row?
    5. The enumerator shows the two examples in figure 1.

Same as in the first activity, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. For example, if you solve only 6 correctly, you will earn 30 birr.

6. Now, you will begin the actual activity. Before we proceed, could you tell me how many of these questions you expect to solve correctly by your own? _____

- At this stage, the enumerator in UPA treatment group provides additional information to the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

> *We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is a farmer from [name] village. Note that for every question you refer to your advisor, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your advisor using my cell phone.*

7. Now, together with your advisor, how many of these questions do you expect to solve correctly?" _____[Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- The enumerator starts to show the matrices to the farmer and records the answers.
- The enumerator proceeds to administer activities 3 and 4 (COMMON TO ALL TREATMENT ARMS).

****

2.2. Nudging low-trust untrained peer advisors (LTUPA)

Activity 1: Framed test

- The enumerator will read the following instructions:

    1. You will be solving 10 farming-related multiple-choice questions. The questions are related to the agricultural activities commonly practiced by farmers in this woreda.
    2. I will be reading the questions and the choices for you. Feel free to ask me to re-read them for you until you understand the question and the choices very well.
    3. I will record the answer you give me and the computer [enumerator shows the tablet to the farmer] will check if it is the correct answer.
    4. As you know, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. If you solve only 6, you will earn 30 birr.
    5. Now, I will show you two examples so that you have an idea what kinds of questions to expect [enumerator shows the two exercise questions presented in box 1.]
    6. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the LTUPA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

    We would like to inform you that for any of the 10 questions you can refer to the farmer that is designated as your advisor. Your advisor is a farmer from [name] village. Note that they may or may not know the correct answer to all the questions. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your *advisor using my cell phone.*

7. Now, together with your advisor, how many of these questions do you expect to solve correctly?_____

- The enumerator starts to show the matrices to the farmer.

Activity 2: Cognitive ability test

- The enumerator proceeds to the Raven Matrices test and uses the following instructions;
    1. Now, you will solve the cognitive ability questions.
    2. These questions do not require reading and writing skills.
    3. Now, I will show you 2 examples of this test.
    4. Have a look at the shapes in the boxes on top. Do you see how related they are to each other? Can you find the answer that goes in the empty box so the shapes in the bottom row will relate to each other in the same way as the shapes in the top row?
    5. The enumerator shows the two examples in figure 1.
    6. Same as in the first activity, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. For example, if you solve only 6 correctly, you will earn 30 birr.
    7. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the LTUPA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

    We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is a farmer from [name] village. Note that, they may or may not know the correct answer to all the questions. Note that for every

question you refer, you will have to pay 1 birr.1 Once you decide on which of the questions you would like to refer to your advisor, I will contact your advisor using my cell phone.

8. Now, together with your advisor, how many of these questions do you expect to solve correctly?_____

- The enumerator starts to show the matrices to the farmer and records the answers.
- The enumerator administers activities 3 and 4 (COMMON TO ALL TREATMENT ARMS).

****

2.3. Nudging high-trust untrained peer advisors (HTUPA)

Activity 1: Framed test

- The enumerator will read the following instructions:

1. You will be solving 10 farming-related multiple-choice questions. The questions are related to the agricultural activities commonly practiced by farmers in this woreda.
2. I will be reading the questions and the choices for you. Feel free to ask me to re-read them for you until you understand the question and the choices very well.
3. I will record the answer you give me and the computer [enumerator shows the tablet to the farmer] will check if it is the correct answer.
4. As you know, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. If you solve only 6, you will earn 30 birr.
5. Now, I will show you two examples so that you have an idea what kinds of questions to expect [enumerator shows the two exercise questions presented in box 1.]

[1] We use the pronoun "they" because it translates into a respectful gender-neutral reference to a person in Amharic. This way, we will avoid priming gender

6. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the HTUPA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is a farmer from [name] village. Your advisor is well equipped as you are, and maybe highly likely to help you solve the questions. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your advisor using my cell phone.

8. Now, together with your advisor, how many of these questions do you expect to solve correctly?_____

- The enumerator starts to show the matrices to the farmer.

Activity 2: Cognitive ability test

- The enumerator proceeds to the Raven Matrices test and uses the following instructions;
    1. Now, you will solve the cognitive ability questions.
    2. These questions do not require reading and writing skills.
    3. Now, I will show you 2 examples of this test
    4. Have a look at the shapes in the boxes on top. Do you see how related they are to each other? Can you find the answer that goes in the empty box so the shapes in the bottom row will relate to each other in the same way as the shapes in the top row?
    5. The enumerator shows the two examples in figure 1.
    6. Same as in the first activity, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. For example, if you solve only 6 correctly, you will earn 30 birr.
    7. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about

your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the HTUPA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is a farmer from [name] village. Your advisor is well equipped as you are and maybe highly likely to help you solve the questions. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your advisor using my cell phone.

8. Now, together with your advisor, how many of these questions do you expect to solve correctly?_____

- The enumerator starts to show the matrices to the farmer and records the answers.
- The enumerator administers activities 3 and 4 (COMMON TO ALL TREATMENT ARMS).

****

2.4. Trained peers as advisors (TPA)

Activity 1: Framed test

- The enumerator will read the following instructions:
  1. You will be solving 10 farming-related multiple-choice questions. The questions are related to the agricultural activities commonly practiced by farmers in this woreda.
  2. I will be reading the questions and the choices for you. Feel free to ask me to re-read them for you until you understand the question and the choices very well.
  3. I will record the answer you give me and the computer [enumerator shows the tablet to the farmer] will check if it is the correct answer.
  4. As you know, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. If you solve only 6, you will earn 30 birr.

5. Now, I will show you two examples so that you have an idea what kinds of questions to expect [enumerator shows the two exercise questions presented in box 1.]
6. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in TPA treatment groups provides additional information to the farmer about the option to seek advice (answers) from designated advisors. He will read the following instruction;

> *We would like to inform you that for any of the 10 questions you could refer to your advisor. Your advisor is a farmer from [name] village who has taken training on the topics covered in the test. Note that for every question you refer to your advisor, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will* contact your *advisor using my cell phone.*

7. Now, together with your advisor, how many of these questions do you expect to solve correctly?" _____

- The enumerator starts administering the test by reading the questions and the choices and records the answers.

Activity 2: Cognitive ability test

- The enumerator proceeds to the Raven Matrices test and uses the following instructions;
  1. Now, you will solve the cognitive ability questions.
  2. These questions do not require reading and writing skills.
  3. Now, I will show you 2 examples of this test
  4. Have a look at the shapes in the boxes on top. Do you see how related they are to each other? Can you find the answer that goes in the empty box so the shapes in the bottom row will relate to each other in the same way as the shapes in the top row?
  5. The enumerator shows the two examples in figure 1.

6. Same as in the first activity, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. For example, if you solve only 6 correctly, you will earn 30 birr.
7. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in TPA treatment group provides additional information to the farmer about the option to seek advice (answers) from designated advisor. He will read the following instruction;

> *We would like to inform you that for any of the 10 questions you could refer to your advisor. Your advisor is a farmer from [name] village who has taken training on the topics covered in the test. Note that for every question you refer to your advisor, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will* contact your *advisor using my cell phone.*

8. Now, together with your advisor, how many of these questions do you expect to solve correctly?" _____

- The enumerator starts to show the matrices to the farmer and records the answer.
- The enumerator administers activity 3 and 4 (COMMON TO ALL TREATMENT ARMS).

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2.5. Nudging low-trust trained peer advisors (LTTPA)

Activity 1: Framed test

- The enumerator will read the following instructions:

1. You will be solving 10 farming-related multiple-choice questions. The questions are related to the agricultural activities commonly practiced by farmers in this woreda.

2. I will be reading the questions and the choices for you. Feel free to ask me to re-read them for you until you understand the question and the choices very well.
3. I will record the answer you give me and the computer [enumerator shows the tablet to the farmer] will check if it is the correct answer.
4. As you know, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. If you solve only 6, you will earn 30 birr.
5. Now, I will show you two examples so that you have an idea what kinds of questions to expect [enumerator shows the two exercise questions presented in box 1.]
6. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the LTTPA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

> *We would like to inform you that for any of the 10 questions you could refer to your advisor. Your advisor is a farmer from [name] village who has taken training on the topics covered in the test. Notwithstanding the training received on topics related to the questions, they may or may not know the correct answer to all the questions. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will* contact your *advisor using my cell phone.*

7. Now, together with your advisor, how many of these questions do you expect to solve correctly?_____

- The enumerator starts to show the matrices to the farmer

Activity 2: Cognitive ability test

- The enumerator proceeds to the Raven Matrices test and uses the following instructions;
    1. Now, you will solve the cognitive ability questions.
    2. These questions do not require reading and writing skills.
    3. Now, I will show you 2 examples of this test
    4. Have a look at the shapes in the boxes on top. Do you see how related they are to each other? Can you find the answer that goes in the empty box so the shapes in the bottom row will relate to each other in the same way as the shapes in the top row?
    5. The enumerator shows the two examples in figure 1.
    6. Same as in the first activity, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. For example, if you solve only 6 correctly, you will earn 30 birr.
    7. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the LTTPA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

    We would like to inform you that for any of the 10 questions you could refer to your advisor. Your advisor is a farmer from [name] village who has taken training on the topics covered in the test. Notwithstanding the training received, they may or may not know the correct answer to all the questions. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your *advisor using my cell phone.*

    8. Now, together with your advisor, how many of these questions do you expect to solve correctly?_____

- The enumerator starts to show the matrices to the farmer and records the answers.

- The enumerator administer activities 3 and 4 (COMMON TO ALL TREATMENT ARMS).

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2.6. Nudging high-trust trained peer advisors (HTTPA)

Activity 1: Framed test

- The enumerator will read the following instructions:

    1. You will be solving 10 farming-related multiple-choice questions. The questions are related to the agricultural activities commonly practiced by farmers in this woreda.
    2. I will be reading the questions and the choices for you. Feel free to ask me to re-read them for you until you understand the question and the choices very well.
    3. I will record the answer you give me and the computer [enumerator shows the tablet to the farmer] will check if it is the correct answer.
    4. As you know, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. If you solve only six, you will earn 30 birr.
    5. Now, I will show you two examples so that you have an idea what kinds of questions to expect [enumerator shows the two exercise questions presented in box 1.]
    6. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the HTTPA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

    We would like to inform you that for any of the 10 questions you could refer to your advisor. Your advisor is a farmer from [name] village who has taken training on the topics covered in the test and is well equipped to know the

correct answers. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your *advisor using my cell phone.*

7. Now, together with your advisor, how many of these questions do you expect to solve correctly?_____

- The enumerator starts to show the matrices to the farmer.

Activity 2: Cognitive ability test

- The enumerator proceeds to the Raven Matrices test and uses the following instructions;
    1. Now, you will solve the cognitive ability questions.
    2. These questions do not require reading and writing skills.
    3. Now, I will show you 2 examples of this test
    4. Have a look at the shapes in the boxes on top. Do you see how related they are to each other? Can you find the answer that goes in the empty box so the shapes in the bottom row will relate to each other in the same way as the shapes in the top row?
    5. The enumerator shows the two examples in figure 1.
    6. Same as in the first activity, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. For example, if you solve only 6 correctly, you will earn 30 birr.
    7. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]
- At this stage, the enumerator in the HTTPA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

    We would like to inform you that for any of the 10 questions you could refer to your advisor. Your advisor is a farmer from [name] village who has taken training on the topics covered in the test and is well equipped to know the correct answers. Note that for every question you refer, you will have to pay 1

birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your *advisor using my cell phone.*

8. Now, together with your advisor, how many of these questions do you expect to solve correctly?_____

- The enumerator starts to show the matrices to the farmer and records the answers.
- The enumerator administers activities 3 and 4 (COMMON TO ALL TREATMENT ARMS).

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3. Procedures in extension-agent advisor treatment arms

3.1. Untrained extension agents as advisors (UEAA)

Activity 1: Framed test

- The enumerator will read the following instructions:
  1. You will be solving 10 farming-related multiple-choice questions. The questions are related to the agricultural activities commonly practiced by farmers in this woreda.
  2. I will be reading the questions and the choices for you. Feel free to ask me to re-read them for you until you understand the question and the choices very well.
  3. I will record the answer you give me and the computer [enumerator shows the tablet to the farmer] will check if it is the correct answer.
  4. As you know, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. If you solve only 6, you will earn 30 birr.
  5. Now, I will show you two examples so that you have an idea what kinds of questions to expect [enumerator shows the two exercise questions presented in box 1.]
  6. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the UEAA treatment group provides additional information to the farmer about the option to seek answers from designated advisors. He reads the following instruction;

  We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is an extension agent from [name] village. Note that for every question you refer to your advisor, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your *advisor using my cell phone.*

7. Now, together with your advisor, how many of these questions do you expect to solve correctly?_____

- The enumerator starts administering the test by reading the questions and the choices and records the answers.

Activity 2: Cognitive ability test

- The enumerator proceeds to the Raven Matrices test and uses the following instructions;

1. Now, you will solve the cognitive ability questions.
2. These questions do not require reading and writing skills.
3. Now, I will show you 2 examples of this test
4. Have a look at the shapes in the boxes on top. Do you see how related they are to each other? Can you find the answer that goes in the empty box so the shapes in the bottom row will relate to each other in the same way as the shapes in the top row?
5. The enumerator shows the two examples in figure 1.

6. Same as in the first activity, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. For example, if you solve only 6 correctly, you will earn 30 birr.
7. Now, you will begin the actual activity. Before we proceed, could you tell me how many of these questions you expect to solve correctly by your own? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the UEAA treatment group provides additional information to the farmer about the option to seek answers from designated advisors. He reads the following instruction;

  We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is an extension agent from [name] village. Note that for every question you refer to your advisor, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your *advisor using my cell phone.*

  8. Now, together with your advisor, how many of these questions do you expect to solve correctly? _____

- The enumerator starts to show the matrices to the farmer and records solutions provided by the farmer.
- The enumerator administers activities 3 and 4 (COMMON TO ALL TREATMENT ARMS).

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3.2. Nudging low-trust untrained extension agent advisors (LTUEAA)

Activity 1: Framed test

- The enumerator will read the following instructions:

1. You will be solving 10 farming-related multiple-choice questions. The questions are related to the agricultural activities commonly practiced by farmers in this woreda.
2. I will be reading the questions and the choices for you. Feel free to ask me to re-read them for you until you understand the question and the choices very well.
3. I will record the answer you give me and the computer [enumerator shows the tablet to the farmer] will check if it is the correct answer.
4. As you know, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. If you solve only 6, you will earn 30 birr.
5. Now, I will show you two examples so that you have an idea what kinds of questions to expect [enumerator shows the two exercise questions presented in box 1.]

6. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the LTUEAA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

> *We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is an extension agent from [name] village. Note that, they may or may not know the correct answer to all the questions. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will* contact your *advisor using my cell phone.*

7. Now, together with your advisor, how many of these questions do you expect to solve correctly? _____

- The enumerator starts administering the test by reading the questions and the choices and records the answers.

Activity 2: Cognitive ability test

- The enumerator proceeds to the Raven Matrices test and uses the following instructions;
    1. Now, you will solve the cognitive ability questions.
    2. These questions do not require reading and writing skills.
    3. Now, I will show you 2 examples of this test
    4. Have a look at the shapes in the boxes on top. Do you see how related they are to each other? Can you find the answer that goes in the empty box so the shapes in the bottom row will relate to each other in the same way as the shapes in the top row?
    5. The enumerator shows the two examples in figure 1.
    6. Same as in the first activity, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. For example, if you solve only 6 correctly, you will earn 30 birr.

7. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the LTUEAA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is an extension agent from [name] village. Note that, they may or may not know the correct answer to all the questions. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your *advisor using my cell phone.*

8. Now, together with your advisor, how many of these questions do you expect to solve correctly? _____

- The enumerator starts to show the matrices to the farmer and records the answers.
- The enumerator administers activities 3 and 4 (COMMON TO ALL TREATMENT ARMS).

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3.3. Nudging high-trust untrained extension agent advisors (HTUEAA)

Activity 1: Framed test

- The enumerator will read the following instructions:

1. You will be solving 10 farming-related multiple-choice questions. The questions are related to the agricultural activities commonly practiced by farmers in this woreda.
2. I will be reading the questions and the choices for you. Feel free to ask me to re-read them for you until you understand the question and the choices very well.

3. I will record the answer you give me and the computer [enumerator shows the tablet to the farmer] will check if it is the correct answer.
4. As you know, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. If you solve only 5, you will earn 25 birr.
5. Now, I will show you two examples so that you have an idea what kinds of questions to expect [enumerator shows the two exercise questions presented in box 1.]
6. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the HTUEAA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

  We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is an extension agent from [name] village. Your advisor is well equipped as you are, and maybe highly likely to help you solve the questions. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your advisor using my cell phone.

  7. Now, together with your advisor, how many of these questions do you expect to solve correctly?_____
- The enumerator starts administering the test by reading the questions and the choices and records the answers.

Activity 2: Cognitive ability test

- The enumerator proceeds to the Raven Matrices test and uses the following instructions;
  1. Now, you will solve the cognitive ability questions.
  2. These questions do not require reading and writing skills.
  3. Now, I will show you 2 examples of this test
  4. Have a look at the shapes in the boxes on top. Do you see how related they are to each other? Can you find the answer that goes in the empty

box so the shapes in the bottom row will relate to each other in the same way as the shapes in the top row?

5. The enumerator shows the two examples in figure 1.
6. Same as in the first activity, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. For example, if you solve only 6 correctly, you will earn 30 birr.
7. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the HTUEAA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is an extension agent from [name] village. Your advisor is well equipped as you are, and maybe highly likely to help you solve the questions. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your *advisor using my cell phone.*

8. Now, together with your advisor, how many of these questions do you expect to solve correctly?_____

- The enumerator starts to show the matrices to the farmer and records the answers.
- The enumerator administers activities 3 and 4 (COMMON TO ALL TREATMENT ARMS).

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3.4. Trained extension agents as advisors (TEAA)

Activity 1: Framed test

- The enumerator will read the following instructions:

1. You will be solving 10 farming-related multiple-choice questions.

2. I will be reading the questions and the choices for you. Feel free to ask me to re-read them for you until you understand the question and the choices very well.
3. I will record the answer you give me and the computer [enumerator shows the tablet to the farmer] will check if it is the correct answer.
4. As you know, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. If you solve only 6, you will earn 30 birr.
5. Now, I will show you two examples so that you have an idea what kinds of questions to expect [enumerator shows the two exercise questions presented in box 1.]
6. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the TEAA treatment group provides additional information to the farmer about the option to seek advice (answers) from a designated advisor. He will read the following instruction;

> *We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is an extension agent from [name] village who has taken training on topics covered in the test. Note that for every question you refer to your advisor, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will* contact your *advisor using my cell phone.*

7. Now, together with your advisor, how many of these questions do you expect to solve correctly?_____

- The enumerator starts administering the test by reading the questions and the choices and records the answers.

Activity 2: Cognitive ability test

- The enumerator proceeds to the Raven Matrices test and uses the following instructions;
    1. Now, you will solve the cognitive ability questions.
    2. These questions do not require reading and writing skills.
    3. Now, I will show you 2 examples of this test

4. Have a look at the shapes in the boxes on top. Do you see how related they are to each other? Can you find the answer that goes in the empty box so the shapes in the bottom row will relate to each other in the same way as the shapes in the top row?
5. The enumerator shows the wo examples in figure 1.

6. Same as in the first activity, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. For example, if you solve only 6 correctly, you will earn 30 birr.

7. Before we proceed, could you tell me how many of these questions you expect to solve correctly by your own? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the TEAA treatment group provides additional information to the farmer about the option to seek answers from designated advisors. He reads the following instruction;

We would like to inform you that for any of the 10 questions you could refer to your advisor. Your advisor is an extension agent from [name] village who have taken training on topics covered in the test. Note that for every question you refer to your advisor, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your *advisor using my cell phone.*

8. Now, together with your advisor, how many of these questions do you expect to solve correctly? _____

- The enumerator starts to show the matrices to the farmer and records the answers.
- The enumerator administers activities 3 and 4 (COMMON TO ALL TREATMENT ARMS).

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3.5. Nudging low-trust trained extension agent advisors (LTTEAA)

Activity 1: Framed test

- The enumerator will read the following instructions:

1. You will be solving 10 farming-related multiple-choice questions. The questions are related to the agricultural activities commonly practiced by farmers in this woreda.
2. I will be reading the questions and the choices for you. Feel free to ask me to re-read them for you until you understand the question and the choices very well.
3. I will record the answer you give me and the computer [enumerator shows the tablet to the farmer] will check if it is the correct answer.
4. As you know, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. If you solve only 6, you will earn 30 birr.
5. Now, I will show you two examples so that you have an idea what kinds of questions to expect [enumerator shows the two exercise questions presented in box 1.]
6. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the LTTEAA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

> *We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is an extension agent from [name] village who has taken training on topics covered in the test.* N*otwithstanding the training received on topics related to the questions, they may or may not know the correct answer to all the questions. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will* contact your *advisor using my cell phone.*

7. Now, together with your advisor, how many of these questions do you expect to solve correctly? _____

- The enumerator starts administering the test by reading the questions and the choices and records the answers.

Activity 2: Cognitive ability test

- The enumerator proceeds to the Raven Matrices test and uses the following instructions;
    1. Now, you will solve the cognitive ability questions.
    2. These questions do not require reading and writing skills.
    3. Now, I will show you 2 examples of this test
    4. Have a look at the shapes in the boxes on top. Do you see how related they are to each other? Can you find the answer that goes in the empty box so the shapes in the bottom row will relate to each other in the same way as the shapes in the top row?
    5. The enumerator shows the two examples in figure 1.
    6. Same as in the first activity, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. For example, if you solve only 6 correctly, you will earn 30 birr.
    7. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]
- At this stage, the enumerator in the LTTEAA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

> *We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is an extension agent from [name] village who has taken training on topics covered in the test. Notwithstanding the training received, they may or may not know the correct answer to all the questions. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will* contact your *advisor using my cell phone.*

8. Now, together with your advisor, how many of these questions do you expect to solve correctly? _____

- The enumerator starts to show the matrices to the farmer and records the answers.
- The enumerator administers activities 3 and 4 (COMMON TO ALL TREATMENT ARMS).

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3.6. Nudging high-trust trained extension agent advisors (HTTEAA)

Activity 1: Framed test

- The enumerator will read the following instructions:

1. You will be solving 10 farming-related multiple-choice questions. The questions are related to the agricultural activities commonly practiced by farmers in this woreda.
2. I will be reading the questions and the choices for you. Feel free to ask me to re-read them for you until you understand the question and the choices very well.
3. I will record the answer you give me and the computer [enumerator shows the tablet to the farmer] will check if it is the correct answer.
4. As you know, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. If you solve only 5, you will earn 25 birr.
5. Now, I will show you two examples so that you have an idea what kinds of questions to expect [enumerator shows the two exercise questions presented in box 1.]
6. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]

- At this stage, the enumerator in the HTTEAA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is an extension agent from [name] village who has taken training on topics covered in the test and is well equipped to have the correct answers. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your *advisor using my cell phone."*

7. Now, together with your advisor, how many of these questions do you expect to solve correctly?_____

- The enumerator starts administering the test by reading the questions and the choices and records the answers.

Activity 2: Cognitive ability test

- The enumerator proceeds to the Raven Matrices test and uses the following instructions;
    1. Now, you will solve the cognitive ability questions.
    2. These questions do not require reading and writing skills.
    3. Now, I will show you 2 examples of this test.
    4. Have a look at the shapes in the boxes on top. Do you see how related they are to each other? Can you find the answer that goes in the empty box so the shapes in the bottom row will relate to each other in the same way as the shapes in the top row?
    5. The enumerator shows the two examples in figure 1.
    6. Same as in the first activity, for each correct answer, you will receive 5 birr. This means, if you answer all 10 questions correctly, you will earn 50 birr from this activity alone. For example, if you solve only 6 correctly, you will earn 30 birr.
    7. Before we proceed, could you give me an estimate of how many of the questions you expect to solve correctly? _____ [Think carefully about your answer because you have a chance to win a 15 birr mobile call credit if you guess correctly.]
- At this stage, the enumerator in the HTTEAA treatment group informs the farmer about the option to seek advice (answers) from a designated advisor by reading the following instruction;

    We would like to inform you that for any of the 10 questions you can refer to your advisor. Your advisor is an extension agent from [name] village who has

taken training on topics covered in the test and is well equipped to have the correct answers. Note that for every question you refer, you will have to pay 1 birr. Once you decide on which of the questions you would like to refer to your advisor, I will contact your *advisor using my cell phone.*

8. Now, together with your advisor, how many of these questions do you expect to solve correctly? _____

- The enumerator starts to show the matrices to the farmer and records the answers.
- The enumerator administers activities 3 and 4 (COMMON TO ALL TREATMENT ARMS).

****

Activity 3: Lottery game (COMMON TO ALL TREATMENT ARMS)

As you know, you will receive 30 birr for coming and taking part in today's activities. Now, you can buy a lottery worth anything between 0 and 30 birr. If you win, you get to double the amount you invested in the lottery. If you lose, you halve the amount you invested. The probability of winning or losing is 50, 50. Once you decide how much you would like to invest, I will toss a coin and if it lands on "*sew*" (heads) you win, if it lands on "*ambessa*" (tails) you lose. Is it clear?

To make sure you understood the game; could you tell me the answers to the following questions?

1. Assume that you invested 10 birr and the coin lands on *sew*. How much will you earn from the lottery?
    a. 5 birr
    b. 10 birr
    c. 20 birr
2. Assume that you invested 15 birr and the coin landed on *ambessa*. How much will you earn from the lottery?
    a. 15 birr
    b. 7.5 birr
    c. 30 birr

****

Farm related questions used in the main task (familiar task). [some of the names in the choices are in the local language]

1. In your village, which one of the following diseases is the most prevalent in affecting the local sheep?
   a. Fasciola
   b. Viral infection
   c. Bacterial infection
   d. All

2. In your village, how long does it take to fatten sheep?
   a. 3 months
   b. 2 months
   c. 4 months
   d. 6 months

3. How old should a sheep be to be fattened effectively?
   a. Not too old not too young
   b. Below 7 months
   c. Above 2 years
   d. Between 7 and 17 months

4. What kind of sheep fattening is the most demanded by the export market?
   a. Castrated
   b. Free-range
   c. Uncastrated
   d. White-colored

5. What is the optimal distance between rows in farrow planting for wheat?
   a. 50 to 60 cm
   b. 40 to 50 cm
   c. 60 to 70 cm
   d. Up to 1 meter

6. Compared to an unfurrowed wheat plot, how much more yield does furrow planed wheat yield?
   a. Quadrupled
   b. Tripled
   c. Doubled
   d. The unfurrowed plot does not yield anything

7. Which of the following bread-wheat varieties is high-yield Variety?
   a. Hidase
   b. Dashen

c. Menz
d. Tsehay

8. What is the recommended amount of Urea fertilizer for one hectare of a wheat field by the agricultural officers?
   a. 225 kg
   b. 275 kg
   c. 300 kg
   d. 125 kg

9. Which one of the following is an effective treatment for Wheat Rust?
   a. Karate
   b. Celekron
   c. Tilt
   d. Baylaten

10. Which fertilizer has recently been replaced?
    a. Urea
    b. DAP
    c. NPS-Boren
    d. Potassium

****

❖ **The images from the Raven matrices can be supplied by authors upon request.**

F

APPENDIX: ETHICAL APPROVAL

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6200 MD Maastricht

Ethical Review Committee Inner City Faculties

Our reference
ERCIC_167_12_12_2019

Maastricht
17 January 2020

Dear Prof. Møllgaard,

After examination of the research study protocol entitled 'Understanding farmers' knowledge-seeking behavior: Evidence from a lab-in-the-field experiment in Ethiopia' and relevant annexes, submitted by Eleonora Nillesen, the Ethical Review Committee Inner City faculties (ERCIC) has concluded that there are no ethical objections to the execution of the research project.

Any changes in the research design require a renewed review by ERCIC.

Yours sincerely,

Prof. Teun Dekker
Chair

Dr. Natasja Reslow
Secretary

CC Eleonora Nillesen; Nyasha Tirivayi; Hiwot Mesfin; Francesco Cecchi

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IMPACT PARAGRAPH

The impact paragraph of this dissertation is added in compliance with article 22.5 of the "Regulations for obtaining the doctoral degree at Maastricht University" decree by resolution of the board of deans, dated 1 October 2020.

This dissertation consists of three empirical chapters, each addressing topics that revolve around the formation and consequences of human and social capital.

The first empirical chapter contributes to our understanding of the family environment's role, specifically, the effects of siblings' sex ratio on adolescents' human capital in a low-income country—a setting less examined by existing studies. The results of this chapter show a positive brothers' effect on adolescents' human capital, meaning that having a greater share of brothers rather than sisters leads to higher human capital outcomes. The mechanism analyses indicate that the positive brothers' effect is arising from spillovers of parental investments on boys. The implication of these results is that adolescents with a greater share of sisters rather than brothers could suffer from parental under-investment and end up with less human capital. These results could inform households and policymakers, help them make more equitable investment decisions, and design policies that could improve adolescents' human capital outcomes.

The second empirical chapter contributes to the debate on whether conditional or unconditional cash transfers are better policy tools to fight poverty by investigating their effects on important but less studied outcomes—social capital and voting. The results show that while conditional cash transfer increases social capital, mainly among beneficiaries with reciprocal beliefs, both transfers reduce the likelihood of voting. Since the conditional cash transfer program positively affects social capital, policymakers may be better off adopting the conditional model than the unconditional one. Additionally, the results with regards to voting could alarm stakeholders such as NGOs and local politicians to investigate further why the two transfers reduce the likelihood of voting and undertake corrective measures.

Otherwise, the transfer programs could have grave consequences on the democratization efforts in Africa.

Lastly, the third empirical chapter enables us to understand the demand-side constraints to information seeking among smallholder farmers. The chapter makes a novel contribution to the literature by showing the extent of overconfidence among farmers and its relationship to information seeking. It also contributes to our understanding of the effects of trust and quality in driving information seeking. The chapter shows that overconfidence is widespread among farmers and that it predicts less information seeking. Moreover, farmers seek more information when they perceive the source as high quality. The results could serve both farmers and agricultural extension service providers to improve the uptake of agricultural information.

The insights from these chapters will be of interest to researchers, policymakers, individuals, households, and NGOs and hence require dissemination. Thus far, two of the chapters have been presented at conferences. For example, chapter 2 has been presented at the weekly seminar of UNICEF Office of Research-Innocenti, Florence, Italy. Chapter 4 has been presented at the UNU-MERIT internal conference, Maastricht University, The Netherlands. This paper has also been submitted to the Economic Development and Cultural Change journal and is accepted for publication. Currently, chapters 2 and 3 are ready to be submitted to peer-reviewed journals.

ABOUT THE AUTHOR

Hiwot Mekonnen Mesfin holds an MSc. in Rural Development from Ghent (Belgium) and Humboldt (Berlin, Germany) Universities and a BSc. in Agricultural Economics from Haramaya University, Ethiopia. Before starting her Ph.D., she worked as a Lecturer and Head of the Agribusiness Program at the School of Agricultural Economics and Agribusiness, Haramaya University, Ethiopia. Broadly, her research interests revolve around understanding the dissemination of knowledge and innovation, human and social capital formation, behavioral sciences, and evaluation of programs and policies.

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