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Economic and Intergenerational Decision-Making in Families

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To Santiago

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Contents

Introduction

Understanding economic decision-making within the family, household and close social environment is crucial to analyze societies and economies as a whole. In these micro-level units of analysis, individuals often make decisions on the use and allocation of resources that involve multiple generations, such as human capital investments, bequests or other transfers. The intergenerational nature of these choices implies a high relevance for public policy for both low- and high-income contexts, because it can shape important outcomes such as social mobility and inequality.

For instance, in the developing country context characterized by weak public institutions, children may experience sub-optimal educational inputs and outcomes, because parents' decision-making on human capital investments are financially and socially constrained by poverty, unequal decision powers between genders and imperfect information (Baland & Ziparo, 2017).

Bequests, another form of intergenerational transfers within the family, have gained renewed attention in developed countries, where socio-economic inequality over generations is increasing over time (Piketty & Saez, 2014; Adermon *et al.*, 2018). The optimal design of redistributive policies, such as an intergenerational wealth tax, warrants a detailed understanding of how families transfer wealth over generations and which behavioral responses might occur.

In both examples, the economic outcomes that are of interest from a policy-maker's perspective, are observed at the family or household level. They represent an array of underlying individual preferences, decision powers and information asymmetries. To open this complex black box of determinants of household decision-making is empirically challenging. My dissertation, which contains three stand-alone chapters, uses multiple empirical methodologies, ranging from experimental to structural approaches, to study economic and intergenerational choices within families and social networks in important decision domains. Consequently, these methods require different type of data sources. For chapters one and three, I have designed

and conducted household surveys and economic experiments with families in Tanzania. In chapter three, we make use of rich Swedish administrative data on individual characteristics, wealth and bequests.

In the first chapter, "Parental Decision-Making and Educational Investments: Experimental Evidence from Tanzania", I show that differences in decision power between spouses have significant negative implications for educational investments on children. In a recent review of the literature on household decision-making in low-income countries Baland & Ziparo (2017) note that "in developing countries, very little research is being done on the implications of strategic behavior during marriage for large irreversible decisions, such as child education". To shed light on this issue, I conducted a lab-in-the-field experiment with parents at their children's primary schools in urban Tanzania. It tests whether mothers avoid bargaining with their more powerful spouses, thereby sacrificing the ability to finance expensive educational inputs through income pooling. Mothers and fathers separately participated in an economic experiment, in which they were asked to allocate money between a cash payout and a voucher for school materials. Additionally, each parent could make the decision individually or jointly with the spouse. The experiment randomly varied how much couples could gain by deciding jointly on the allocation (through changes in the joint budget size), making it less or more attractive to enter a bargaining process with the spouse. The experiment was incentivized, meaning that depending on the parents' choices, the household received money in cash or could order school materials for their child, which were delivered on the following school day.

I find that parents strategically react to higher levels of the treatment (the return to deciding jointly) by cooperating more, but mothers in particular continue to avoid bargaining and sacrifice on average 5.8% of voucher value by investing inefficiently. I show that these results are driven by mothers with low empowerment, who believe their spouses disagree with their preferred allocations. In essence, unequal gender decision powers trigger strategic choices to shield financial resources from the control of the spouse and by doing so lead to an inability to realize household economies of scale.

After the redemption of the voucher for school materials, children of noncooperative parents achieve significantly lower test scores five months after the experiment, implying a negative intergenerational externality of parents' decisions. In particular, cooperative parents are able to achieve large investments in the form of textbooks, which have substantial impacts on grades. The findings of the paper also shed light on the emergence of alternative strategies of mothers to finance educational goods, such as informal saving groups or hiding income (Anderson & Baland, 2002; Ashraf, 2009).

In the second chapter, "Behavioral Responses and Design of Bequest Taxation" (joint with Maksym Khomenko), we study individual bequest preferences to inform on the optimal design of an intergenerational wealth tax, commonly represented by either inheritance or estate taxation. This type of taxation is in the center of active policy debates. On the one hand, it is argued to be a tax that causes relatively small distortions (Economist, 2017). It is also viewed to be an important policy tool against intergenerational inequality (Piketty, 2011). Depending on the tax design, old-age individuals can react with a number of responses, ranging from adjustments of wealth accumulation and inter-vivos gifts to changes in the distribution of inheritances among heirs. Although this complexity highlights the importance of the design of the bequest tax, the identification of several dimensions of individual preferences that determine bequest decisions is problematic (Lockwood, 2012, 2018). Therefore, we leverage the unique and appropriate setup of Swedish inheritance taxation and rich administrative data on bequests and the behavior of old-age individuals that allow us to overcome these issues. To understand individual behavior under various tax schemes, we estimate a comprehensive empirical structural model that captures several dimensions of individual responses, namely wealth accumulation and bequest allocation. More precisely, we exploit institutional features that allow individuals with specific family structures to fully avoid the inheritance tax by redistributing bequests over multiple generations. The presence of this subgroup, whose decisions should not be affected by

the inheritance tax, allow recovering pure bequest preferences separately from other parameters that guide the choice of the wealth accumulation process. Furthermore, the availability of a generous social security system for the elderly allows overcoming another identification problem associated with the presence of precautionary savings (Ameriks *et al.*, 2020). The estimates of the model allow decomposing the determinants of wealth accumulation and a bequest distribution and, shed light on the design of the bequest tax. We find that comparable inheritance and estate taxes result in similar distortions to wealth accumulation and bequest distribution. By limiting strategic avoidance through adjustments in bequest distributions, estate taxation outperforms inheritance taxes in terms of tax revenues. Our model enables policymakers to design a bequest tax that balances distortions, progressiveness, tax revenue and tax incidence according to the chosen social welfare function.

The third chapter of the thesis, "Distributional Preferences in Adolescent Peer Networks" (joint with Yonas Alem, Martin G. Kocher, Fredrik Carlsson and Mikael Lindahl), studies distributional ("social") preferences in adolescent peer networks. These preferences measure how other's material payoffs feature in an individual's utility function and are behaviorally important for economic decision-making of individuals and groups alike. We collect network data on friendship links of 12-13 years old students in three Tanzanian public primary schools. Using incentivized choices between allocations for themselves and a passive agent, children are classified into efficiency-loving, inequality-loving, inequality-averse, and spiteful types. We find children of similar types to be more likely to exhibit friendships ties, and friends' preferences are aligned in 32% of cases. Further, conditional on being friends, types are significantly correlated. These relationships among peers are almost completely driven by inequality-loving and spiteful types. Further analyses suggest that preference peer networks are mostly driven by selection into the network and, to a smaller degree, by transmission. The role of peer networks in explaining distributional preferences goes beyond composition. A low rank in academic performance and a central position within

the network relate positively to spiteful behavior, suggesting a differential relevance of these types of social hierarchies. Empirical evidence for preference peer networks is important to explain heterogeneity in distributional preferences and the selection into friendship and professional networks, as well as into political initiatives later in life.

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Chapter I

Parental Decision-Making and Educational Investments: Experimental Evidence from Tanzania

Simon Schürz

Abstract

This paper shows that differences in decision power between spouses have significant implications for educational investments in children. I conducted a lab-in-the-field experiment with parents to test whether mothers avoid bargaining with their more powerful spouses, thereby sacrificing the ability to finance expensive educational inputs through income pooling. Mothers and fathers were asked to allocate money between a cash payout and a voucher for school materials. Additionally, each parent could make the decision individually or jointly with the spouse. The experiment randomly varied how much couples could gain by deciding jointly on the allocation. Parents strategically react to higher levels of this treatment by cooperating more, but mothers in particular continue to avoid bargaining and sacrifice on average 5.8% of voucher value by investing inefficiently. I show that these results are driven by mothers with low empowerment, who believe their spouses disagree with their preferred allocations. After the redemption of the voucher for school materials children of noncooperative parents achieve significantly lower test scores five months after the experiment, implying a negative intergenerational externality of parents' decisions. The findings of the paper also shed light on the emergence of alternative strategies of mothers to finance educational goods, such as informal saving groups or hiding of income.

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1. Introduction

Spouses are often required to reach collective economic decisions for the household but may disagree or hold unequal decision-making power. In low-income contexts, household efficiency in the outcomes of such preference aggregation has been rejected for several decision domains, such as risk-sharing (Dercon & Krishnan, 2000; Doss, 2001; Robinson, 2012), task specialization (Udry, 1996) and income pooling and savings (Anderson & Baland, 2002; Ashraf, 2009; Schaner, 2015).[1] Why spouses often appear unable to cooperate in their decision-making to achieve optimal outcomes is poorly understood. One explanation for some of these findings is that women try to avoid bargaining with their more powerful spouses to shield their financial resources. Instead, they seek alternative strategies to individually finance expensive durable or indivisible goods outside the core household, such as through income hiding (Ashraf, 2009; Castilla, 2019) or informal saving groups (Anderson & Baland, 2002), thereby sacrificing potential gains from income pooling and coordination of expenditures with their spouses.

Educational investment in children is one of the most crucial domains of decision-making affected by this behavior. Mothers frequently disagree with their spouses about such investments (Thomas, 1990; Hoddinott & Haddad, 1995; Lundberg *et al.*, 1997; Duflo, 2012) and attempt to finance them outside the family. For example, (Anderson & Baland, 2002, p.968) report that in Kenya many women join informal rotating savings and credit associations (ROSCAs), which feature objectives such as "to help poor women to educate their children" and to make "buying books, uniforms and paying school fees for our school children" the first priority.[2] (Castilla, 2018,

[1] For early and recent reviews of intra-household conflict and decision-making in the developing world see Bruce (1989) and Baland & Ziparo (2017), respectively. In high-income contexts, Mazzocco (2007) and Browning *et al.* (1994) reject the idea of the household as a unitary decision-maker using US and Canadian consumer data, but efficiency is not readily rejected.

[2] The literature on the economics of ROSCAs was the first to highlight the importance of within-household income pooling in developing countries: providing greater access to household durables and large, indivisible goods. Besley *et al.* (1993) view ROSCAs as a

p.4) finds evidence that "women [in India] may be willing to incur costs to maintain control over money fearing their partners would not allocate the money towards children investments."[3] The inability to pool resources within the household to achieve human capital investments, such as expensive school materials or tuition fees, is particularly harmful in developing countries where both governments and private households are extremely financially constrained. If poor households invest their financial resources in education suboptimally, low human capital accumulation can perpetuate poverty and hinder growth.

This paper studies whether parents fail to cooperate when making decisions on educational investments and tests whether low female empowerment and disagreement with the spouse can explain such behavior. Using a novel experimental design, I analyze parental decisions to invest in school materials for primary schoolchildren in urban Tanzania. In this low-income context, gains from the joint management of financial resources are potentially large, as access to formal savings and credit products is scarce and individual incomes often do not suffice to finance expensive, indivisible educational inputs, such as textbooks.[4] If a mother and father agree on the investment and pool their individual incomes, they may be able to afford these large educational expenditures without any need for individual saving. However, parents often disagree and decide not to jointly allocate money to education (Anderson & Baland, 2002; Castilla, 2018). Mothers may have a higher preference for their children's education than fathers but carry less

joint saving device formed by households that cannot finance these goods through autarkic saving. Anderson & Baland (2002) document that up to 84% of ROSCA participants in Kenya are women, who take part despite the Pareto-inefficient nature of these saving groups. They relate intra-household conflict and ROSCA membership through the inability of spouses to agree to save for the purchase of indivisible goods.

[3]Studying the extended family, Angelucci *et al.* (2017) document that well-connected and resource pooling family networks are able to increase human capital investment when some of their members receive cash transfers. Jakiela & Ozier (2016) show that households in Kenya invest inefficiently to keep earnings secret from their kin.

[4]In Tanzania, only 2.1% of children in the public primary school system own math and reading textbooks (SACMEQ, 2011). We surveyed a subsample of 291 students to confirm these statistics for the study sample. Only 4.5% and 5.8% of students reported to possess mathematics and Swahili textbooks, respectively.

weight in household decisions. If these inequalities are too strong, such that the father can enforce an allocation according to his preference in spousal bargaining, the mother would be worse off by contributing to a joint household budget. Her second best option is then to ex ante withdraw from bargaining and to individually invest in cheaper educational inputs or to use costly strategies to transfer income to the next period.[5]

I set up a simple noncooperative model that formalizes these hypotheses and illustrates why mothers may not be able to efficiently invest in their children's education together with their spouses. The theoretical model generates a set of testable predictions to guide my empirical analysis, for which I collected detailed data on parental decision-making using a lab-in-the-field experiment in Dar es Salaam, Tanzania. In early 2018, 362 parental couples participated in experimental sessions at their child's public primary schools. First, mothers and fathers separately allocated a TZS 8,000 (US$3.60) budget between a cash payout and a voucher for school materials.[6] Then, parents chose to either realize that individual decision or make for a joint allocation with the spouse instead. In the latter case, the joint budget was varied by five within-subject treatments with increases up to 37.5%, mimicking the potential benefits of pooling financial resources. One treatment was randomly drawn for payout, which enables the experiment to overcome an important empirical challenge: a household's benefit from cooperative decision-making on educational investments is generally unobserved and may be endogenous to unobserved family heterogeneity. If a parent chose to jointly allocate for the treatment selected for payout, the couple needed to consult and discuss their preferred split. Otherwise the individual allocation was realized. While cash was paid out directly to the family in equal shares, money allocated to the voucher was doubled and could be used to purchase textbooks and other school materials.

[5]These strategies could range from participating in no-interest informal saving groups such as ROSCAs Anderson & Baland (2002) to hiding income from the husband (Ashraf, 2009) or engaging in in-kind credits (Goetz & Gupta, 1996).

[6]Exchange rate: US$1 = TZS 2,230 (December 2017).

To account for spousal disagreement, belief about the spouse's preference was elicited using an additional cash incentive. This individual-level measure of perceived preference difference reflects the information a parent has when making the decision whether to pool resources with the spouse prior to eventual bargaining. Mothers also participated in a short experiment to measure female empowerment. I use a choice list design that captures women's empowerment via willingness to pay to control resources within the household (Almås *et al.*, 2018) and accompany it with a more conventional empowerment index based on survey questions.

The first prediction of the theoretical model is that the higher the benefit of pooling incomes for educational investments, the lower the likelihood that parents avoid managing financial resources together with their spouses." Those who do invest in education inefficiently, sacrifice additional educational returns by being unable to finance large cost-effective investments. Consistent with this prediction, I find that in my experimental sample, more parents choose to allocate a joint budget if the treatment, which varies the size of the joint budget, increases. Particularly mothers react strongly and strategically by increasing the likelihood of joint decision-making by 0.13 for a 1% higher treatment. Up to 59% of parents in the sample avoided a joint decision at least once, showing that this behavior is widespread. Parents who avoided bargaining with the spouse on average gave up 4.7% additional voucher value, which translated into an average loss of TZS 1,520 (US$0.70) to the child. Mothers' losses were significantly higher than those of fathers (5.75%, diff. $p < 0.000$), suggesting that inferior bargaining power may play an important role.

Second, subjective disagreement and differences in decision-making power between spouses are predicted to negatively affect the likelihood of joint decision-making. The intuition behind this underlying mechanism is that a mother may fear being overpowered in the bargaining process, because she has little decision power and prefers a different allocation than her husband does. Experimental results confirm that parents with a one standard deviation higher belief of disagreement with the spouse are 7.1% more likely to

sacrifice voucher value. Female decision power has a similarly strong negative impact of –4.4% per standard deviation. Because of endogenous marital matching, these estimates could be biased due to unobserved household heterogeneity, which would allow for alternative explanations other than those brought forward by my theoretical framework. I leverage the within-subject design of the experiment to alleviate this concern. Using multiple decisions per parent and per couple, I implement a household fixed effects estimator and confirm the impact of both variables of interest. I find evidence for assortative matching of couples, which likely introduces upward bias in the ordinary least squares (OLS) estimates.

Finally, the model predicts that, if the joint management of resources allows for investments with higher returns, pooling incomes should have meaningful consequences for children's school outcomes. To test this hypothesis, I relate the value of educational vouchers to administrative school grades before and after the experiment. Larger voucher payouts imply the possibility of receiving more and effective school materials and are directly related to sizable improvements in the children's test scores five months after the study. An additional US dollar of voucher value increases grades by 0.5%. Next, I decompose the voucher value into parts related to individual preferences and gains from cooperation through the treatments on the joint budget. The fraction earned by the latter yields an even larger improvement of 1.4% per US dollar. One potential reason for this high coefficient, supported by evidence for large subject-specific impacts of textbooks, is that parents who decide jointly are more likely to earn vouchers large enough to afford one or multiple books. Textbooks are also likely to generate positive spillover effects, as students reported sharing them with their friends for co-studying. School outcomes for girls are particularly dependent on cooperative parental decision-making, which implies the presence of gender bias in household decisions.

Additionally, I find that uncertainty about the spouse's preference, proxied by the accuracy of beliefs elicited in the experiment, reinforces noncooperative behavior. The experimental data show that only 38.7% of parents

correctly predict their spouses' preferences for the educational voucher and that accuracy of beliefs decreases with actual disagreement.

My results suggest that women's fear of losing allocative control over their income leads them to make educational investments without consulting their husbands, even if this means that they are using an inefficient investment strategy. I find that observed behavior in the experiment predicts mothers' involvement with alternative strategies to finance human capital investments outside of the household. Withdrawing from joint management of financial resources with the spouse is positively correlated with female participation rates in ROSCAs. However, if income is hidden or saved informally, potential gains from pooling incomes and coordinating expenses are lost. The experiment does not allow me to address the question of how these alternative strategies of women may remediate for the lower voucher values of noncooperative couples. Although these strategies reestablish the possibility of making bulky and expensive investments, they carry significant costs as a result of forgone interest income and the effort to hide income (Besley *et al.*, 1993; Anderson & Baland, 2002; Ashraf, 2009).

This paper contributes to the literature on household decision-making mainly by highlighting the prevalence, determinants and consequences of noncooperative behavior in a crucial decision domain that can result in significant and negative intergenerational externalities: investments on children's education. In a recent overview of the literature on intra-household bargaining in poor countries, (Baland & Ziparo, 2017, p.10) state that "in developing countries, very little research is being done on the implications of strategic behavior during marriage for large irreversible decisions, such as child education." I provide evidence for noncooperative parental decisions that can help explain existing suboptimal levels of school inputs, delays in educational outcomes (Heyneman *et al.*, 1981; Lockheed & Hanushek, 1988; Glewwe *et al.*, 2011; Bold *et al.*, 2018) and persistent poverty in low-income contexts.[7] Importantly, uncovering whether and why women withdraw from

[7]In a related study, Ringdal & Sjursen (2016) attempt to experimentally increase educational investments by inducing a change in bargaining power in a similar context, but they don't not find any significant impact.

joint management of financial resources sheds light on the emergence of second best strategies of women to invest in their children's human capital in developing countries. This applies in particular to membership in informal saving groups (Anderson & Baland, 2002; Luengas-Sierra, 2018) and income hiding (Ashraf, 2009; Baland *et al.*, 2011; Castilla & Walker, 2013). The behavior of parents regarding the joint management of resources that are uncovered in this paper may not be limited to the low-income context of the study, as preference heterogeneity and unequal distribution of the "power of the purse" are similarly prevalent for couples of some social classes in high-income settings (Kenney, 2006).

By estimating the impact of unequal decision power and disagreement between spouses on the quality of household decisions, the paper also contributes to a larger literature that attempts to identify the key determinants of household efficiency. Iversen *et al.* (2011) and Mani (2019) document that spouses do not realize efficiency gains in public good games in Uganda and India. They show that increased control over the allocation and assortative matching on observable characteristics has a positive impact on contribution levels. Ashraf (2009) explores the importance of information and communication in spousal resource allocation in the Philippines. In particular, she observes that spouses who do not control the financial decisions in the household are more likely to use resources for their own benefit, when they are not obligated to communicate with the partner and when choices are private. Schaner (2015) documents that households sacrifice returns to savings. In her sample from Kenya, couples whose discount factors differ avoid joint saving accounts even if they provide higher interest. Almås *et al.* (2018) use an experiment to show that women in Macedonia forgo substantial amounts of money to gain control over windfall income in the household. My paper extends this literature and suggests that these determinants can lead to a complete withdrawal of spouses from the bargaining process. The household fixed effect specification improves the identification of the impact of decision powers and spousal disagreement by removing confounders at the

household level and quantifying the statistical bias that arises from the use of endogenous couple-level characteristics as explanatory variables.

The key drivers of noncooperative parental decision-making that this paper uncovers have important policy implications. Besides highlighting the importance of empowering women within the household, there is a large scope for targeting women to improve educational outcomes of children via their second-best strategies. For instance, offering accessible formal saving opportunities to women gives them the chance to safeguard their income against their husbands' control. Prina (2015) shows that provision of formal saving accounts to female household heads in Nepal resulted in a shift in expenditure toward educational goods. Ashraf *et al.* (2010) find that women with low decision-making power were able to increase household spending in their preferred durable goods, when they received access to formal commitment saving devices. Aker *et al.* (2016) provide tentative evidence that the introduction of mobile payment accounts to women in Niger allowed them to alter the household's expenditure pattern by concealing income from the partner's reach. Furthermore, my findings suggest that some parents avoid bargaining because of high uncertainty about their spouses' preferences. Given the low frequency of these investment decisions, reducing asymmetric information between partners through communication interventions such as parent-teacher meetings at the school could foster cooperation.

The remainder of the paper proceeds as follows. Section 2 sets up the theoretical framework that guides the empirical analysis. Section 3 discusses the study context, data, and sample selection. Section 4 describes the experimental design, and Section 5 reports the main results. Section 6 relates additional findings and Section 7 presents robustness checks. Section 8 concludes.

2. Theoretical Framework

To illustrate how parental decision-making can affect educational investment through gains from income pooling, I set up a simple noncooperative model

that expands the classic collective household model (Browning *et al.*, 1994; Browning & Chiappori, 1998) with an option for parents to opt in or out of bargaining at a prior stage. The model exemplifies mothers' trade-off between the ability to achieve large, cost-effective educational investments together with their husbands and the fear of losing allocative control over their income shares. The aim is to derive a number of predictions that can be tested using data from the lab-in-the-field experiment.

2.1. Decision Structure

Consider a core household consisting of a father f, a mother m and one child, in which each parent has a utility function u over a public consumption good c and the child's human capital h. Father and mother may differ in their preference for education relative to consumption ϕ. The utility function $u_i(c, \phi_i, h)$ with $i = \{f, m\}$ is continuous, increasing, concave and additive in its inputs. Human capital h is produced by cheap and small (b) and expensive and indivisible (B) school materials, hereafter referred to as pens and textbooks for simplicity. The price of a textbook is normalized to 1, while pens and the consumption good can both be bought at a cheaper price $p < 1$. Textbooks are assumed to be a more cost-effective educational input than pens. This means that the return on a textbook is higher than the return on the number of pens that could be bought at the same price.[8] Equation (1) shows this difference in returns and denotes it by λ:

$$\frac{\partial h}{\partial B} - \frac{\partial h}{\partial b} \cdot \frac{1}{p} = \lambda > 0 \tag{1}$$

[8]Textbooks are argued to be particularly cost-effective educational investments in developing countries (Heyneman *et al.*, 1981; Lockheed & Hanushek, 1988; Fuller & Clarke, 1994). This simplifying assumption can be motivated by several arguments. For instance, the two inputs are arguably complements in human capital production. This means that textbooks increase the marginal product of pens and vice versa. On the extensive margin, access to a textbook generates higher returns than pens on the intensive margin at equal expenditure. Focusing on the extensive margin reflects the fact that textbooks are subject specific and the curriculum is designed for only one book per subject. Alternatively, differences in marginal products of the two inputs could also arise if the marginal product of pens decreases faster than that of textbooks.

Each parent receives a private income y, which can be allocated between a public consumption good c and human capital investments $\{b, B\}$. The price of a textbook exceeds individual income, $1 > y$, and thus one parent's financial resources alone are not sufficient to purchase it. The budget constraint therefore limits an individual parent's choice to purchasing pens and the consumption good.

Mothers and fathers can always choose to individually spend their income according to their individual preferences. Once realized, the chosen allocation is revealed to the spouse. For instance, a mother can use her income to buy consumption goods and pens without first consulting her husband. The father also gains utility from the mother's use of resources through consumption and human capital investment, but cannot interfere in the allocation decision. The static nature model implies that income cannot be transferred to a future period by saving or hiding resources from the partner.[9]

Alternatively parents may consult and manage the money together with their spouses instead of deciding individually on the allocation of their income. In this case, the income enters the joint household budget irreversibly and is subject to a joint decision-making process. Irreversibility implies that once a spouse with higher decision-making power has learned about the other spouse's income, the spouse with less power cannot regain full control over it. If both parents combine their income, the joint household budget is large enough to potentially purchase the expensive, indivisible input — that is, the textbook: $y_f + y_m > 1$. For the joint budget allocation, parents realize the outcome of the collective decision model (Browning *et al.*, 1994; Browning & Chiappori, 1998). This means that parents' utility functions enter the household welfare function with gender-specific decision weights τ to determine a Pareto-efficient allocation of resources. The timeline of the decision-making process outlined above can be summarized in three simple steps:

[9]Section 2.4 discusses the rationale behind the public nature of the consumption good, the assumption of borrowing constraints and to what extent this assumption can be relaxed.

1. The mother and the father simultaneously receive their private income. Each one of them decides whether to combine the income in a joint household budget, denoted by action $J_i = \{0, 1\}$ for $i = \{f, m\}$. Pooled income enters the household budget irreversibly.

2a. Parents who prefer to individually decide on the allocation of their income make their choice between consumption and human capital investments.

2b. Parents who bring their income to the joint household budget jointly allocate it through collective bargaining.

3. Allocations are revealed in the household.

2.2. Equilibrium Strategies

For simplicity, the decision-making problem in this subsection is considered from the mother's point of view. Fathers face identical choices. A woman's optimal decision whether to choose to use her personal money individually or jointly with her spouse is determined by weighing the expected utility of the two alternatives. In other words, backward induction is used to inform the decision at step (1) by first solving optimization problems at steps (2a) and (2b).

Individually (step 2a), the mother maximizes utility subject to the budget constraint, resulting in an optimal individual allocation x'_m. Consumption and education in the household are public, such that the mother would receive utility $u_m(x'_m, x_f)$ from her own and the father's allocations. Note that purchasing a textbook does not satisfy the budget constraint of the individual maximization:

$$x'_m = \underset{\substack{c,b \\ \text{s. t. } y=p(c+b)}}{\text{argmax}} \quad u_m \tag{2}$$

If the mother brings her money to the joint household budget (step 2b), she needs to agree with her spouse on how to allocate it.[10] Therefore, the joint utility maximization in the collective model, subject to the budget constraint, defines the joint allocation x'' in the joint budget:

$$x'' = \underset{\substack{c,b,B \\ \text{s. t. } y''=p(c+b)+B}}{\text{argmax}} \quad \tau u_m + (1-\tau)u_f \tag{3}$$

Vector x'' is a function of the preferences (ϕ) and the gender-specific decision weights (τ for the mother and $(1-\tau)$ for the father). The allocation crucially depends on whether the joint budget y'' includes one or both parental incomes y_m and y_f.[11] $u_m(x'')$ denotes the utility that the mother would derive from the joint allocation vector through the lens of her own utility function.

Ex ante, this utility level is uncertain for two reasons. First, it is subject to the mother's belief about the father's preference for human capital investment ϕ_f relative to consumption. The true value of ϕ_f will only be revealed in the bargaining process to allocate a joint household budget. Second, in this simple framework, bringing her money to a joint household budget benefits the mother only if the father does so as well.[12] Therefore, the mother compares the expected utility from individual and joint allocations and decides for or against adding her income to the joint household budget. The best response function of a mother is then given by

[10] Section 2.4 discusses the possibility that repeated interactions might affect collective bargaining at this point.

[11] $x''_{fm} = x''(y_m + y_f) = \{c'', b'', B''\}$ allows for the purchase of a textbook, while $x''(y_m) = x''(y_f) = \{c'', b''\}$ does not.

[12] Pooling incomes to have a large enough budget to afford investments is not the only benefit of joint resource management in poor households. Other benefits of income pooling include the coordination of expenses and information and the mutual use of savings technologies.

$$J_m^* = \begin{cases} 1 \quad if \quad \overbrace{J_f \cdot E_m\left[u_m(x''_{fm})\right] + (1-J_f)\cdot E_m\left[u_m(x''_m, x'_f)\right]}^{\text{E(U) of pooling}} \\ \qquad\qquad > \overbrace{(1-J_f)\cdot E_m\left[u_m(x'_m, x'_f)\right] + J_f \cdot E_m\left[u_m(x'_m, x''_f)\right]}^{\text{E(U) from nonpooling}} \\ 0 \qquad otherwise \end{cases} \tag{4}$$

Since each parent can choose between two pure strategies, the best response function takes into account all four potential payoffs, including bilateral, unilateral, and no pooling of resources. Although parents can theoretically play mixed strategies, the following analysis is restricted to pure strategies. The left-hand side of the inequality of equation (4) denotes the expected payoff if the mother opts for joint management of finances. The right-hand side captures the outcomes when she allocates money individually. The best response function increases monotonically in decision weight τ and decreases monotonically in the belief about difference in preferences for the child's human capital ϕ.

> **Proposition:** *Under the assumption of common knowledge parents play a noncooperative normal form game with two subgame perfect Nash equilibria (SPNE) in pure strategies:* $\{J_m = 0, J_f = 0\}$, $\{J_m = 1, J_f = 1\}$ *iff the necessary conditions below hold. If at least one condition is violated, parents play a normal form game with a unique SPNE without pooled incomes* $\{J_m = 0, J_f = 0\}$.[13]

[13] See Appendix Section D for proof.

a. The purchase of the indivisible goods is valuable: $\lambda > 0$.

b. At least one parent prefers to purchase B, i.e. λ and preference ϕ_i are sufficiently large.

c. Differences in preferences (ϕ) and gender decision weights (τ) are sufficiently close to zero.

d. The uncertainty about the spouse's preference is sufficiently small.

To characterize the two SPNE normatively, I set them in relation to a benchmark case in which both parents' utilities enter bargaining with equal weights $\{J_m = 1, J_f = 1.\ \tau = 1/2\}$. Compared with the *individual* SPNE, this benchmark gives parents the chance to reap all additional returns related to textbooks, while ensuring that neither of them has to fear the loss of allocative control over his or her income share. Educational investment under the benchmark is denoted by (B', b').

First, I consider the potential return rate to educational investment. The loss in ex-ante return rate (ex-ante of bargaining) in the two SPNE compared with the benchmark strategy is a function of whether income was pooled and of which share of the educational investments goes to the textbook as opposed to pens.[14] The return rate loss measures the additional return to investing in education efficiently through income pooling:

$$\textit{return rate loss} = \begin{cases} \frac{\lambda \cdot B'}{p \cdot b' + B'} & \text{if couple does not pool income} \\ 0 & \text{if couple pools income} \end{cases} \tag{5}$$

Comparing the ex-post return loss (after bargaining) with the benchmark, the *individual* SPNE fares weakly worse than the benchmark. The outcome for the *joint* SPNE is ambiguous, depending on the investment

[14]This definition of return rate loss allows for the benchmark to be a Pareto-efficient outcome, because the return rates of the *joint* SPNE $\{J_m = 0, J_f = 0\}$ and the benchmark coincide.

resulting from bargaining (B'', b''). For instance, even if income pooling potentially allows for additional returns to investment through the purchase of large inputs, the father could force an allocation with significantly smaller investment. On the other hand, if the father has a higher preference for education than the mother, the loss for educational investments can potentially turn into a gain:

$$\textit{return loss} = \begin{cases} \lambda B & \text{if couple does not pool income} \\ \lambda(B' - B'') + (b' - b'') \gtrless 0 & \text{if couple pools income} \end{cases} \tag{6}$$

2.3. Predictions

The following predictions of the model are derived directly from the necessary conditions for the SPNE and are subsequently tested empirically using individual data from a lab-in-the-field experiment.

Prediction 1: *The larger the benefits of income pooling, the more likely parents are to opt for joint decision-making. Those who avoid bargaining and joint allocation of the budget give up additional returns to educational investments.*

If pooling incomes allows parents to achieve investments with additional returns, then the higher these returns are, the more likely parents are to engage in joint decision-making. Even if mothers are reluctant to bargain with their spouses, the potential for higher gains from pooling incomes might push them toward joint decision-making to avoid losses from using an inefficient investment strategy.

Prediction 2: *The higher the level of perceived disagreement with their spouses, the greater the likelihood is that parents will avoid bargaining.*

Prediction 3: *The more unequal the decision weights of spouses, the greater the likelihood is that the less powerful parent fears losing control over her income and will avoid joint decision-making.*

These two predictions both refer to a low expected utility from joint decision-making. If parents believe that their spouses' preference for educational investments differs substantially from their own, the outcome of the collective bargaining model deviates strongly from their preferred allocation. Hence they may prefer to withdraw from joint decision-making. Similarly, if a woman's decision power is significantly lower than her husband's, she is less likely to assert her preferences in the bargaining process and may therefore choose to allocate her income individually.

Prediction 4: *Higher uncertainty about the spouse's preference for the child's human capital increases the likelihood that a risk-averse parent will be reluctant to pool incomes.*

Because of the role of uncertainty in the best response functions of parents, the quality of knowledge about the spouse's preference increases the utility of jointly managing household finances for risk-averse parents. In other words, the more uncertain the outcome of bargaining, the less likely it is that a parent will opt for it, even though this means sacrificing valuable investment in education.

2.4. Caveats

Because of its simplicity, the model has some limitations. By using a one-shot decision model in the case of income pooling, I exclude strategic interactions of parents that could arise from repeated bargaining. Although educational investment decisions in the context of this study are repeated only at yearly or half-yearly frequency, the threat of spouses retreating to an outside option in future periods is theoretically possible and can affect income pooling, as shown by Lundberg & Pollak (1993) and Browning *et al.* (2010). However, Baland & Ziparo (2017) argue that several factors limit

the ability of women in developing countries to punish their husband. Most important, traditional social norms limit or exclude the right to use outside options such as divorce or separation. Low discount rates and short time horizons due to health hazards further decrease the possibility of a spouse using punishment in repeated interactions. Domestic violence is more common in developing countries, making a credible threat potentially very costly for women (DHS, n.d.). It also theoretically possible that a woman may fear being punished by her husband once her individual allocation is revealed in the household. I regard this as unlikely for the following reasons. In the real-life context of a developing country, per-period incomes are likely to vary substantially over time and thus cannot be easily predicted by the spouse. Although the educational investment will eventually be revealed to the spouse through the human capital of the child later on, it is not necessarily directly observable by the husband and therefore may not be indicative of the mother's income.

The model restricts income pooling to a binary choice, which excludes the possibility that a parent brings only part of his or her income to the joint household budget. Without loss of generality, this simplifying assumption can be relaxed for the reason that the strategic decision-making process by the parent continues to be uniquely determined by preference, decision weights, and beliefs.

The public nature of the consumption good restricts parents' trade-off to consumption versus educational investment. This means that in the model the parents decide only how much, but not what, to consume. The public cash payout to parents in equal shares in the experimental design reflects this choice, intentionally narrowing down parents' decision space to study the research question at hand.

Finally, excluding intertemporal choices, such as individual saving or hiding of income to transfer it to the next period reflects to a large degree the realities in the context of developing countries, where there is low access to formal, efficient saving technologies, in particular for mothers. On the other hand, to the extent that Anderson & Baland (2002) and Ashraf (2009)

have documented the use of informal saving devices and hiding of income, these strategies are costly, hard to time and require, in the case of school inputs, a relatively high planning effort.

3. Sample and Data

The data collection took place in public primary schools in Ilala District, Dar es Salaam, Tanzania, at the beginning of the new school year in early 2018. The design of the experiments and the empirical strategy were registered as a preanalysis plan before beginning of the fieldwork.[15] In collaboration with the District Educational Office, I randomly chose 8 out of 112 schools for participation.[16] Public primary schools in Tanzania are tuition-free, but parents are required to cover the costs of school uniforms, books, stationery, tutoring and transport.[17,18] Invitation letters to parents were sent home with the students of grade 6 classes, ages 12 to 13, informing them about the study, a minimum participation compensation of TZS 22,000 (US$9.90) and the chance to earn more money in economic experiments, depending on their choices.[19] The only requirement to participate was that both biological parents or stepparents must attend. On average, a family earned TZS

[15] Available online at www.socialscienceregistry.org/trials/2672. Any deviations from the registered plan are discussed in Appendix E.

[16] See Figure B.1 in Appendix B for the location and spatial distribution of sample schools.

[17] Tuition fees were abolished in 2002 with the aim of increasing overall enrollment. The seven year education (standard 1–7, ages 7–14) completes compulsory schooling on the Tanzanian mainland. Net enrollment (91.4% male, 92.5% female) and completion (82.3% male, 89.8%) rates are high for Sub-Saharan Africa (Ministry of Education and Vocational Training, 2015), but the abrupt introduction of free primary education has led to a decrease in quality due to high pupil-to-teacher ratios and scarce resources (Valente, 2019).

[18] In a small fact-finding survey conducted prior to the experiments parents reported schooling expenses of TZS 97,000 (US$44) per year per enrolled child.

[19] This age group was selected because of the high importance of the year before the final examination to enter secondary school, as well as its appropriateness for a separate project for which we simultaneously ran experimental sessions with the children.

41,000 (US$18.40) from participating in the experiment. This corresponds to almost three days' worth of income of an entire household.[20]

Upon arrival at the primary school, parents were introduced to the study and instructed about data security and privacy. Subsequently, mothers and fathers were divided into separate classrooms for the economic experiments. The sessions consisted of three parts. Mothers started with an experiment to measure female empowerment, while fathers answered a household survey. After that, measures for time and distributional preferences were elicited for both parents.[21] One out of these two (for fathers) or three (for mothers) experiments was drawn randomly for payout at the end of the day. Finally, after a short break with refreshments, parents engaged in a decision-making experiment regarding the allocation and joint management of monetary resources. Any payoffs from this final task were paid out with certainty immediately after the experiments. To avoid income effects from the decision-making experiment, the timeline of the sessions was kept fixed during the entire data collection, and random payouts were drawn after all experiments had been conducted. Enumerator teams of four persons per classroom were randomly rotated between mothers' and fathers' sessions.[22] The entire experimental session took approximately three hours, including a break.

[20] Calculated from self-reported income in the household survey. This figure is equivalent to about four days' pay at minimum wage for construction workers (www.wageindicator.org/salary/minimum-wage/tanzania/.)

[21] Standard incentivized experimental choice list designs proposed by Sutter *et al.* (2013) for patience (the preference in a money earlier or later [MEL] experiment) and Kerschbamer (2015) for distributional preferences were used. These measures mainly serve in a separate research project, which investigates distributional preferences of schoolchildren, except for several regressions that use the measure for patience (MEL) as a control variable. See Appendix C.4 for a detailed description of the MEL design.

[22] Enumerators were trained PhD or master's students, who communicated all instructions in Swahili and gave clarifications privately if needed.

Table 1: Summary statistics

		By Parent		
	Households	Fathers	Mothers	
Age of parent	40.20	43.32	36.90	***
	(7.489)	(9.039)	(7.504)	***
Education (years of schooling)	7.160	7.272	7.034	
	(1.519)	(1.879)	(1.850)	
Literacy (0/1)	0.917	0.925	0.911	
	(0.232)	(0.263)	(0.285)	
Married (0/1)	0.923	|	|	
	(0.268)	|	|	
Years spent as a couple	15.57	|	|	
	(7.693)	|	|	
Household size	5.826	|	|	
	(1.893)	|	|	
Number of children in household	2.924	|	|	
	(1.373)	|	|	
Household income (monthly, US$)	209.80	|	|	
	(333.1)	|	|	
Muslim (0/1)	0.577	|	|	
	(0.478)	|	|	
Significant household debt (0/1)	0.380	|	|	
	(0.486)	|	|	
Formal savings account (0/1)	0.233	0.320	0.146	***
	(0.339)	(0.467)	(0.354)	***
Mobile payment account (0/1)	0.971	0.972	0.970	
	(0.148)	(0.164)	(0.172)	
Member of saving group (0/1)	0.428	0.457	0.399	
	(0.427)	(0.499)	(0.490)	
Alcohol (at least once a week) (0/1)	0.181	0.276	0.0856	***
	(0.311)	(0.448)	(0.280)	***
Smoke (at least once a week) (0/1)	0.0822	0.150	0.0139	***
	(0.204)	(0.358)	(0.117)	***
Observations	362	362	362	724

Notes: Standard deviations in parantheses; significance of within household difference in last column. Years of schooling is calculated as the minimum number of years to reach the highest reported completed school grade. Literacy is a dummy equal to one if a person can read and write. Results of t-tests are robust to the use of rank-sum testing. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The household survey included information on demographic family characteristics, income, and the use of saving technologies and decision-making in the household. Table 1 reports summary statistics of these observable characteristics. Most households in the sample have a low socioeconomic status and elementary educational level. Modest literacy rates and familiarity with financial technologies such as bank accounts (23.3%), mobile payment accounts (97.1%), and saving groups (43.2%) suggest that participants could understand the financial choices they faced in the experiments. Wives are on average six years younger than their husbands and less likely to have access to saving devices or to consume temptation goods such as alcohol and cigarettes.

A total of 362 parental couples participated in the experiment. The sample schools combined had 1,892 students in grade 6. Thus, the gross attendance rate of the study is 19%. An additional survey of all students in the first three participating schools shows that only 52% of students live with both biological parents.[23] If that percentage is applied to the entire sample, the eligible student body decreases to 984, and the net attendance rate then is 37%. To avoid any contamination of experimental results through communication among parents after the experiments, only one date per school class was offered for the experimental sessions. Given these restrictions, the sample is a nontrivial fraction of the target population.

In contrast to most experimental studies in the field, I am able to address the issue of sample selection using administrative school grade data available for the entire student body of the sample schools. The sample mean and standard deviation of the normalized rank of students in the final sample are almost identical to the theoretical counterparts of sampling complete

[23]This percentage is particularly high in the urban context of my study because many children are sent from rural to urban areas to live with relatives and attend school there. Other reasons include absent fathers and mothers because of work in other regions, sickness or death.

classes of that size. This suggests no selection on the school grade of the child.[24]

Additionally, I am able to use information on child characteristics of all grade 6 students for a subsample of schools (3 out of 8). Comparing the 164 participants with the 484 nonparticipants in this subsample, I find some evidence for selection on family size, in particular on the number of children, but not on religion or the children's gender (see Table A.3 in Appendix A). It is possible that both the economic incentive and the time and location of the experimental sessions particularly tended to attract families with more children. In fact, for the sample of participants, the number of children in the household is negatively correlated with income.

4. The Decision-Making Experiment

4.1. Design

To investigate whether parents cooperate when making decisions on educational investments, I use a simple decision-making experiment that reflects the essential decision process that parents undergo in the theoretical framework. For simplicity, it limits the strategic nature of the process to unilateral choices between individual and joint investment decisions. This means the trade-off between withdrawing from and entering into a bargaining process with the spouse is re-created, while allowing benefits from joint decision-making to be realized independently of whether the spouse also decides to make a joint decision. My design allows me to experimentally and randomly vary the benefit of income pooling with the spouse and overcome an important empirical challenge: The degree to which households benefit from cooperative decision-making on educational investments is generally unobserved and varies between families or is even endogenous to unobserved family heterogeneity. Imposing the return to cooperation as an experimental treatment and observing parental decisions at different levels enables me

[24] The distribution of within-class ranks of sample children is almost uniform, suggesting that there is no selection of participants on this characteristic, see Figure B.2 in the Appendix.

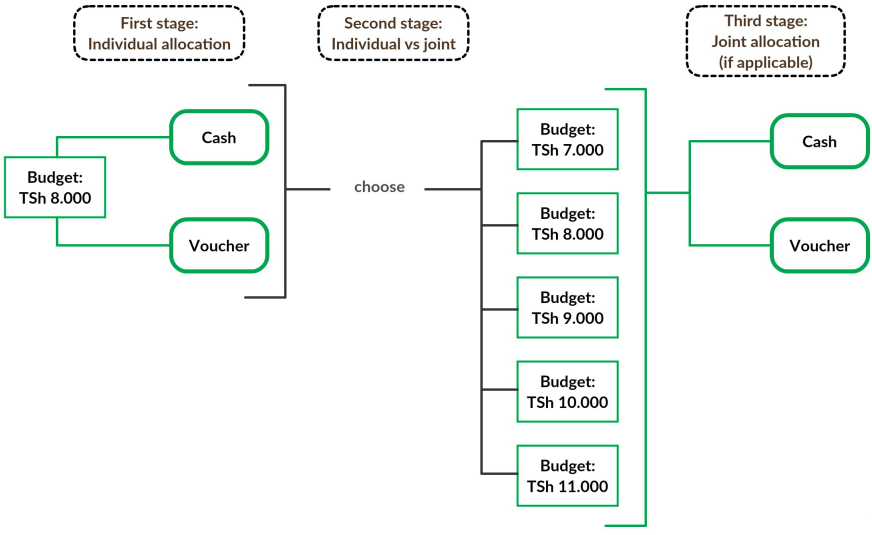


Figure 1: Experimental design

to credibly answer the following questions: Do parents fail to opt for joint decision-making even if it is beneficial to do so? Are they thereby sacrificing additional returns on educational investment?

Conducting the experiment in the field, at public primary schools, has several additional advantages. It provides the possibility of opening the black box of household decision-making by measuring fundamental underlying factors, such as preferences, decision powers, and information structure, and keeps the subject composition, choices, and payoffs as close to reality as possible. For the experiment, mothers and fathers were separated in different classrooms and randomly seated at single desks. The decision-making experiment consisted of three stages (described below), each of which was introduced in detail by the team of enumerators. Figure 1 summarizes these stages of the experimental design.

Stage 1: Individual Budget Allocation

Mothers and fathers were separately asked to indicate their preferred allocation of a budget of TZS 8,000 (US$3.60). To do so, they had to divide eight play money bills of value TZS 1,000 between a *cash* and a *voucher* basket. To make the vouchers attractive, any money allocated to the *voucher* basket was doubled.[25] Alternatively, any budget share allocated to the *cash* basket would be paid out at the end of the session. Enumerators wrote down the chosen allocation on a decision sheet that remained with the participants. Next, parents were each asked to state what they believed to be their spouse's preferred allocation. If their belief was correct, they were paid additional TZS 1,000 (US$ 0.45) in cash at the end of the session.

Parents were informed that the vouchers could be used to purchase school materials. The possibility of redeeming the vouchers for expensive textbooks (US$4.50 each) was emphasized. Enumerators would take orders for school materials for the voucher value at the end of the session and deliver them to the school the following day.[26] The range of textbooks and stationery offered for voucher redemption included all necessary grade 6 materials, and the fast delivery to the school eliminated substantial transport and transaction costs for parents.[27] Another intention of the voucher was that parents would not simply replace any existing and planned expenses that would have occurred regardless of the study. We therefore encouraged the purchase of textbooks until the remaining value was lower than the textbook price. The remaining amount should then be spent on exercise books, rulers, pencils, or pens.[28] Furthermore, the experiment took place approximately two weeks into the

[25]Without an increase in the voucher value, parents would have an incentive to opt for the cash and spend it free from any limitations that voucher redemption may introduce. The voucher was also attractive because it eliminated any transaction or transport costs for the purchase of educational materials. By controlling voucher redemption and distributing grade-6-specific textbooks and school materials, the experiment made arbitraging on the voucher choice by selling it or reallocating it to other children unlikely.

[26]Through the collaboration with the school administration and the University of Dar es Salaam parents trust between parents and the study personnel was ensured.

[27]Grade-6-specific textbooks for mathematics, Swahili, science, geography, and English are not readily available at shops outside the city center.

[28]Prior to the experiment, we confirmed with teachers that almost no students owned a textbook for any given subject and that none of them possessed the complete set for all

new school year, by which time most planned purchases of school materials had already taken place.

Stage 2: Individual versus Joint Decision

Subsequently, parents were asked to indicate whether they wanted to remain with the allocations that they had just chosen or to opt for joint budget allocation with their spouses. Choosing to remain with the individual allocation would simply mean that it would be realized with certainty. If a parent opted for a joint allocation, a new allocation would be elicited from the couple after they were reunited and allowed to discuss the choice privately. Note that this possible joint allocation was independent of the spouse's decision in his or her parallel session.[29]

Individual and joint allocations were identical with the exception that the budget size for the latter varied with treatment levels T = {-12.5, 0, 12.5, 25, 37.5}, which marks the percentage decrease and increase. A within-subject design was used, meaning that parents were asked to make a choice for each of these five treatment levels. Given the initial budget of TZS 8,000 (US$3.60), a variation in the joint budgets between TZS 7,000 and TZS 11,000 (US$3.14 and US$4.93) was introduced. This variation of the joint budget mimicked the unknown benefit (λ) from pooling incomes in the theoretical framework. The design implies that it was not beneficial to opt for joint decision-making at all levels. The decision sheet clearly stated the new budget size if parents opted for the joint decision.[30] The individual allocation was marked on the decision sheet to help parents recall the initial choice in stage 1.

subjects. We also ensured that the books we provided were compatible with the study curriculum of the school.

[29]This implies that couples could face no, one, or even two joint allocations at the end of the experiment.

[30]Choice lists for stage 1 and 2 are provided in Appendix C.1.

Stage 3: Joint Decision and Payout

The final payout was determined by randomly drawing one of the five levels for the joint budget. If a parent chose the individual option for the randomly drawn choice, the final payout would be determined from the initial individual allocation. If a parent opted for joint allocation for the drawn choice, a new allocation with the applicable budget size would be elicited from the couple. Thus, all stages of the experiment were relevant for payout and therefore incentivized participants to reveal their true preferences. The within-subject design allowed me to collect a large number of responses, while the random element alleviated the concern that the benefit of joint-decision making in a given family might be endogenous. The cash payouts were given to parents immediately in equal shares.The amount allocated to the voucher was doubled and used to order school material.

Note that both parents simultaneously and independently participated in the first two stages of the experiment. If they met to jointly allocate a budget, they did so because either one or both spouses drew a payout choice for which they opted for joint decision-making. This means they could be jointly allocating a maximum of two budgets, one from each parent. Decision-making was therefore subject to asymmetric income effects in this third stage, so the analysis in this paper is deliberately concentrated on choices in stages 1 and 2 of the experiment.

4.2. Background Results from Stage 1

The first stage of the experiment provides data on the individual budget allocations of mothers and fathers. The budget share that a parent allocated to the voucher is interpreted as the revealed preference for educational investments relative to consumption.[31] Figure 2 shows the budget shares

[31]To elicit a preference for human capital investments in this specific framing implies that families with different financial and educational backgrounds and child characteristics may differ in their choices. While I attempt to control for many of these factors by survey measures and school grades, most of the analysis in this paper focuses purely on preference differences, such that confounding factors at the household level cancel out.

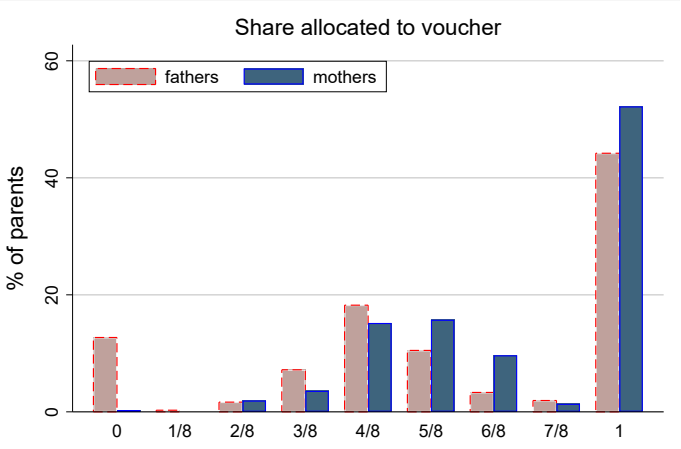


Figure 2: Parents' preferences for educational voucher

Notes: Allocation of TZS 8,000 (US$3.60) budget between cash and educational voucher. Percentages of parents by share of budget allocated to educational voucher.

allocated to the voucher separately by gender.[32] There is large variation in preferences both across and within households. Almost half of the couples opted to use the entire budget for the educational voucher, while 6.49% of parents opted for a pure cash payoff, and 45.31% allocated to both the cash and the voucher baskets.[33]

The shares allocated to the voucher by fathers and mothers are on average 0.268 apart. Mothers allocated a significantly (p-value$<$ 0.000) higher share (80%) to human capital investment than fathers (67%). The prefer-

[32] Allocations from joint decision-making, though possibly distorted by income effects, are reported in Figure B.3 in Appendix B for those participants who opted for the joint budget allocation for the randomly drawn payout. Overall, the distribution of allocations, though distorted by income effects, largely resembles the individual counterpart. Differences regarding the origin of the joint choice, either from the mother or from the father, are small and partly reflect the distortions stemming from the sometimes already realized individual allocation of the spouse (the income effect).

[33] Multiplying the amounts in the voucher basket by a factor of two clearly made it very attractive to invest in school materials. However, any lower, noninteger factor would have made the budget allocation overly complex for parents.

ence for the voucher correlates significantly with children's school grades, religion, consumption of temptation goods (alcohol, cigarettes), debt, patience (as measured by an incentivized money earlier or later [MEL] experiment), and school fixed effects.[34] There are no substantial differences in the share allocated to the voucher based on the gender of the child. In particular, neither fathers nor mothers seemed to treat children of the same sex preferentially (see Figure B.7 in Appendix B).

5. Main Results

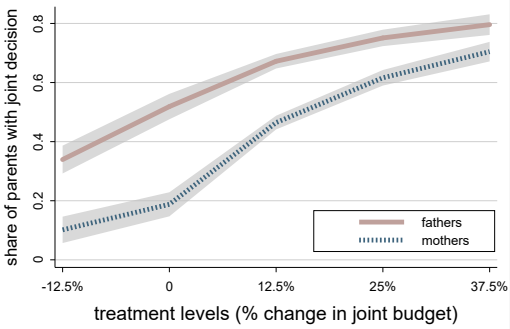
5.1. Joint Decision-Making and Voucher Losses: Testing Prediction 1

In the second stage of the experiment, parents could choose to secure their individual allocations or opt for joint management of financial resources and decide on an allocation in consultation with the spouse. At the highest treatment level, joint decision-making resulted in a budget that was up to TZS 3,000 (US$1.35) higher than with the individual allocations. If allocated entirely to the voucher basket, this additional income was worth TZS 6,000 (US$2.69). Conversely, the lowest treatment level was negative and reduced the joint budget by TZS 1,000 (US$0.45).

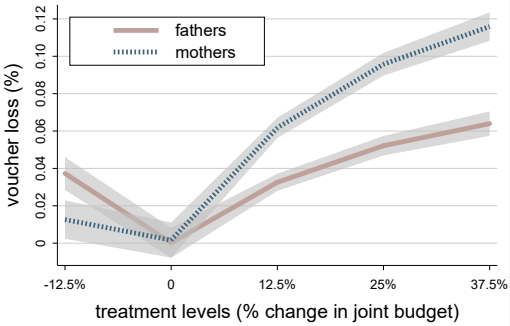
In Figure 3, I focus on how frequently mothers and fathers chose to allocate the budget jointly with their spouses. Overall, parents opted for joint decision-making in about half of the five decisions. On the extensive margin, 77.9% of participants avoided the joint budget allocation for at least one of the five treatment levels. Graph (a) shows that the share of decisions made jointly increased as the returns for doing so increased as a result of a higher joint budget.[35] Especially women, who started at a very low rate of 18% when joint management carries no benefits, strategically opted for cooperative decision-making at higher treatment levels.

[34] See Table A.5 in Appendix A for details on the correlates of the share allocated to the educational voucher.

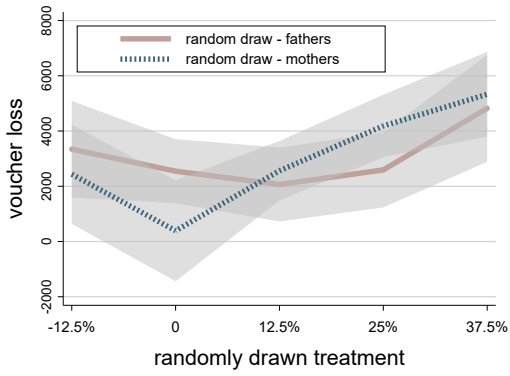
[35] See Table A.6 in Appendix A for a detailed descriptive analysis of experimental choices on joint decision-making and related losses for noncooperative parents.



(a) Percentage of parents who chose joint (with spouse) over individual decision-making. Treatment levels increased or decreased the baseline budget of TZS 8,000 (US$3.60) for joint decision-making.



(b) Voucher losses (%) from noncooperative decision-making. Treatment levels increased or decreased the baseline budget of TZS 8,000 (US$3.60) for joint decision-making.



(c) Voucher losses (TZS) at the randomly drawn treatment for payout. Treatment levels increased or decreased the baseline budget of TZS 8,000 (US$3.60) for joint decision-making.

Figure 3: Joint decision-making and voucher losses

These results are confirmed by OLS estimates in Table 2. Regressing the share of joint decisions of parents on the treatment T shows that a 1% increase in the joint budget increases the likelihood of allocating together with the spouse by 0.9% for fathers and 1.3% for mothers. These results are robust to using only the randomly drawn treatment for payout (column 2), alleviating the concern that they could be biased by an endogenous reaction to the benefit level of joint decision-making.

Next, graph (b) of Figure 3 shows what percentage of the potential voucher is lost by allocating the budget individually as opposed to jointly with the spouse:[36]

$$\text{Voucher Loss (\%)} = \begin{cases} T & \text{if} \quad T > 0, \quad S > 0, \quad J = 0 \\ |T| & \text{if} \quad T < 0, \quad S > 0, \quad J = 1 \\ 0 & \text{otherwise} \end{cases} \tag{7}$$

where S is the share of the budget allocated to the voucher. The voucher loss from investing inefficiently in education measures potential losses per share of the budget allocated to the voucher, ex ante of bargaining. When benefits of joint decision-making increase, so do the potential losses of those who avoid bargaining with the spouse. Parents sacrifice on average 4.7% of voucher value and therefore give up additional educational returns for their children. Mothers are more hesitant to include their spouses in the cash versus voucher decision ($p < 0.001$). Consequently, they experience on average a higher likelihood (+7.3%, $p < 0.001$) and magnitude (+2.3%, $p < 0.001$) of loss. In monetary terms, this noncooperative behavior translates to an average loss of TZS 599.9 (US$0.27), but at the highest treatment level, a nonpooling parent loses on average half the price of a textbook. Disaggregating the losses by treatments and gender, OLS regression coefficients in columns 3 and 4 of Table 2 confirm these results.

[36]This percentage loss is calculated under the assumption that the demand for the voucher is unit elastic with respect to the budget in the observed range TZS 7,000–TZS 11,000 (US$3.14–US$4.93). This means that a mother who prefers a fifty-fifty split for a budget of TZS 8,000 (US$ 3.60) is assumed to prefer the same division of shares for any budget from TZS 7,000 to TZS 11,000.

Table 2: Treatment (T) effects on joint decision-making and voucher losses

	Joint (0/1)		Voucher Loss (%)			Voucher Loss
	(1)	(2)	(3)	(4)		(5)
	All Choices	Random Draw	All Choices	Random Draw		Random Draw
T	0.916***	1.043***	0.0833***	0.0938**	T (Father)	1777.0
	(0.0554)	(0.134)	(0.0181)	(0.0310)		(2439.5)
T × Mother	0.375***	0.281	0.157***	0.136**	T (Mother)	6982.4**
	(0.0827)	(0.182)	(0.0271)	(0.0454)		(2368.5)
Mother (0/1)	-0.250***	-0.231***	-0.00326	0.00184		
	(0.0284)	(0.0410)	(0.00213)	(0.00522)		
Controls	Yes	Yes	Yes	Yes		Yes
Observations	3595	710	3595	710		353

Notes: This table shows the coefficients of an OLS regression of joint decision-making and voucher loss on treatment levels. Standard errors are clustered at the family level (columns 1–4) and robust (column 5). Treatment refers to the percentage decrease or increase applied to the baseline (TZS 8.000) for joint decision-making. Columns 2, 4 and 5 consider only the randomly drawn treatment for payout. Controls include demographic characteristics (income, Muslim (0/1), household size, child's school grade, parents' education) and financial knowledge (being a member of a saving group, having a savings account/mobile payment account, having debt). $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Finally, I focus on the realized voucher values for the random payout draws after bargaining, if applicable. The final voucher value that was paid out can be compared with the hypothetical benchmark, for which both parents decide jointly with the spouse without taking control over each others income share (the empirical counterpart to equation (6)). Graph (c) of Figure 3 and column 5 of Table 2 shows that drawing a one-level-higher treatment for the mother translates on average to TZS 872.8 (US$0.39) smaller vouchers for the child compared with the efficiency benchmark. The effect is increasing in the mother's preference for education. This last set of results comes with the caveat that bargaining outcomes may be biased by income effects, if one parent already realized an individual allocation before entering bargaining.

5.2. Mechanism: Predictions 2 and 3

Predictions 2 and 3 of the theoretical framework point out two main dimensions of household heterogeneity that can affect parents' likelihood of jointly managing their financial resources. Sufficiently small preference differences and decision weights are necessary conditions for the existence of the joint SPNE. I measure these variables through parents' decisions in the experimental session and test the following hypotheses in line with the model predictions:

1 When joint decisions on educational investments are valuable, parents who believe their spouse have similar preferences are more likely to enter bargaining.

2 Higher female empowerment implies more equal decision powers and therefore a higher probability of joint decision-making. To the extent that high female empowerment reduces fathers' decision power, the opposite effect is expected for men.

5.2.1 Measuring Disagreement and Decision Weights

Spouses may have different preferences for the educational voucher. When a parent decides whether to bring income into the joint household budget, he or she does so based on a subjective belief about how large the disagreement with the spouse is.

In the first stage of the main experiment, participants revealed their individual preferences for the voucher, as well as their belief about the allocation the spouse would choose. Taken together, I can use these two measures to assess both the actual and subjective preference differences between spouses. For example, from the perspective of a mother m in household h, the belief about the preference difference with her spouse f takes the following form:

$$\mathbf{disagree}_m = |\mathbf{voucher}_m - E_m\left(\mathbf{voucher}_f\right)| \tag{8}$$

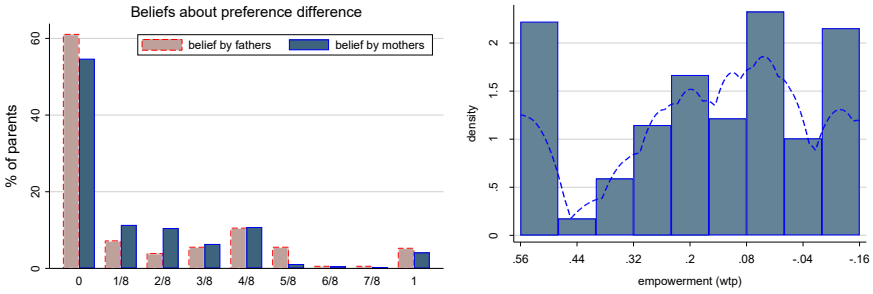


Figure 4: Parents' belief about disagreement with spouse and distribution of experimental female empowerment measure

Notes: **Left Panel:** Absolute value of the difference between the share allocated to the voucher by a parent and the belief about the share that the spouse would choose. **Right Panel:** Histogram and kernel density of the normalized willingness to pay (WTP) measure from the empowerment experiment. Low WTP corresponds to high empowerment. For a comparison of the experimental and the alternative survey-based measure for female empowerment, see Appendix C.3.

The results suggest that, on average, parents believed that their share allocated to the voucher differed by 0.18 (sd 0.27) from that of the spouse. While a large fraction of both fathers and mothers expect little disagreement with the partner, there is substantial variation across households, which represents a clear potential for intra-household conflict.

To identify a parent's decision weight in the household is empirically challenging. Instead, I proxy the mother's decision power by an experimental measure of female empowerment and allow its impact on the mother's and father's decisions to vary in sign. The theoretical framework implies that the more a mother is empowered in household decision-making, the more weight her preferences will carry in the collective allocation of income. To experimentally elicit empowerment of mothers, I follow the approach by Almås *et al.* (2018). A woman's willingness to pay to receive a cash transfer herself rather than having it go to her spouse is elicited using an incentivized choice list experiment. The idea behind this experimental measure for empowerment is that nonunitary household models, such as the

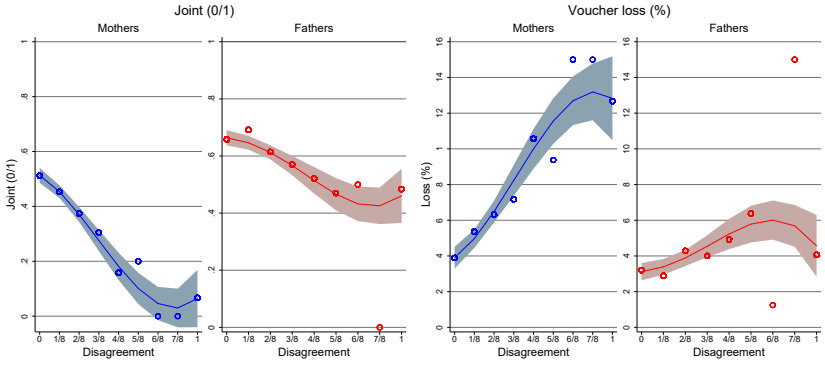
collective model, predict that less-empowered women are willing to sacrifice more money in order to control resources. The experiment highlights the "trade-off between the total amount of resources available to the household and those controlled by the participant" and shows that some mothers are "willing to pay [...] to change the [decision] weights" (Almås *et al.*, 2018, p.617).[37]

In a 10-item choice list design, the mother chooses that a certain amount of cash is paid either to the father or to herself. The amount for the father remains constant at TZS 7,500 (US$3.36), while the mother's amount decreases monotonically from TZS 8,700 (US$3.90) to TZS 3,300 (US$1.48). During the experiment, mothers were separated from their husbands and assured that their decisions would remain confidential and would not be revealed to their spouses at any point.[38] To obtain a comparable measure for empowerment from the choice list design, I use the halfway value of the transfer to the mother around the switching point and normalize it by the amount paid to the father.

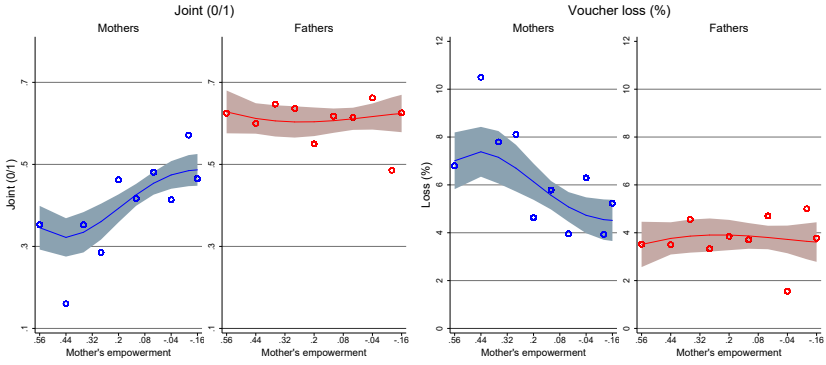
As shown in the right panel of Figure 4, around 65% of mothers are willing to sacrifice a positive amount of cash in order to gain control over the transfer. Mothers are on average willing to pay 16% of the maximum amount they could get. In comparison with the results from Macedonia by Almås *et al.* (2018), the distribution is overall similar but shows a higher frequency of large WTP and fewer individuals with negative values. This could be attributed to particularly high gender inequality in Tanzania.

[37] Conversely, in the unitary model mothers have no incentive to sacrifice resources to receive a transfer. For a detailed discussion of the measure in the context of different household decision-making models, see Almås *et al.* (2018).

[38] We did not disclose the nature of the experiment to the husbands, indicating that the payout to the mother was merely a compensation for the time spent at the study. To avoid possible appropriation of cash by the father, transfers to the mother were paid to her private mobile payment account. Mobile payment services such as M-Pesa transfer money directly between cellphones, ensuring that the mother would have full control over the transfer. To foster trust, there was at least one female enumerator in the room at all times during this experiment. Full information on payouts, but not on experimental decisions, was given to both the woman and the spouse, thereby excluding hiding motives. In case the mother drew this experiment for payout, one of the 10 rows of the choice list was chosen randomly and paid out according to the marked decision. The choice list and instructions are provided in Appendix C.2.



(a) Subjective disagreement



(b) Mother's empowerment

Figure 5: Determinants of joint decision-making and voucher loss

Notes: Y-axes depict the share of joint budget allocations (left panels) and voucher loss (right panels). X-axes denote the level of perceived disagreement (upper panels) and female empowerment (bottom panels). Graphs show fractional polynomial fit with confidence intervals and means for levels of preference difference and empowerment.

5.2.2 Heterogeneity Analysis: Disagreement and Decision Weights

Figure 5 graphically illustrates that the raw data confirm predictions 2 and 3. Joint decision-making decreases with the continuous measure of subjective disagreement. The relationship is particularly pronounced for mothers,

while fathers follow a similar, but less striking, pattern. Higher female empowerment is associated with more cooperative behavior for mothers, but there does not appear to be a comparable effect on fathers. As the lack of joint decision-making implies sacrificing benefits from potentially larger joint budgets, these relationships also hold for the previously defined measure of voucher loss (%).[39]

Next, I empirically test whether that household heterogeneity along these two dimensions represents the underlying mechanism through which noncooperative decision-making negatively affects educational investments. I start by estimating the following specification for decision l (for each of the five treatments) of parent $i \in \{f, m\}$ in household h using OLS.

$$voucher\ loss_{ihl} = \gamma_0 + \gamma_1 disagree_{ih} + \gamma_2 emp_h \cdot D_i + \pi T_{il} + X'_{ih}\eta + \epsilon_{ihl} \quad (9)$$

The dependent variable denotes the voucher loss (%) defined in equation (7). The main explanatory variables of interest *disagree* and *emp* denote the expected preference difference and the experimental female empowerment measure. To allow the proxy for gender decision weights *emp* to affect mothers and fathers differentially, it is interacted with a gender dummy D. X is a matrix of demographic, financial knowledge and individual controls, as well as school fixed effects. T is the treatment fixed effect of a given decision. Standard errors are clustered at the household level.

Estimates of coefficient γ_1 in columns 1–4 of Table 3 reveal a significant relationship between perceived disagreement and inefficient educational investments. A change of one standard deviation in the belief of preference difference for the voucher implies a 1.4% (0.18 sd) change in voucher loss. A similarly sized effect per standard deviation change in the empowerment measure (γ_2) is found for mothers (0.97%, 0.12 sd), while there is no signif-

[39]Interestingly, Figure B.6 in Appendix B shows that the correlation between voucher loss and disagreement/female empowerment becomes stronger at higher levels of treatment T. This suggests that household heterogeneity is tightly connected to the strategic choices of parents.

icant effect for fathers. All findings are robust to the inclusion of controls such as demographic characteristics, time preferences, and measures of financial knowledge in columns 3 and 4. As shown graphically, the results are mainly driven by the behavior of mothers. Because of their weak position in household decision-making, women are more prone to think strategically and take potential disagreement with the husband into account.

Although the OLS estimates in Table 3 are intuitive and in line with the predictions of the theoretical framework, alternative explanations cannot be readily excluded. For instance, one can expect that couples with different preferences for educational investments are also heterogeneous on a range of other observable and unobservable characteristics. If reluctance to make decisions together with the spouse simply reflects a preference for individual decision-making, such confounding factors could render the variables of interest endogenous. The OLS estimator does not control for all such observable and unobservable characteristics. Because of the fact that parents might have married assortatively with regard to these confounding factors, I refer to the issue as marital matching endogeneity. The error term ϵ of equation (9) is the sum of unobserved family heterogeneity a_h and an idiosyncratic error term. The coefficients γ_1 and γ_2 will be biased if unobservables are correlated with the explanatory variables:

$$\begin{aligned} Cov(disagree_{ih}, a_h) &\neq 0 \\ Cov(emp_h D_i, a_h) &\neq 0 \end{aligned} \tag{10}$$

To fully control for time-invariant unobserved heterogeneity at the family level, I implement a household fixed effects approach. The sampling of couples and observations of parental decisions for various treatment levels per parent allow for this strategy by generating a panel data with 2×5 decisions per family. As the experiments took place in a single session, unobserved family heterogeneity is unlikely to vary across treatment levels and is therefore de facto time-invariant. Equation (9) is expanded with family fixed effects ψ, which control for marital matching endogeneity:

Table 3: Exploring the mechanism: determinants of voucher loss

Voucher Loss (%)	Ordinary Least Squares				Household Fixed Effects			
Mean=0.047	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Perceived preference difference	0.0658***		0.0661***	0.0661***	0.0439***		0.0455***	0.0453***
	(0.00740)		(0.00767)	(0.00764)	(0.0114)		(0.0113)	(0.0112)
Mother's empowerment (WTP)		-0.0674*	-0.0543*	-0.0540*		-0.0429*	-0.0456*	-0.0433*
× Mother (0/1)		(0.0264)	(0.0245)	(0.0243)		(0.0186)	(0.0185)	(0.0184)
Mother's empowerment (WTP)		-0.0284	-0.0117	-0.0123				
× Father (0/1)		(0.0257)	(0.0250)	(0.0247)				
Mother (0/1)	0.0172***	0.0107*	0.00990+	0.00910+	0.0122**	0.00467	0.00430	0.00358
	(0.00443)	(0.00528)	(0.00519)	(0.00533)	(0.00458)	(0.00533)	(0.00524)	(0.00570)
Saving group (0/1)				-0.00355				0.000625
				(0.00547)				(0.0111)
Preference for voucher	0.0324***	0.0250***	0.0364***	0.0364***	0.0678***	0.0678***	0.0701***	0.0713***
	(0.00669)	(0.00676)	(0.00691)	(0.00691)	(0.0114)	(0.0118)	(0.0115)	(0.0115)
School FE			Yes	Yes			Yes	Yes
Controls			Yes	Yes			Yes	Yes
Observations	3615	3600	3570	3570	3615	3600	3570	3570

Notes: This table shows coefficients of OLS (columns 1–4) and household fixed effects (5–8) regressions of voucher loss on parent characteristics. Standard errors are clustered at the family level (columns 1–4) and robust (5–8). Preference difference (belief) is measured by the difference between a parent's own share allocated to the voucher and the belief about the spouse's share allocated to the voucher. Empowerment is measured by the experimental WTP measure. Standard controls includes treatment fixed effects, dummies for censored empowerment values and gender. In columns (3–4) and (7–8) controls include sets of demographic characteristics (income, Muslim (0/1), household size, child's school grade, and parent's education) and time preferences. Columns (4) and (8) include additional controls for financial knowledge (being member of a saving group, having a savings account/mobile payment account, having debt). $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

$$voucher\ loss_{ihl} = \delta_0 + \delta_1 disagree_{ih} + \delta_2 emp_h \cdot D_i + \pi T_{il} + X_i'\eta + \psi_h + v_{ihl} \tag{11}$$

Because of mechanical collinearity, the effect of mother's empowerment interacted with the gender dummy for fathers is omitted in this specification. Controls X capture individual parent characteristics, as well as school fixed effects. Standard errors are clustered at the household level.

Columns (5–8) in Table 3 report the fixed effect estimates. Though not definitively causal, because of potential confounds at the individual level, the significant impacts of the belief of preference difference and mother's empowerment strongly suggest that the hypothesized mechanism is active and important. The fixed effects estimates also highlight the importance of controlling for marital matching endogeneity. Point estimates in the OLS specification in column 4 are upward biased by 45.9% for disagreement and 24.7% for mother's empowerment. Results are robust to the inclusion of individual controls, such as education, financial knowledge, and patience (as measured by the incentivized MEL experiment).

5.3. Impact on Children's School Outcomes

What are the consequences for the child if parents do not invest efficiently in school materials? In other words, can parents' noncooperative decision-making create intergenerational effects through a negative impact on children's test scores? By combining information on the redemption of vouchers from the experiment and administrative data on school grades, I can study whether the experimental results are meaningful in explaining across family differences in educational investments and child outcomes. Given that one experimental treatment was randomly drawn for payout, I can quantify by how much the voucher value increased in response to cooperative decision-making by parents.

As a first step, I confirm that there is a strong negative relationship between noncooperative behavior in the experiment and the voucher payout that parents received.[40] A one standard deviation decrease in voucher loss corresponds on average to TZS 2,832 (US$1.27) higher voucher payouts from the experiment. Considering only the random draw for payout and the realizations of the joint allocations, these numbers remain similar, at TZS 2,545 (US$1.14) higher voucher value. The number of textbooks a child received through the voucher redemption is also negatively correlated with voucher loss in the experiment.

To provide evidence that noncooperative decision-making can lead to a negative externality for children through lower educational investments, I estimate the relationship between overall and subject-specific grades and educational inputs at household level h at time $t = 1$ (after the experiment):

$$school\ grade_{h,1} = \alpha_0 + \alpha_1 voucher_{h,1} + \theta_s + a_h + u_{h,1} \tag{12}$$

The dependent variable measures the school grade five months after the experiment.[41] θ_s controls for school fixed effects. If unobservable household characteristics a, such as the parenting style or the quality of parents' relationships, affect both school grades and decision-making during the experiment, estimates suffer from endogeneity bias. Under the assumption that these heterogeneities are time-invariant and that all remaining changes in grades are due to voucher impact, controlling for the lagged dependent variable (the school grade one month prior to the experiment) would remove the bias:[42]

$$school\ grade_{h,1} = \beta_0 + \beta_1 voucher_{h,1} + \beta_2 school\ grade_{h,0} + \theta_s + u_{h,1} \tag{13}$$

[40] For details, see Table A.8 in Appendix A.

[41] School grades are the results of a national exam and represent the grade point sum for all 10 subjects: Swahili, English, mathematics, science, geography, civic education, history, art/handicraft, communication/informatics/ICT, and physical education.

[42] In Figure B.4 in Appendix B, I provide an alternative specification using changes in students' ranks within their school as the outcome variable to provide robustness to any changes in the distribution of grades that are not controlled for by school fixed effects.

Essentially, the specification boils down to a first difference estimator for two reasons: (i) the voucher in the experiment represented additional school materials unrelated to prior inputs, and therefore $voucher_1 - voucher_0 = voucher_1$ and (ii) the estimated coefficient for the baseline grade is 1.03, with confidence interval $[0.97, 1.09]$. Formally, the first-difference estimator requires changes over time in the error term conditional on the voucher value and controls to equal zero in order to be unbiased and consistent: $E\left(u_{h,1} - u_{h,0} | voucher, ...\right) = 0$. I keep the specification in levels rather than differences in order to address the validity of this assumption via Oster (2019) bounds for the identified set and proportional selection values. This approach assumes that selection on observables and unobservables is proportional and provides coefficient bounds for the extreme cases that unobservables are related to the key explanatory variable either not at all or fully proportional with observable controls.

Another empirical challenge is that it may not be sufficient to control for baseline grades in levels without capturing the fact that children of noncooperative parents might be on lower trajectories in a dynamic human capital accumulation process. Therefore, I attempt to exploit the random element of drawing one choice per parent for payout by instrumenting the voucher values with this random treatment T. As shown before, this treatment predicts voucher losses, but is by design uncorrelated with the child's test scores.

Figure 6, which reports the parameter estimates of β_1 in specification (13), shows that the educational voucher significantly increases children's grades. A US$1 increase in the value of a voucher results in a 2.5 point increase in the grade point sum. At the average voucher payout of US$10.80, this effect represents a 5.5% improvement in mean baseline grades.

Since most of the variation in voucher payout is driven by parents' baseline preference for educational investments, I decompose the voucher value between preference and gains from cooperative decision-making. The additional part of the voucher, which parents achieved through cooperative joint decision-making, proves to be highly relevant in explaining improvements in

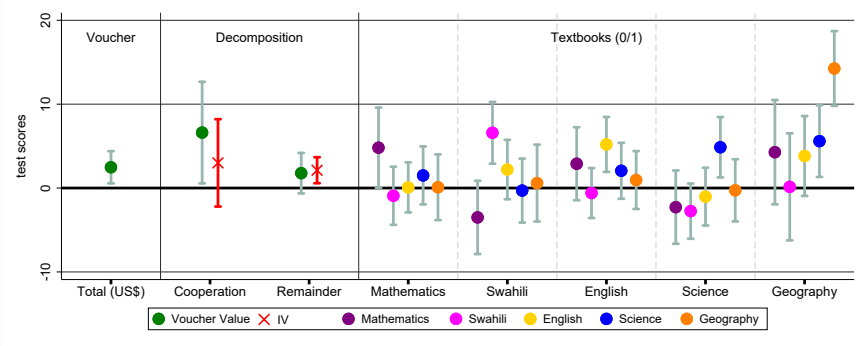


Figure 6: Voucher value and school grades (OLS •, IV x)

Notes: Coefficients of OLS regressions with robust standard errors. The dependent variable is the change in grade point sum and subject-specific grades between one month before and five months after the experiment. Controls include baseline grade, total voucher value and school fixed effects.

school performance. One additional US dollar from this source corresponds to a 6.6 point higher grade. One explanation for this large effect is that for high treatments, joint decision-making increases the budget enough for parents to be able to afford textbooks. Both teachers and students reported these grade-specific books to be the most valuable educational inputs. In a follow-up survey, children whose parents redeemed the vouchers for textbooks reported high usage of 3.7 days per week, usefulness (73.2%), and small to large impact on grades (60.2% and 35.8%). In fact, even conditional on the voucher value, textbooks for mathematics, Swahili, English, science, and geography have large impacts on grades in these specific subjects.[43]

The coefficient bounds reported in Table A.7 in Appendix A provide evidence that even under equal importance of observable and unobservable factors, the coefficient for the voucher value would not go toward zero when controlling for more and more explanatory variables. In particular, the lower

[43]Figure 6 shows cross-diagonal coefficients for textbooks from different subjects on subject-specific grades, which are reassuringly not significantly different from zero.

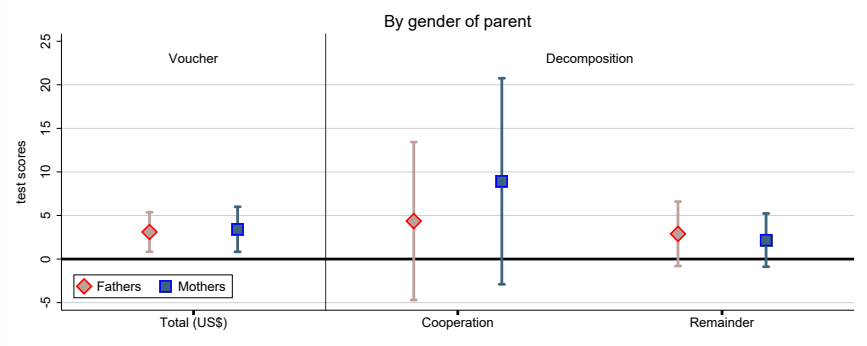


Figure 7: Voucher value and school grades by parent (OLS)

Notes: Coefficients of OLS regressions with robust standard errors. The dependent variable is the change in grade point sum and subject-specific grades between one month before and five months after the experiment. Controls include baseline grade, total voucher value and school fixed effects.

bounds for the impact of total voucher value and its decomposition lie within the standard confidence intervals. Using a related approach based on Altonji *et al.* (2005) the selection on unobservables in my main specification (column 1) would have to be 3.39 times as important as selection on observables in order to reject a nonzero impact of the voucher, an unlikely possibility at the high R^2 of 0.782.

Finally, the instrumental variable (IV) estimates suggest that the coefficient for the gain in the voucher due to cooperation may be upward biased because of parents who have realized cooperative gains in the past and therefore have pushed their children onto higher trajectories in school outcomes. Because of a low number of compliers and a marginally weak instrument, the IV estimates are not precise enough to conclude that the remaining impact is significant.

The results also suggest that the impact of joint decision-making on grades is mainly driven by mothers. According to Figure 7, one additional US dollar of voucher values through the experimental treatment on joint budget for mothers results in almost twice as high an effect on grades as for

fathers (diff: p-value <0.001). The difference is mostly driven by mothers' higher baseline preference for the vouchers. The impact of the voucher differs slightly, though not significantly, by the gender of the student. The absence of gender-specific effects reflects the equal treatment of boys and girls in parents' allocation to the voucher and balanced baseline school grades by gender. However, cooperative decision-making by parents has a larger effect on the overall improvement in school grades of girls than of boys.[44] The overproportional effect on girls of mothers' inability to reap the gains from joint decision-making with their spouses adds a gender dimension to the intergenerational consequences of intra-household conflict. If lower educational outcomes translate into worse labor market outcomes and lower empowerment for girls, parental decision-making can have persistent effects on gender inequality.

Interestingly, the average impact of the total voucher payout (+0.24 sd) and textbooks (+0.19 sd) correspond closely to the causal impact of textbooks on school performance for the top quintile of students (+0.22 sd) estimated by Glewwe *et al.* (2009) in a randomized control trial in Kenyan primary schools.[45]

6. Additional Results

6.1. Interaction of Determinants

The equilibrium conditions for joint decision-making have to hold simultaneously. Therefore, Figure 8 takes a closer look at the interaction between disagreement and decision-power and its effect on educational investments. Voucher losses by mothers, represented by dark areas, are more prevalent when beliefs of high disagreement coincide with low empowerment. The complementarity in the mechanism to explain income pooling is intuitive

[44] Coefficients by children's gender are reported in Figure B.5 in Appendix B.

[45] Glewwe *et al.* (2009) report that effect sizes from providing textbooks in English to primary school students were small because of misalignment of school materials and curricula with children's needs. Unlike the program in Kenya, we provided textbooks in Swahili as per the recommendations of the teachers of the schools.

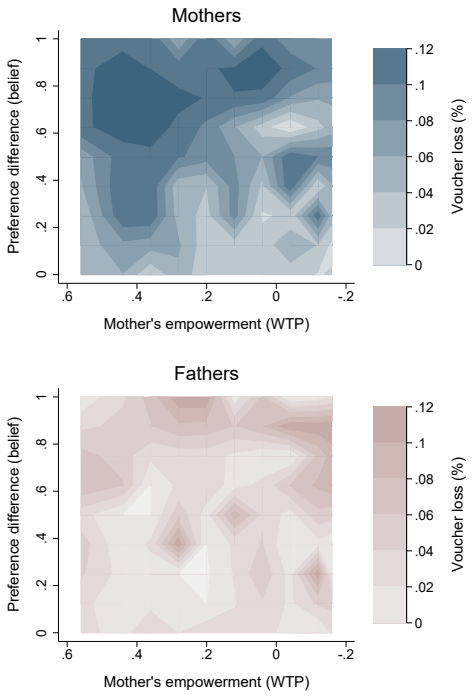


Figure 8: Determinants of noncooperative decision-making: Complementarity

Notes: Values of voucher loss per parent averaged over treatment levels. Smaller values of mother's empowerment (willingness to pay to control resources) indicate higher empowerment. Dark areas indicate high share of noncooperative parents.

and becomes clear by looking at extreme cases. If there is little or no disagreement on how the income should be spent, decision weights become irrelevant, as any combination of them would yield the same budget allocation. In this case, the collective household model converges to the unitary one. If, on the other hand, a woman is empowered enough that decision weights are close to equal, she is less likely to avoid joint management of household finances, even if her preferences differ from her husband's.

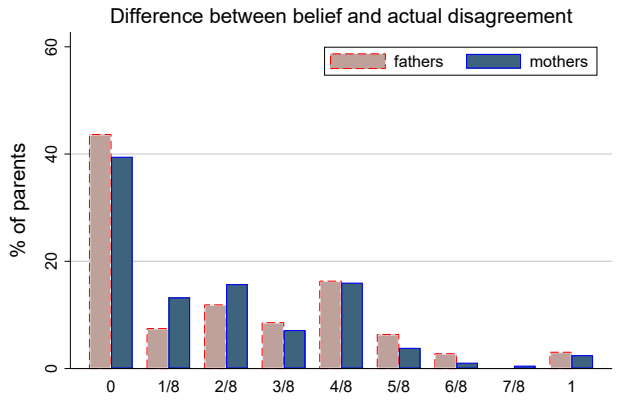


Figure 9: Accuracy of beliefs about spouse's preference for educational voucher

Notes: Allocation of TZS 8,000 (US$3.60) budget between cash and educational voucher. Percentages of parents by belief about share of budget allocated to educational voucher by spouse.

6.2. Uncertainty and Accuracy of Beliefs (Prediction 4)

Throughout the analysis, beliefs about spouse's preference difference are a strong predictor of joint decision-making. Theoretically, because of risk aversion, uncertainty about the partner's preferences decreases the expected utility from collective decisions. Furthermore, asymmetric information between spouses can require additional incentive compatibility constraints in the household model to sustain cooperation. This is the case because parents could potentially mask and misreport their own preference in the collective decision-making to manipulate the choice in their favor.

While I cannot measure uncertainty directly, the accuracy of beliefs can function as a proxy. Surprisingly, only 38.7% of parents had a correct belief about the share their partner would allocate to the voucher (within 0.5 sd). The only covariates that are significantly correlated with this characteristic are patience (measured through the MEL experiment) and education (years of schooling). Intuitively, making rushed, present-oriented decisions can impede the formation of accurate beliefs. To explore the role of beliefs

in more depth, Table 4 shows preference differences and experimental outcomes by subgroups of parents with correct and inaccurate beliefs. Having a correct belief makes parents on average 7.9% more likely to opt for joint decision-making. This translates into 31% less voucher losses. I also find a clear relationship between the magnitude of actual preference difference and the accuracy of beliefs. Strong disagreement intuitively makes it harder to correctly assess how big the preference difference really is. There seems to be significant potential to study and reduce the magnitude of inaccurate beliefs by improving spousal communication through parental training and mentoring.

One reason for such low levels of accuracy is that couples in the study context operate in the separate spheres framework (Lundberg & Pollak, 1993), where traditional gender roles divide the responsibility for certain public goods between partners. However, at least half of the participating couples reported that they jointly decide on issues regarding their children's education and finances. It is therefore possible that unfamiliarity with the partner's preferences for large educational investment could be explained by the low frequency of such decisions rather than separate spheres. For instance, the necessity of pooling incomes for textbooks is limited to one or two occasions per school year. As of now, schools are not actively promoting the purchase of textbooks to both parents at the start of the school year. Informational parent meetings could function as a communication catalyst for parents.

6.3. Alternatives to Income Pooling

The lack of spousal income pooling for the purchase of a large investment or durables has been linked to the emergence of alternative saving strategies by women (Anderson & Baland, 2002; Luengas-Sierra, 2018). Using survey data, I can confirm the hypothesized relationship between joint decision-making in the household and the prevalence of such strategies. Figure 10 shows that parents who experience high voucher losses in the experiment are on average less likely to be members of informal saving groups. However,

Table 4: The role of accurate beliefs about a spouse's preference

	Inaccurate (61.3%)		Correct (38.7%)		
Joint decision (0/1)	0.485	(0.392)	0.564	(0.338)	**
Voucher loss (0/1)	0.254	(0.241)	0.179	(0.224)	***
Voucher loss (%)	0.0540	(0.0620)	0.0369	(0.0553)	***
Actual preference difference	0.361	(0.263)	0.122	(0.244)	***
Share of parents	0.61		0.39		***
Observations	444		280		

Notes: This table shows summary statistics of joint decision-making and voucher loss by accuracy of the perceived preference difference. T-test statistics are robust to the use of rank-sum testing. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

the share of mothers in these groups increases significantly for those parents with higher average losses in the decision-making task. The use of formal savings accounts by mothers is not correlated with income pooling, most likely due to a lack of accessibility.

7. Robustness Checks

The empirical evidence of this study relies heavily on experimental data. In this section, I perform a number of robustness checks to confirm that my findings are not driven by the data-collection process and measurement errors.

The choice list design I used to measure empowerment of mothers is likely to have two limitations. First, willingness to pay for full control of income is both left and right censored. Thus, I do not observe potential extremely low and high values. Second, the interpretation of negative WTP is difficult. On the one hand, such values could be chosen by highly empowered women, who take a large role in decision-making in the household. On the other hand, strong traditional gender-roles and social norms could lead to mothers giving up control to their husband. To address these issues, I control for binary control variables if an observation is in the censored range and run robustness checks excluding couples with negative WTP. Table A.11 in Appendix A shows that the results are robust to the exclusion

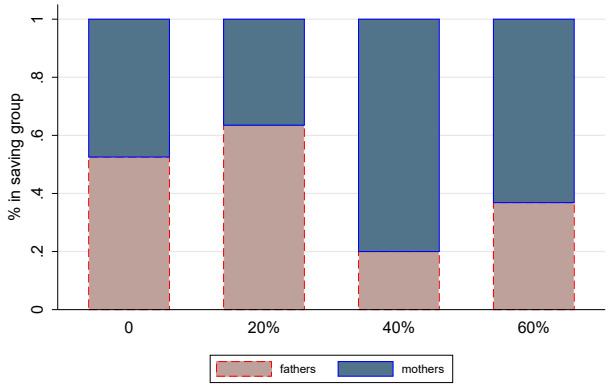


Figure 10: Saving group membership by percentage of noncooperative choices

of negative empowerment values, with slightly larger point estimates for the non-negative subsample. This suggests that negative and left-censored values capture on average higher empowerment. A second issue is related to the extent to which the experimental WTP measure captures true empowerment. I cannot directly address this question but rely on the argument of Almås *et al.* (2018) that commonly used survey empowerment measures are too noisy and lack variation. Nevertheless, Table A.11 in Appendix A shows that a simple survey index can qualitatively reproduce the results obtained with the experimental measure. Appendix C.3 discusses the construction of the survey index and its relationship to the WTP measure.

The revealed preference measure for human capital investment could introduce bias to the analysis if fathers and mothers reacted differently to the specific goods that we provided for the voucher. It is therefore reassuring that the overall results are robust to using differences in the raw experimental measure of patience from the MEL experiment instead of preferences for the educational voucher (see Table A.12 in Appendix A). Intuitively, this makes sense, as patience (MEL) is a significant predictor of the share that a parent allocated to the voucher. Furthermore, this evidence suggests that

the mechanism uncovered in this study can be applied to a larger range of indivisible or durable goods that require income pooling. For instance, the willingness to pay for cook stoves in rural Ethiopia and Bangladesh depends on time preferences and bargaining powers and differs between genders (Miller & Mobarak, 2013; Alem *et al.*, 2019).

8. Conclusions

This paper shows that noncooperative parental decision-making can have intergenerational effects through educational investments. Parents in low income households who do not make use of the benefits of joint management of financial resources invest inefficiently in their children's education. This behavior is directly related to lower educational outcomes for the children. Perceived disagreement between spouses is a strong predictor of avoiding bargaining with the spouse. A large fraction of parents misjudge the preference difference with their partners, thereby reinforcing the issue. A second important factor that causes noncooperative behavior is decision power in the household. Empowered women are less likely to avoid making financial decisions with their spouses and are more often able to cooperate to acquire expensive educational goods. Disagreement and decision weights complement each other in explaining the lack of income pooling.

To generalize the findings, the experimental results should be interpreted within the study context. Outside of the lab-in-the-field setting, the inability to pool resources and jointly manage them is not likely to translate into the same magnitude of loss. Some parents, mothers in particular, have second-best strategies to make large educational investments. These strategies include the use of informal and potentially inefficient saving devices, such as ROSCA-type saving groups (Anderson & Baland, 2002) or the hiding of resources (Ashraf, 2009), which have been shown to be risky and costly. In fact, by setting my results in relation to the literature on efficiency losses from intra-household conflict, I find that these alternative strategies often lead to slightly smaller losses. Recall that the average loss in human capital

investment in my sample is TZS 599.9 (US$ 0.27), which is driven by 59% of parents who experience a loss for at least one treatment level. On average, parents lose 4.7% of potential educational investment. Schaner (2015) documents that because of mismatch in discount rates, couples in Kenya lose on average 4.4% in interest rates when they have access to either individual or joint savings accounts, which translates into losses of US$ 0.232.[46] Anderson & Baland (2002) report that women who participated in a ROSCA gave up any interest from standard saving devices. Jakiela & Ozier (2016) find that subjects in Kenya were willing to pay 4.6% of their investment earnings to keep them a secret from their kin. Similarly, Ashraf (2009) notes that participants in the Philippines were willing to pay to 5.15% to secure income from their spouses in the comparable treatment, in which payouts were public information. If the frequency of intra-household income pooling improves, at least a non-negligible fraction of these loses could be prevented.

With regard to economic and social policy, there are two main takeaways from this paper. First, policies could alter the fundamentals of the decision-making process. I analyze the role of two of such fundamentals: empowerment and beliefs about the preferences of the spouse. There are potential gains from fostering female empowerment and efficient marital matching. A more tangible approach is to increase the awareness and communication about spousal needs and preferences through parental training and school meetings. In particular, the institutional inclusion of the father in educational matters could yield significant improvements in how parents make decisions on education.

Second, policies could be set in place to provide low-risk, low-cost second best options for mothers. For example, Aker *et al.* (2016) suggest that the introduction of mobile payment systems in Niger benefits women and children through an increase in bargaining power and lower costs of concealing income from the husband. Similarly, Prina (2015) observes higher

[46] Calculations are based on 10.4% average losses of couples who save and 42.3% of all couples saving with US$ 12.50 average daily account balances.

educational expenditure by women in Nepal with low empowerment after providing them with access to formal saving devices.

Finally, my results suggest that targeting women with cash transfers may reduce their reliance on joint decisions with their husband to finance larger investments by making them more financially independent. This channel could partly help explain the overall finding that cash transfer programs for women benefit children's health and education (Yoong & Diepeveen, 2012).

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Appendix

A. Additional Tables

Table A.1: Summary statistics: parental decision-making

Who Decides?	Mean	SD
Consumption choices		
Father	0.268	(0.444)
Mother	0.199	(0.400)
Both	0.533	(0.500)
Financial choices		
Father	0.356	(0.480)
Mother	0.0552	(0.229)
Both	0.588	(0.493)
Child-rearing choices		
Father	0.152	(0.359)
Mother	0.108	(0.310)
Both	0.740	(0.439)
Educational choices		
Father	0.215	(0.412)
Mother	0.0746	(0.263)
Both	0.710	(0.454)
Observations	362	

Note: Variables constructed from survey questions on 'who typically decides on various household issues'.

Table A.2: Textbook use

	Endline Subsample	
	Mean	SD
# of textbooks received	1.406	(0.985)
# of days/week textbook use	3.691	(1.718)
Share with friends (0/1)	0.878	(0.329)
How often was textbook shared?		
Once a week	0.620	(0.488)
Once every other week	0.148	(0.357)
Once every month	0.231	(0.424)
Was textbook useful for studies?		
Not useful	0.268	(0.445)
Useful	0.732	(0.449)
Impact on grades		
No impact	0.0407	(0.198)
Little impact	0.602	(0.492)
Large impact	0.358	(0.481)
Observations	185	

Note: Variables constructed from questions in the endline survey, conducted with a subsample of children eight months after the experiment.

Table A.3: Sample selection of parents (based on children's characteristics)

I. Full sample	*Participant Sample (364)*		*Potential Sample (1892)*		
	Mean	SD	Mean	SD	T-test
Normalized rank in class	0.529	0.288	0.5	0.289	
II. Subsample	*Participant Sample (162)*		*Non-part. Sample (484)*		
Child characteristics	Mean	Sd	Mean	Sd	T-test
Female	0.512	0.500	0.537	0.503	
Muslim	0.564	0.480	0.614	0.487	
Household size	5.707	1.729	5.265	2.084	*
Children in household	2.911	1.411	2.551	1.279	**

Notes: Normalized rank is the ranking of a student of grade 6 at a given school divided by the number of grade 6 students at that school. T-test results are robust to the use of rank-sum testing. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.4: Budget allocations and preference difference

			By Parent				
	Parents		Husband		Wife		T-test
Share allocated to voucher	0.736	(0.303)	0.672	(0.349)	0.799	(0.232)	***
Spouse's voucher share (belief)	0.708	(0.344)	0.711	(0.378)	0.705	(0.307)	
Preference difference (actual)	0.268	(0.281)	|	|	|	|	
Preference difference (belief)	0.181	(0.273)	0.188	(0.290)	0.173	(0.256)	
Observations	724		362		362		724

Notes: This table shows summary statistics on the allocation of TSh 8,000 budget between cash and educational voucher. Average share allocated to voucher. Belief about spouses share allocated to voucher (incentivized elicitation). T-test statistics are robust to the use of rank-sum testing. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.5: The determinants of parents' preference for the educational voucher

			By Gender	
Mean=73.57	Full Sample	Full Sample	Father	Mother
Education	0.288	0.294	-0.552	0.975
	(0.601)	(0.624)	(0.940)	(0.750)
ln(monthly income)	-1.361	-1.164	-1.646	-0.447
	(1.481)	(1.556)	(2.296)	(1.598)
Muslim (0/1)	-8.305***	-8.515***	-11.82**	-5.146*
	(2.428)	(2.466)	(3.925)	(2.519)
Household size	0.853	0.870	1.229	0.461
	(0.647)	(0.648)	(1.024)	(0.597)
Impatience (MEL)	-11.45***	-11.19***	-8.814+	-11.91***
	(2.763)	(2.755)	(4.858)	(2.940)
Child's GPS	0.0282**	0.0264**	0.0386**	0.0143
	(0.00894)	(0.00902)	(0.0143)	(0.00916)
Mother (0/1)	10.31***	10.95***		
	(1.998)	(2.107)		
Alcohol (0/1)	-3.945	-4.588	-7.995	2.195
	(3.731)	(3.803)	(4.906)	(4.368)
Smoke (0/1)	-11.18*	-11.25*	-12.45*	-7.326
	(5.001)	(5.046)	(5.675)	(9.604)
Savings acc. (0/1)		3.047	3.530	1.720
		(3.190)	(4.497)	(3.637)
Mobile acc. (0/1)		-4.375	-5.982	-3.172
		(6.091)	(10.62)	(6.947)
Savings group (0/1)		-1.389	-0.880	-2.694
		(2.667)	(4.061)	(2.879)
Debt (0/1)		-4.307+	-7.602+	-0.783
		(2.551)	(3.967)	(2.598)
Observations	689	681	342	339

Notes: This table shows the relationship between the share allocated to the educational voucher and individual and household characteristics. Standard errors are clustered at the family level (columns 1–2) and robust (3–4). All columns include school fixed effects. The independent variable is the budget share allocated to the voucher in percentage. Education is calculated as the minimum number of years to reach the highest completed school grade. Debt is a dummy equal to one if the household has a significant amount of debt. Alcohol and smoke are dummies equal to one if the parent drinks or smokes at least once a week. Child's grade point sum (GPS) is the sum over test scores in all 10 subjects (max 1000). * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.6: Experimental results: joint decision-making and voucher loss

	All Decisions	.	By Treatment				
			-12.5%	0%	12.5%	25%	37.5%
Joint Decision (0/1)							
Fathers	0.615		0.340	0.514	0.680	0.757	0.787
	(0.382)		(0.474)	(0.501)	(0.467)	(0.430)	(0.410)
Mothers	0.415		0.102	0.177	0.492	0.602	0.702
	(0.336)		(0.303)	(0.382)	(0.430)	(0.430)	(0.410)
T-test	***		***	***	***	***	**
Overall	0.515		0.221	0.345	0.586	0.680	0.745
			(0.373)	(0.476)	(0.493)	(0.467)	(0.437)
Voucher Loss (0/1)							
Fathers	0.188		0.298	0	0.271	0.199	0.174
	(0.215)		(0.458)	0	(0.445)	(0.400)	(0.380)
Mothers	0.261		0.102	0	0.508	0.398	0.298
	(0.252)		(0.303)	0	(0.501)	(0.490)	(0.458)
T-test	***		***		***	***	***
Overall	0.225		0.200	0	0.390	0.298	0.236
	(0.237)		(0.401)	(0)	(0.488)	(0.458)	(0.425)
Voucher Loss (%)							
Fathers	0.0372		0.0373	0	0.0338	0.0497	0.0653
	(0.0539)		(0.0573)	0	(0.0556)	(0.0999)	(0.154)
Mothers	0.0575		0.0128	0	0.0635	0.0994	0.112
	(0.0641)		(0.0379)	0	(0.0626)	(0.123)	(0.172)
T-test	***		***		***	***	**
Overall	0.0474		0.0250	0	0.0487	0.0746	0.0886
	(0.0999)		(0.0501)	(0)	(0.0610)	(0.114)	(0.159)
Observations	362	362	362		362	362	362

Notes: This table shows summary statistics of joint decision-making and voucher loss by treatment level. Variable Joint Decision is the average over treatments of a dummy variable equal to one if an individual chose joint decision-making for a given treatment level. Voucher Loss (0/1) is the average over treatments of a dummy variable equal to one if an individual did not choose joint (individual) decision-making for positive (negative) treatment levels. T-test results are robust to the use of rank-sum testing.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.7: Voucher value and improvements in school performance

	Test Score		By Subjects					Test Score
			Math	Swahili	English	Science	Geog.	(IV)
Mean Grade (baseline) = 484.48	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Voucher value (US$)	2.478*							
	(0.812)							
Identified set (Oster, 2019)	[1.81; 4.55]							
Cooperation part of voucher (US$)		6.614*						3.001
		(2.561)						(2.657)
Identified set (Oster, 2019)		[3.64; 15.46]						
Preference part of voucher (US$)		1.776						2.126**
		(1.020)						(0.790)
Identified set (Oster, 2019)		[0.77; 4.47]						
Textbook (0/1)			5.639*	7.273***	5.094**	3.744*	14.32***	
			(2.219)	(1.736)	(1.545)	(1.652)	(2.079)	
Remaining voucher value (US$)			0.594*	-0.123	0.166	-0.0789	-0.0188	
			(0.246)	(0.155)	(0.181)	(0.178)	(0.168)	
Baseline grade	1.033***	1.033***	0.677***	0.743***	0.539***	0.611***	0.599***	1.034***
	(0.0396)	(0.0396)	(0.0755)	(0.0572)	(0.0504)	(0.0613)	(0.0589)	(0.0369)
Observations	345	345	226	227	227	227	227	345
R^2	0.782	0.784	0.526	0.514	0.365	0.525	0.399	0.783

Notes: This table shows the coefficients of an OLS regression of school grades on voucher value. Standard errors are robust. All columns include school fixed effects. The dependent variable in columns (1–7) is the change in grade point sum and subject specific grade from one month prior to five months after the study. In column 8 voucher part from cooperation is instrumented by the random payout draw. The dependent variable is the voucher loss as % of potential educational investment. Voucher value is the value for educational investments that the household earned as payout in the experiment. Textbook (0/1) is a dummy variable if a child got a textbook in a specific subject paid by the voucher. Identified sets under the assumption of proportional selection on observables and unobservables ([uncontrolled β; biased-adjusted β]). First stage F-statistic for excluded instruments in IV estimation: 239.81. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.8: Experimental choices and voucher value

	Voucher Value		# of Textbooks	
Mean = 10.78 / 1.35	(1)	(2)	(3)	(4)
Voucher loss (%) - all treatments	-12.87*		-1.643	
	(5.320)		(1.360)	
Voucher gain (%) - random payout choice		12.68***		2.448***
		(2.615)		(0.553)
Observations	348	338	229	219

Notes: This table shows the relationship between cooperation in the experiment and realized school materials from voucher redemption. Standard errors are robust. All columns include school fixed effects. The dependent variable is the voucher value for educational investments that the household earned as payout in the experiment. Its value depends on the randomly drawn choice. # of Textbooks is the number of books a child got through the voucher redemption. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.9: Exploring the mechanism: determinants of noncooperative decision-making (monetary voucher losses)

Voucher Loss (TZS)	Ordinary Least Squares				Household Fixed Effects			
Mean=599	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Preference difference (belief)	820.0***		820.8***	812.6***	593.4***		617.0***	627.9***
	(114.5)		(115.0)	(113.7)	(175.0)		(174.8)	(175.8)
Mother's empowerment (WTP)		-658.3+	-552.5+	-531.6		-278.2	-340.7	-322.1
× Mother (0/1)		(365.3)	(333.8)	(333.3)		(262.6)	(259.5)	(257.7)
Mother's empowerment (WTP)		-380.0	-231.6	-226.0				
× Father (0/1)		(347.5)	(334.3)	(331.8)				
Mother (0/1)	300.4***	240.0**	247.9**	237.5**	301.7***	240.0**	241.1**	225.3**
	(61.42)	(75.73)	(75.17)	(77.24)	(61.59)	(75.70)	(74.48)	(81.44)
Saving group (0/1)				-125.1*				-196.6
				(58.16)				(123.0)
School FE			Yes	Yes			Yes	Yes
Controls			Yes	Yes			Yes	Yes
Observations	3615	3600	3570	3570	3615	3600	3570	3570

Notes: Standard errors are clustered at the family level (columns 1–4) and robust (5–8). The dependent variable is the monetary voucher loss. Preference difference (belief) is measured by the difference between a parent's own share allocated to the voucher and the belief about the spouse's share allocated to the voucher. Empowerment is measured by the experimental WTP measure. Standard controls include treatment fixed effects, dummies for censored empowerment values and gender. In columns (3–4) and (7–8) controls include sets of demographic characteristics (income, Muslim (0/1), household size, child's school grade and parent's education) and time preferences. Columns 4 and 8 include additional controls for financial knowledge (being a member of a saving group, having a savings account/mobile payment account, having debt). $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.10: Exploring the mechanism: Determinants of non-cooperative decision-making (extensive margin)

Voucher Loss (0/1)	Ordinary Least Squares				Household Fixed Effects			
Mean=0.225	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Preference difference (belief)	0.259***		0.261***	0.261***	0.164***		0.168***	0.168***
	(0.0284)		(0.0295)	(0.0294)	(0.0443)		(0.0441)	(0.0435)
Mother's empowerment (WTP)		-0.239*	-0.187+	-0.187+		-0.169*	-0.177*	-0.168*
× Mother (0/1)		(0.105)	(0.0984)	(0.0975)		(0.0716)	(0.0711)	(0.0708)
Mother's empowerment (WTP)		-0.0874	-0.0239	-0.0274				
× Father (0/1)		(0.102)	(0.0994)	(0.0978)				
Mother (0/1)	0.0591***	0.0337+	0.0301	0.0259	0.0351*	0.00707	0.00525	0.000945
	(0.0172)	(0.0203)	(0.0201)	(0.0207)	(0.0177)	(0.0204)	(0.0202)	(0.0221)
In saving group				-0.0277				-0.0750+
				(0.0186)				(0.0384)
Preference for voucher	0.139***	0.108***	0.158***	0.159***	0.303***	0.298***	0.309***	0.315***
	(0.0267)	(0.0274)	(0.0274)	(0.0275)	(0.0433)	(0.0449)	(0.0441)	(0.0444)
Observations	3615	3600	3570	3570	3615	3600	3570	3570

Notes: Standard errors are clustered at the family level (columns 1–4) and robust (5–8). The dependent variable is a dummy equal to one if a parent experienced any voucher loss at a given decision. Preference difference (belief) is measured by the difference between a parent's own share allocated to the voucher and the belief about the spouse's share allocate to the voucher. Empowerment is measured by the experimental WTP measure. Standard controls include treatment fixed effects, dummies for censored empowerment values and gender. In columns 3–4 and 7–8 controls include sets of demographic characteristics (income, Muslim (0/1), household size, child's school grade and parent's education) and time preferences. Columns 4 and 8 include additional controls for financial knowledge (being a member of a saving group, having a savings account/mobile payment account, having debt). $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.11: Robustness check: Alternative and non-negative empowerment measure

Voucher Loss (%)	Empowerment Index		Empowerment (WTP)>0	
Mean=0.047	(1)	(2)	(3)	(4)
Empowerment index × Mother (0/1)	-0.0110	-0.0141^{+}		
	(0.00835)	(0.00827)		
Empowerment index × Father (0/1)	-0.00314	-0.00206		
	(0.00647)	(0.00644)		
Empowerment (WTP>0) × Mother (0/1)			-0.0619**	-0.0639**
			(0.0202)	(0.0200)
Empowerment (WTP>0) × Father (0/1)			0.0116	0.00661
			(0.0168)	(0.0168)
Mother (0/1)	0.0277*	0.0306**	-0.00276	-0.00400
	(0.0113)	(0.0112)	(0.00805)	(0.00805)
School FE		Yes		Yes
Controls		Yes		Yes
Observations	3620	3595	2690	2685

Notes: Standard errors are clustered at the family level. The empowerment index is constructed from survey questions using factor analysis with polychoric correlation matrix. Empowerment (WTP) is measured by the experimental empowerment measure for observations with WTP>0. Standard controls include treatment fixed effects and gender. In columns 2 and 4 controls include sets of demographic characteristics (income, Muslim (0/1), household size, child's school grade and parent's education), time preferences and financial knowledge (being a member of a saving group, having a savings account/mobile payment account, having debt).$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.12: Robustness check: difference in time preference

Voucher Loss (%) (mean=0.047)	(1)	(2)	(3)
Diff. in impatience	0.0121^{+}	0.00852	0.00767
	(0.00643)	(0.00623)	(0.00607)
Mother (0/1)	0.0203***	0.0207***	0.0195***
	(0.00446)	(0.00447)	(0.00459)
Impatience		-0.00138	-0.00154
		(0.00581)	(0.00591)
In Savings Group			-0.00987*
			(0.00491)
School FE		Yes	Yes
Controls		Yes	Yes
Observations	3610	3590	3590

Notes: Standard errors are clustered on family level. Impatience of spouses is elicited from a choice list experiment. Standard controls includes treatment fixed effects and gender. In columns (2) and (3) controls include sets of demographic characteristics (income, Muslim (0/1), household size, child's school grade and parent's education) and time preferences. Columns (3) include additional controls for financial knowledge (being member of a savings group, having a savings account/mobile payment account, debt).
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

B. Additional Figures

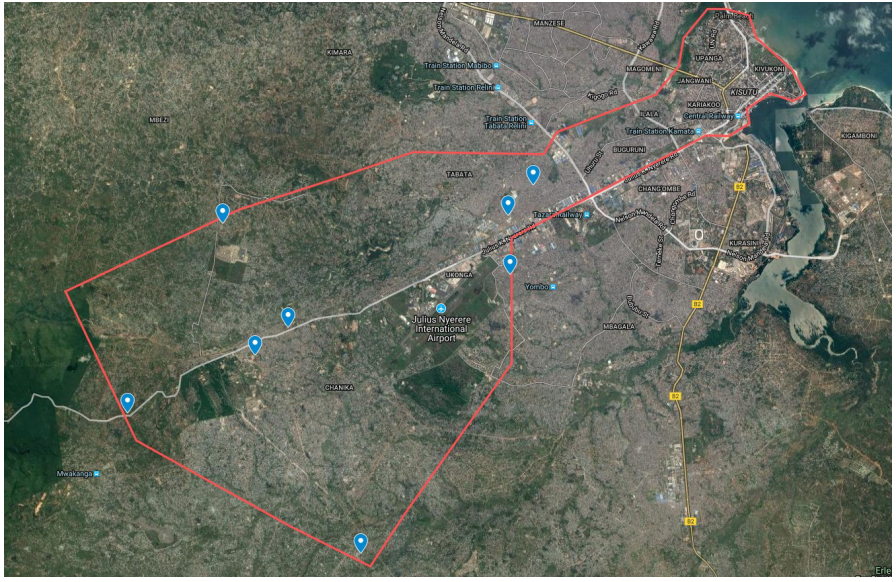

Figure B.1: Location of sample schools within Ilala district, Dar es Salaam

Note: The 8 sample schools were randomly selected from 112 schools in Ilala district, one of five district of Dar es Salaam.

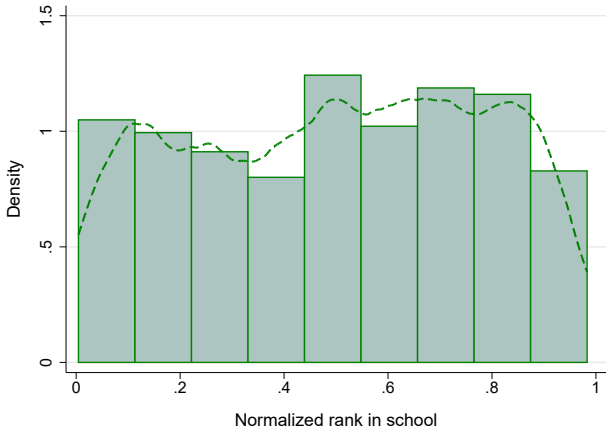

Figure B.2: Distribution of school ranks of sampled students

Notes: Rank of students according to grade point sum over all 10 subjects and normalized by number of students. Uniform distribution would correspond to no selection or full sample.

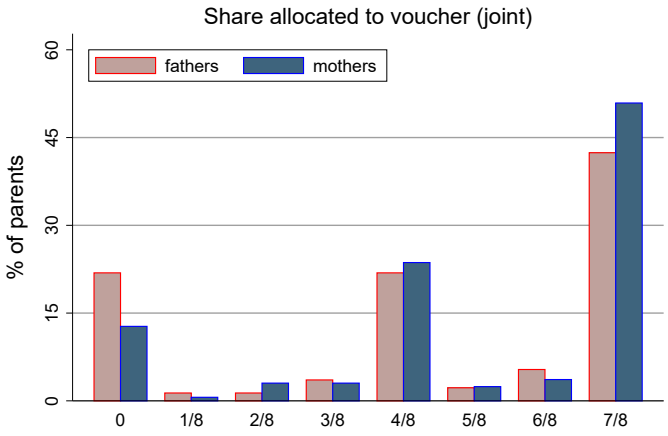

Figure B.3: Joint decision-making: share allocated to voucher

Notes: Allocation of applicable joint budget (TZS 7,000– 11,000) between cash and educational voucher if a parent chose joint for the randomly drawn payout choice. Allocations are potentially distorted by income effects. Percentages of parents by share of budget allocated to educational voucher.

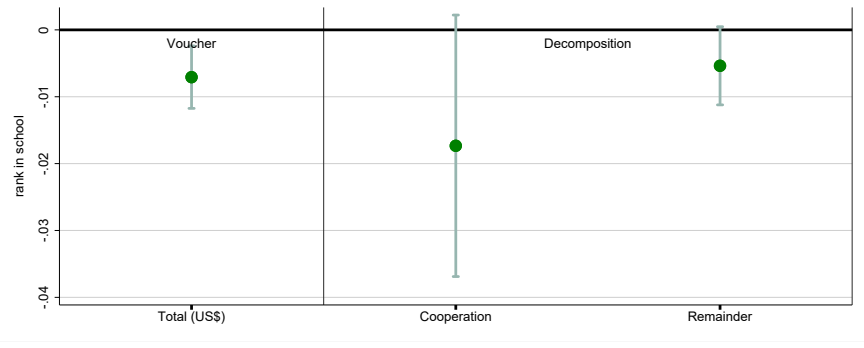

Figure B.4: Voucher value and rank in school

Notes: Coefficients of OLS regressions with robust standard errors. Controls include baseline grade, total voucher value, and school fixed effects.

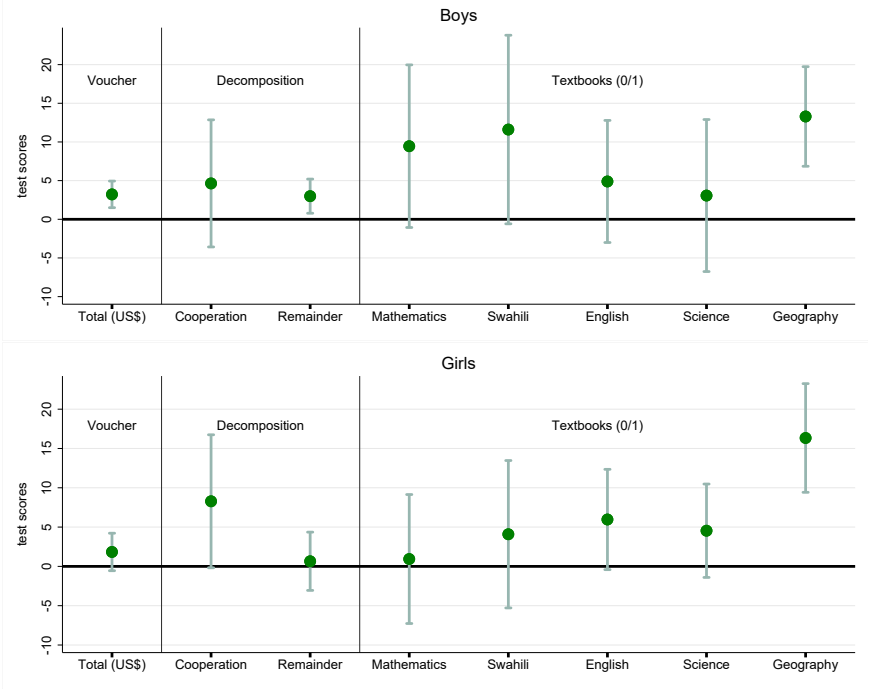

Figure B.5: Voucher value and school grades by gender

Notes: Coefficients of OLS regressions with robust standard errors. Controls include baseline grade, total voucher value, and school fixed effects.

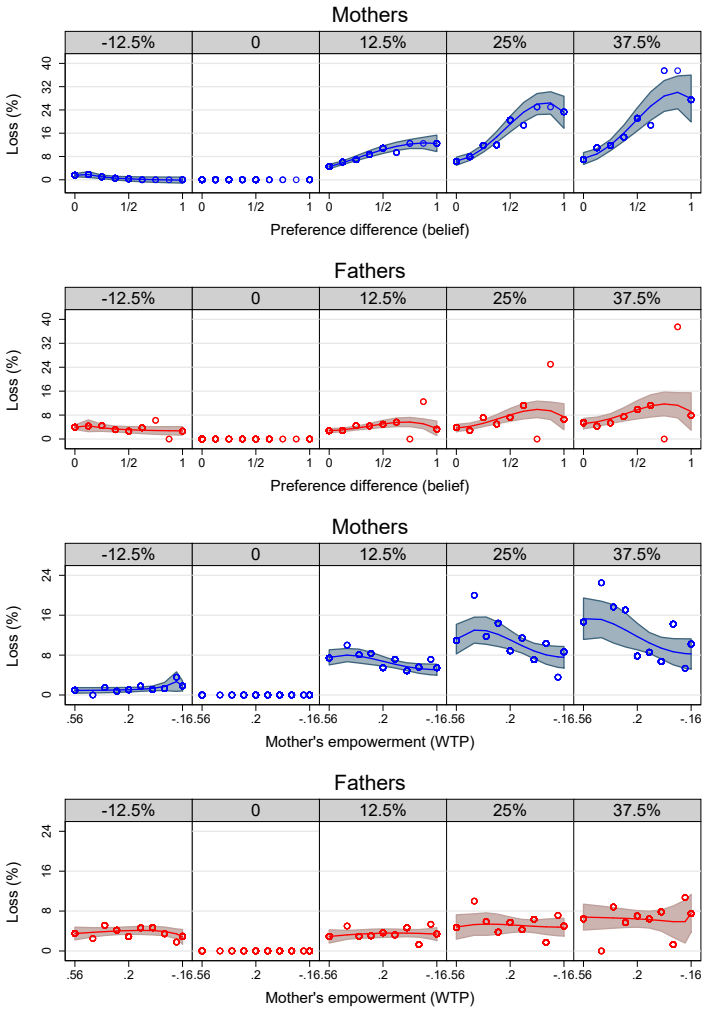

Figure B.6: Determinants of voucher loss by treatment

Notes: Y-axes depict voucher loss. X-axes denote the level of perceived disagreement (upper panels) and female empowerment (bottom panels). Fractional polynomial fit with CIs and means for levels of preference difference and empowerment.

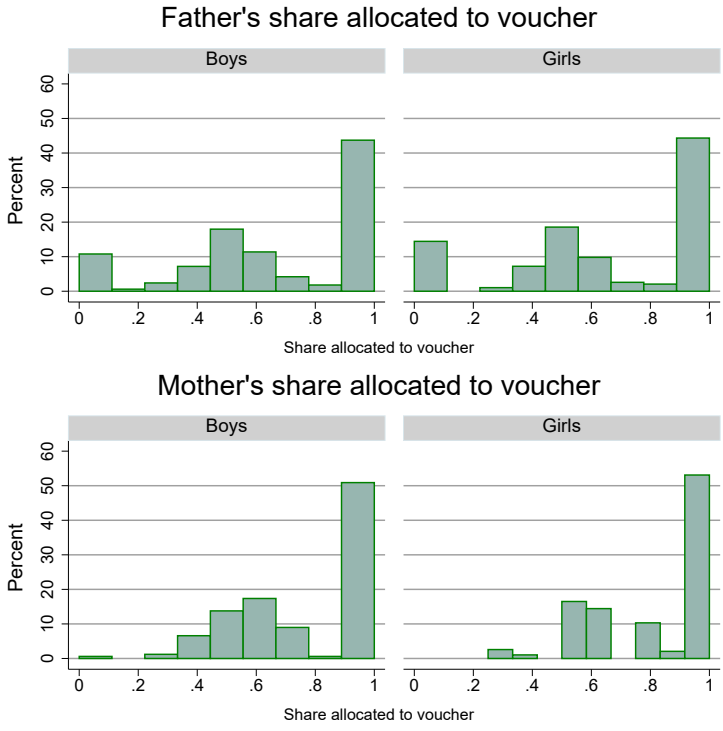

Figure B.7: Voucher preference and voucher loss by child's sex

Notes: Allocation of TZS 8,000 (US$3.60) budget between cash and educational voucher. Percentages of parents by share of budget allocated to educational voucher separated by gender of child.

C. Experimental Materials (Choice Lists and Instructions)

C.1. Decision-Making Experiment

Family ID: Participant ID:

Individual Decision

Cash (TZS) 	*School Material Voucher (TZS)* 
Budget: 10.000	
.....	.....

BELIEF about spouse: ....

Figure C.1: Individual allocation

Family ID: Participant ID:

	Stay			*Joint decision with spouse*		
	Individual Budget 10.000 **Your choice:**  ..... 		*or*	*Cash (TZS)* 	*School Material Voucher (TZS)* 	
1.	Stay with individual decision	O		O	Joint Budget	*8.000*
2.	Stay with individual decision	O		O	Joint Budget	*10.000*
3.	Stay with individual decision	O		O	Joint Budget	*12.000*
4.	Stay with individual decision	O		O	Joint Budget	*14.000*

Figure C.2: Stay with individual decision vs. make joint decision with spouse

Enumerators (start by reading the following instructions to the participants: *We will now proceed with the final part of today's session. Before we start, we will explain the rules of this decision-making experiment. If you have any questions during the explanation, please stop me and ask. Depending on your decisions you will earn some money. That's why it is important that you understand the rules of the experiment. Part 1: This experiment has two parts. Let's start with rule for the first part: You will now make one individual choices. The decision is to divide a budget of 10.000 TZS between the two cups in front of you. The first cup is the cash cup. Any money that is put into this cup, will be paid out to you in cash by transferring it to your mobile account at the end of the day. The second cup is the educational voucher cup. Any money that is put into this cup, will be doubled and given to your family in the form of a voucher. With the value of the voucher you will be able to purchase educational materials for your child. It can exclusively be used for your child's education which may increase your child's grades and opportunities in the future! It can for instance be exchanged for mathematics or reading textbooks. Your choices will be relevant for the second part of this experiment and for determining your final payout for this experiment, depending on your choices in the second part. Let's look at an example (Budget of TZS 10.000, TZS 4.000 allocated to cash option, TZS 6.000 allocated to voucher). If you divide the budget of TZS 10.000, such that TZS 4.000 go into the cash cup and TZS 6.000 go into the educational voucher cup, you will get the following payout: 4.000 TZS will be paid out to your family (split among spouses). The TZS 6.000 in the voucher cup are doubled to TZS 12.000 and given to you in the form of a voucher which you can exchange for educational material at the end of the day.Your first stage choice is relevant for the second part of the game. We will explain this carefully in the second part. We will also ask you to state the belief about what your spouse would choose. If you guess the budget split of your spouse correctly you can earn additional TZS 1.000. If there are no further questions, we will now individually collect the first stage choices from you (go from desk to desk and collect choices, write down into list).*

Part 2: Now, in the second part, for your choice from the first part you are asked 4 times to either stay with that individual decision that you made in the first part, or to choose to make a joint decision with your spouse. This part will define your payout. If you decide to stay with the individual decision, you will get the pay-off that you chose in the first stage. The payoff will be paid out to your family without revealing any of your choices. If you decided to make the decision jointly with your partner, you will discuss the choice with your spouse and report your decision after this game. The prize of your choice will then be paid out to your family accordingly. We brought along here an example decision sheet. Imagine that in the first part you chose to divided the budget of 10.000 putting TZS 4.000 to the cash cup and TZS 6.000 (which gives a voucher of TZS 12.000) to the voucher cup. Here are 4 decisions to make in the second part. On the right you see the details of the joint decision. Notice that the joint decision differs from the individual decision only by the size of the budget. This means it is the same type of decisions, just with different budgets to divide between the cups. You are asked to choose whether to stay with the individual split, or to make the decision again with your spouse. You have to make that decision for different budget sizes in the joint decision. Everybody following so far?

C.2. Empowerment Experiment

Namba ya familia: Namba ya mtu binafsi:

	A			B
	TSh to me			TSh to my spouse
1.	8.700 TSh	O	O	7.500 TSh
2.	8.100 TSh	O	O	7.500 TSh
3.	7.500 TSh	O	O	7.500 TSh
4.	6.900 TSh	O	O	7.500 TSh
5.	6.300 TSh	O	O	7.500 TSh
6.	5.700 TSh	O	O	7.500 TSh
7.	5.100 TSh	O	O	7.500 TSh
8.	4.500 TSh	O	O	7.500 TSh
9.	3.900 TSh	O	O	7.500 TSh
10.	3.300 TSh	O	O	7.500 TSh

Figure C.3: Empowerment experiment choice list

Enumerators (start by reading the following instructions to the participants): *We will now start with the first part of today's session. Today you will respond to a survey to study the needs of women and economic decision-making. Your session consists of 4 parts of decision-making tasks. The last part and one additional part, which will be randomly drawn at the end of the day, will determine your payout. Please give sincere answers. Your answers will be kept completely anonymous and no replies will be revealed to anyone except the researchers. If you have any question during the explanation, please stop me to ask. In the following questions you will be facing different choices for which you will have to choose between two alternatives, A or B. You cannot choose both. You will have to state your preferred choice (A or B) in each situation. If you choose A it means you prefer alternative A to alternative B. We will be rewarding you for your choices and your decisions affect your actual reward. The amount of your reward will be communicated at the end of the survey. We will start by providing you with an example, so that you can understand better (A: TZS 4.500 to me, B: TZS 5.000 to my spouse). You will have to state your preferred choice (A or B) in this situation. This means that you will be paid the amount TZS 4.500, stated in A, if you choose alternative A. If you choose alternative B, your spouse will be paid the amount TZS 5.000, stated in B. In total you will be asked to make 10 decisions between A and B by crossing the circle next to that alternative. Once you switch from A to B, you should think carefully if it makes sense to switch back at a later choice as alternative A is decreasing in each row and alternative B stays the same. We will tell you at the end of the today's session which one determines the actual payment for you and your partner. If this part of the survey is randomly chosen, then you will be paid according to one of your decisions. You will draw a numbered cards from 1 to 10 which will define the choice that is relevant for payout. The amount will be paid to you or your spouse without revealing any of your decisions. In the example choice this means that if you chose A, TZS 4.500 will be transferred to your mobile account. If you chose B, TZS 5.000 will be paid to your husband's mobile account. Any questions?*

C.3. Empowerment Measures in Comparison

Decision-making index: This approach uses a questionnaire design to elicit a measure of female empowerment. The respondent was asked to indicate the decision-maker in the household for several categories. If the mother (father) is the decision-maker for a category, it is coded with 0 (2). If the couple decides together, the variable takes value 1. The subcategories are basic consumption (e.g. food, clothing), financial decisions, child raising and educational decisions. To condense these categorical variables to an empowerment index I use a factor analysis with polychoric correlation matrix. Figure C.4 and Table C.1 show the distribution and the factor loading of the decision-making (DM) index. As expected the index is skewed to the left, indicating low decision power of mothers. Factor loading is relatively evenly distributed across the decision-making categories, suggesting that none of them should be excluded. The DM index has been argued to contain very noisy and limited information because of its survey nature and potential simultaneous roles as source and consequences of empowerment.

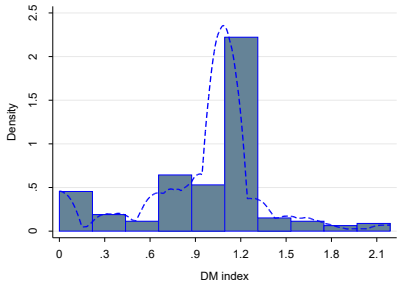

Figure C.4: Distribution of DM index

Notes: Histogram and kernel density of the decision-making index measure from survey questions. High values correspond to low empowerment

Table C.1: Factor loadings

	Factor Loadings
Consumption	0.4896
Financial	0.6056
Child raising	0.6754
Education	0.6811

Note: Variables for decision-making categories take value 0 (2) if mother (father) decides and 1 if both parents decide jointly.

Comparing empowerment measures: For a better understanding of the different empowerment measures and the information they carry about the true decision-making power in the household, Table C.2 reports their

correlation for the full sample and excluding negative WTP couples. The negative correlation between the DM index and WTP is surprising, as one would expect a mother with higher responsibility for decision-making to exhibit lower WTP. However, the correlation is in line with the findings of **?**, who argue that it can be explained by confounding factors. The DM index and WTP carry different information. Both capture the true decision-making power to a certain extent, but they load on different observables or unobservables. While the DM index and WTP can both be correlated with true power, if they load on other variables with different signs, negative correlation between them can arise. Following **?**, one can think about i different empowerment measures that depend on true, unobservable power (P), confounding factors (X), and pure noise (ϵ_i): $m_i = \alpha_i + \lambda_i P + \beta_i X + \epsilon_i$. Using $i = 3$ empowerment measures, they are able to estimate this model using several observable confounds and find that the measures indeed load with opposite signs on variables such as ethnicity, gender of household head, and settlement condition. By including observable characteristics as controls and family fixed effects in the empirical specifications, I can capture confounding factors at the family level while exploiting the information about true power in the empowerment measures.

Table C.2: Correlation matrix of empowerment measures

	Full Sample	Excluding Neg. WTP
	WTP measure	WTP measure
DM_index	-0.00114	-0.0358
Observations	360	269

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

C.4. Patience (Money Earlier or Later)

Time preferences are elicited with choice lists with early and delayed payoffs or time-investment exercises. The choice list design is motivated by (i) its simplicity, making it suitable for a sample of low educated and adolescent subjects and (ii) the use of raw measures without any assumption on the functional form for the utility function (as in **?**). Subjects will select their preferred choice in a list of 10 decisions per decision sheet. Choices are made between upfront payoff of TZS 4,000 (US$1.80) and delayed payoffs between TZS 4,000 (US$1.80) and TZS 8,000 (US$3.60). Starting with equal payoffs, the delayed option increases monotonically. Two decision sheets are presented to the subjects in random order. After all choices are made, one list and one decision are randomly selected for payout. Since transaction costs and uncertainty about the payment could bias the results, particular focus is placed on trust issues related to the delayed payment option. Using mobile phone banking, which is extremely widespread and common in Tanzania, I can alleviate concerns about additional transaction costs for the delayed payments. Using the observed switching point from early to delayed payoff, the *future equivalent* (FE) is calculated at the midpoint of the two delayed payoffs around the switching point. Normalizing it by the early payoff results in a comparable indicator for patience: $t = \frac{FE}{A}$. The higher the *normalized future equivalent* (t), the more impatient the individual is.

D. Theoretical Framework

Proof of Proposition 1: Consider the individual utility optimization problem under risk aversion and the best response function of parent m (mother):

$$\max u_{m;\{c,b\}} = c^{\delta} + \phi_m h(b,B)^{\delta} \quad s.t. \quad y = pc + pb$$

with $\delta < 1$ and $p < y < 1$

$$J_m^* = \begin{cases} 1 \quad if \quad \overbrace{J_f \cdot E_m\left[u_m(x''_{fm})\right] + (1-J_f)\cdot E_m\left[u_m(x''_m, x'_f)\right]}^{\text{E(U) of pooling}} \\ \qquad\qquad > \overbrace{(1-J_f)\cdot E_m\left[u_m(x'_m, x'_f)\right] + J_f \cdot E_m\left[u_m(x'_m, x''_f)\right]}^{\text{E(U) from nonpooling}} \\ 0 \qquad otherwise \end{cases}$$

Necessary Condition 1: B is valuable. Consider the opposite: $\lambda = 0$ (B not valuable), then:

$$E_m[u_m(x''_{fm})] < E_m[u_m(x'_m, x'_f)]$$

and

$$E_m[u_m(x''_m, x'_f)] < E_m[u_m(x'_m, x''_f)]$$

because of risk aversion. It follows that $J_m^* = 0$.
In fact, the best response function is weakly monotonically increasing in λ:

$$\frac{\partial E_m[u_m(x''_{fm})]}{\partial \lambda} \geq \frac{\partial E_m[u_m(x'_m, x''_f)]}{\partial \lambda} \geq 0$$

$$\frac{\partial E_m[u_m(x''_m, x'_f)]}{\partial \lambda} \geq \frac{E_m[u_m(x'_m, x'_f)]}{\partial \lambda} = 0$$

Necessary Condition 2: Parents want to buy B. Consider the opposite: $E_m(B'') = 0$, then:

$$E_m[u_m(x''_{fm})] < E_m[u_m(x'_m, x'_f)]$$

and

$$E_m[u_m(x''_m, x'_f)] \leq E_m[u_m(x'_m, x''_f)]$$

because of risk aversion. It follows that $J^*_m = 0$.

Necessary Condition 3: The best response function is monotonically decreasing in the expected preference difference for education $E_m[\Delta\phi]$:

$$\frac{\partial E_m[u_m(x''_{fm})]}{\partial E_m[\Delta\phi]} < \frac{\partial E_m[u_m(x'_m, x''_f)]}{\partial E_m[\Delta\phi]} < 0$$

$$\frac{\partial E_m[u_m(x''_m, x'_f)]}{\partial E_m[\Delta\phi]} < \frac{E_m[u_m(x'_m, x'_f)]}{\partial E_m[\Delta\phi]} < 0$$

The best response function is monotonically decreasing in inequality in decision-making weights $\Delta\tau = |1 - 2\tau_m|$ with $\tau_m < (1 - \tau_m)$:

$$\frac{E_m[u_m(x''_{fm})]}{\partial \Delta\tau} < \frac{\partial E_m[u_m(x'_m, x''_f)]}{\partial \Delta\tau} < 0 \qquad \textit{with} \quad \tau_m < (1 - \tau_m)$$

$$\frac{\partial E_m[u_m(x''_m, x'_f)]}{\partial \Delta\tau} < \frac{E_m[u_m(x'_m, x'_f)]}{\partial \Delta\tau} < 0 \qquad \textit{with} \quad \tau_m < (1 - \tau_m)$$

Necessary Condition 4: The best response function is monotonically increasing in risk aversion δ:

$$\frac{\partial E_m[u_m(x''_{fm})]}{\partial \delta} > \frac{\partial E_m[u_m(x'_m, x'_f))]}{\partial \delta}$$
$$> \frac{\partial E_m[u_m(x'_m, x''_f)]}{\partial \delta} > \frac{\partial E_m[u_m(x''_m, x'_f)]}{\partial \delta} > 0$$

E. Comment on Preanalysis Plan

Experimental design: The baseline budget for the cash versus voucher choice was adjusted to TZS 8,000 (US$3.60) because of constraints on total household payout imposed by the local authorities. Consequently, treatment levels were changed from -20%, 0%, 20%, 40% to -12.5%, 0%, 12.5%, 25%, 37.5% to ensure that joint budget values are round numbers. The decision-making structure remained unchanged.

Empirical strategy to study impact on test scores: Although the preanalysis plan specifies that experimental outcomes are related to several survey measures and school outcomes, it does not present an empirical strategy because of uncertainty about access to and the quality of test score data. I now employ a first-difference estimator that makes use of two rounds of test scores, one month before and five months after the study.

Empirical strategy to uncover mechanism: Unlike in the proposed analysis in the preanalysis plan, I focus on the joint decision dummy and voucher loss in percentage of the largest potential voucher conditional on individual preferences for the voucher. The latter makes the loss variable independent of this individual preference and simplifies the interpretation. However, the originally proposed specifications (outcomes: absolute value of voucher loss) are all reported in the Appendix A.

Chapter II

Behavioral Responses and Design of Bequest Taxation

Maksym Khomenko Simon Schürz

Abstract

This paper studies the optimal design of an inter-generational wealth tax, commonly represented by either inheritance or estate taxation. Depending on the tax design, old-age individuals can react with a number of responses, ranging from adjustments of wealth accumulation and inter-vivos gifts to changes in the distribution of inheritances among heirs. We leverage a unique and appropriate setup of Swedish inheritance taxation and rich administrative data. To understand individual responses to alternative tax schemes, we estimate a comprehensive structural model of wealth accumulation and bequest decisions in old age. We find that comparable inheritance and estate taxes result in sizable, but similar distortions to wealth accumulation and bequest distributions. By limiting strategic avoidance to wealth adjustments, estate taxation outperforms inheritance taxes in terms of tax revenues. Our model enables policymakers to design an intergenerational wealth tax that balances distortions, progressiveness, tax revenue and tax incidence according to the chosen social welfare functions.

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1. Introduction

Inherited wealth plays a key role in the intergenerational persistence of wealth inequality. This is why, there are active policy debates among economists and policy-makers regarding whether and how to promote social mobility by taxing estates or bequests.[1] While a large body of literature documents the intergenerational and across-family consequences of inherited wealth (Boserup *et al.*, 2016; Elinder *et al.*, 2016; Adermon *et al.*, 2018), the behavior of old-age individuals (bequest donors) with respect to bequests and their responses to taxation is poorly understood. This paper studies the outcomes of different intergenerational wealth tax designs, taking into account the variety of taxpayer reactions.

There are two types of intergenerational wealth transfer taxes commonly adopted around the world: estate and inheritance taxation. In the case of the estate tax, the base of the taxation is the terminal wealth of a deceased individual, whereas inheritance tax is levied on the individual bequest that each heir receives. In the latter case, family structure is an important determinant of the optimal decisions of donors, because exemption levels and marginal tax rates depends on the distribution of bequest across a number of heirs. Therefore, fundamental differences in tax design may lead to different behavioral responses and welfare implications. When donors choose how to optimally transfer wealth to a heterogeneous set of heirs, they can have multi-dimensional responses to intergenerational wealth taxation. For instance, old-age individuals may react by altering the wealth accumulation or use inter-vivos gift exemption levels to fall into lower marginal tax brackets (Joulfaian, 2006; Kopczuk & Lupton, 2007; Glogowsky, 2016). If the tax is levied on heirs, donors may decide to change the distribution of individual

[1] Currently fifteen US states collect an estate tax in place and six states tax inheritances. Maryland and New Jersey have both systems. In Europe, bequest taxation is in place in Denmark, France, Spain, Germany and Finland (inheritance tax) and the UK (estate taxation). A large number of European countries, such as Sweden, Norway, Austria, Hungary, and Portugal as well as several US states have repealed bequest taxation in the last 20 years with ongoing debates about re-introduction. See Figure A.1 in Appendix A for a geographic overview.

bequests to their offsprings. Adjusting the share of the terminal estate that heirs receive can position individual bequests at lower marginal tax rates.[2]

The trade-off that old-age individuals face under bequest taxation can be characterized as a *donor trilemma*. Essentially, old-age individuals gain utility from current consumption, the amount of total bequests and how the estate is split. An intergenerational wealth tax triggers a trade-off between these three factors since it reduces the total value of after-tax bequests to heirs. Depending on how donors address the trade-off, their responses affect tax revenues, the values and distribution of transferred wealth and donor utility. Additionally, responses to specific tax schemes interact with individual donor heterogeneity, such as family structure, age and initial wealth. The choice of tax design and taxpayer reactions to intergenerational wealth taxation are therefore inevitably related.

In this paper, we estimate a structural model of donor decisions to document how the complex nature of behavioral responses to bequest taxation plays out under a number of alternative policy designs. More precisely, using detailed data on bequests, wealth, family structure and characteristics of decedents and heirs in Sweden from 2001 to 2004, we estimate a dynamic model of donor decisions, which involves wealth accumulation, inter-vivos gifts, and end-of-life bequests. There is a number of reasons why this structural approach is appropriate and even necessary in this case. First, to define the optimal policy design, it is required to understand the outcomes of policies that have not been observed. By estimating policy-invariant individual preferences, insufficient variation in observed tax designs can be addressed. Second, the model uncovers the interplay between multiple responses to taxation, rather than pinpointing overall or partial elasticities to the tax using, for example, bunching estimators (Saez, 2010; Glogowsky, 2016; Escobar *et al.*, 2019). Third, we can inform policy-makers by studying counterfactual policy designs along several dimensions including wealth accumulation, bequests, and tax revenues.

[2] Additionally, in Sweden (1992-2004), bequests could be classified into lower tax brackets if heirs decided to cede part or all of the inheritance directly to their offsprings. We discuss this particular tax avoidance strategy in detail in Section 2C.

The model allows us to obtain the fundamental parameters that govern the donors' dynamic trade-off between consumption, the total amount of bequests and the split among heirs. Each period, an old-age individual decides on a fraction of wealth to be consumed or transferred to descendants as gifts. The remaining wealth is conserved for the next period when, depending on whether the old-age individual survives, it is either bequeathed or subject to the same choices. The donor also anticipates that in the case of death, she or he will decide on a split of the terminal wealth among heirs. Finally, the utility from bequeathing is derived from the total after-tax bequest value and the way bequests are split among the potential heirs.

To understand how donors allocate bequests to heirs, it is required to identify policy-invariant bequest preferences. In other words, the model needs to capture the donor's motivation to split the terminal wealth in a specific way in the absence of any taxation. For this purpose, we exploit variation in family structure, wealth and the presence of a ceding rule in the Swedish inheritance tax. This rule allows heirs to transfer all or part of the bequest to direct offsprings upon receipt. Thus, the heir can minimize or even eliminate the tax bill because each recipient of a cede can again make full use of individual exemption levels.[3] We show that a subgroup of donors, whose heirs can all cede and potentially avoid the entire tax bill, do not distort their bequest distribution away from their true preferences as a reaction to taxation.

Following the conventional approach in the literature, we estimate the structural model in a two-step procedure (French, 2005; Lockwood, 2012; Blundell *et al.*, 2016). First, policy-invariant donor preferences for splitting terminal wealth among heirs are recovered by exploiting the variation in family structures and characteristics of donors and heirs in a subsample of decedents. The obtained parameters then enter a second stage, in which we estimate a dynamic life-cycle model à la Blundell *et al.* (2016) and Lockwood (2018).

[3]Ohlsson (2007) and Escobar *et al.* (2019) document this incentive for Swedish heirs and shows that it is a widely used practice.

Using the resulting parameter estimates, counterfactual wealth paths and bequests are simulated under various tax schemes. We find, compared to the no tax case, that donors accumulate significantly lower levels of wealth in old age when intergenerational wealth transfers are taxed. When taxes are progressive, this effect is mainly driven by individuals at the upper tail of the wealth distribution. Consequently, estates are lower and large masses in the bequest distribution are allocated below the kinks of the marginal tax rates. Estate and inheritance tax schedules perform similarly in terms of distortions when marginal tax rates are comparably progressive. Importantly, estate taxes lead to higher tax revenues because they limit donor responses to the adjustment of terminal wealth. Under inheritance taxation, donors can react to the policy by adjusting each individual bequest. Generally, we find that the more flexible the policy is in terms of allowing the donor to react based on the family structure, the higher are the behavioral responses that distort wealth and bequest distributions as well as tax revenues.

This paper contributes to the literature on bequest taxation in several ways. Broadly speaking, this paper is related to a number of papers studying the life-cycle behavior of old-age individuals that, among other things, involve wealth accumulation and bequest decisions (French, 2005; Laitner *et al.*, 2018; Lockwood, 2012, 2018). Our contribution is to propose a novel model to analyze inheritance tax designs under multiple behavioral responses and several dimensions of policymaker objectives. The comprehensive structural model covers taxpayer reactions from adjusting the wealth accumulation (Slemrod & Kopczuk, 2000; Joulfaian, 2006; Kopczuk & Lupton, 2007), inter-vivos gifts (Joulfaian, 2005; Ohlsson, 2011) and strategic changes in individual bequests. It allows studying consequences of such responses on wealth holdings, bequest distributions, and government tax revenues. An important feature of the institutional setting of Sweden is its generous social security system, which includes elderly and health care. It allows us to recover behavioral patterns which are distorted by precautionary saving behavior only to a very minor extent. Therefore, this institutional set-up is particularly suitable to study this question in comparison to, for

instance, the US, where precautionary saving motives must be an important determinant of the end-of-life wealth decisions (Nardi *et al.*, 2016; Lockwood, 2018).

To our knowledge, this paper is the first to estimate such a comprehensive model of bequeathing with detailed micro-level data. In particular, the structural empirical approach is crucial to overcome the complexity of the problem, to deal with limitations of data availability and to ensure the possibility of studying these policy counterfactuals of interest. In particular, it addresses the common problem of non-identification of policy-invariant bequest preferences due to the lack of micro-level data on bequests when no taxation is in place. By providing a micro-level analysis of old-age individual behavior, we complement macro evidence on life-cycle models (De Nardi, 2004; Piketty & Saez, 2013; De Nardi & Yang, 2014) and reduced form evidence on bequest distribution (Light & McGarry, 2004; Erixson & Ohlsson, 2014; Escobar *et al.*, 2019).

More generally, we contribute to the literature on intergenerational wealth taxation by empirically studying the equity-efficiency trade-off under taxpayer responses (Piketty & Saez, 2013). We also touch upon research on bequest motives (Barro, 1974; Becker & Tomes, 1979; Behrman *et al.*, 1982; Cox, 2003; Arrondel & Masson, 2006; Lockwood, 2012, 2018) by incorporating the decedent's altruistic and equality preferences.

The remainder of the paper is structured as follows: Section 2 describes the data, the Swedish institutional background and provides a descriptive analysis of bequest distributions. Section 3 discusses the structural model and Section 4 presents the estimation strategy. Section 5 introduces the counterfactual analysis and reports the results. Section 6 concludes.

2. Data, Institutional Environment and Sample Selection

2.1. Data Sources

The study draws on a population-wide dataset on all bequests in Sweden between 2001 and 2004 provided by the Statistics Sweden (SCB). This so-

called *Belinda* Population Database is a complete dataset of inheritances from 2001-2004 including an identifier for the deceased, the value of the terminal estate, the individual bequests and tax payments, and identifiers and characteristics of the heirs.[4] The bequest database is merged with detailed registry data to obtain background information on donors and heirs, such as labor market status, demographic characteristics, education, and income (LISA database). Importantly, we are able to use detailed individual information on wealth from the wealth (Förmögenhetsregistret) and tax registry data (Inkomst- och Taxeringsregistret) for our study period. The wealth data include real and financial assets as well as debt and is available for the period 1999 to 2007, when the Swedish wealth tax was abolished. The Swedish Multi-generational Registry is used to identify relationships between decedent and heirs and between heirs. To proxy expected conditional survival probabilities by age and gender, we use life tables provided by SCB.

2.2. Institutional Details

Bequest taxation has had a long-standing tradition in Swedish tax policy. From 1885 to 2004, intergenerational wealth transfers were taxed at the heir level (Henrekson *et al.*, 2014). After peaking in 1970, the tax rates decreased steadily until the abolition, which was motivated by high administrative costs compared to small revenues and a long-lasting opposition by entrepreneurial interest groups. While fiscally not important, the main purpose of the tax was the reduction of intergenerational transfers at the upper end of the wealth distribution. To adhere to the ability-to-pay principle of taxation, the scheme was designed in a progressive fashion (Kendrick, 1939).

The inheritance and gift ordinance (*Lagen om arvs- och gåvoskatt*) stipulates the legislation for intergenerational wealth transfers. If an individual passes away, the decedent's estate is documented in the inventory estate report, which contains real and financial assets, private insurance, consumer

[4]See Elinder *et al.* (2014) for a detailed description of the database.

durables, and debt. If the decedent is a surviving spouse herself, it may also include part of the spouses' wealth (*giftorätt*).

Inheritance rules define the default succession order and the distribution of bequests. If the decedent is survived by the spouse, she or he inherits the entire estate, except if the decedent has children with a different partner. The spouse has free disposal of the inheritance but cannot alter the bequest distribution set by the decedent. Such inheritances from previous decedents are separately marked in our data and we will consequently exclude spousal bequests from the analysis. Otherwise, the first non-empty parentelic group inherits equal splits of the final estate. Adoptive children are equal to biological offsprings before the law. Further groups are considered only if there are no heirs in the previous group. Any inheritance intended for a minor under 18 is directed towards the legal guardian of the child. Therefore, we will focus on heirs aged above 18 years.

A stipulated will can redefine the order and distribution of bequests with the limitation that a fraction, 50% of the hypothetical inheritance in absence of a will, is reserved for direct descendants (*Laglotter*). This puts institutional non-binding boundaries on how terminal wealth can be split among heirs. Clearly, wills are also set up for other purposes than unequal splits, for instance, the inclusion of further heirs or specific property transfer. Therefore, a will is a necessary but not sufficient condition for unequal bequests. Gifts and insurance claims are included in the legislation. In our study period, they were generally taxed independently of their intergenerational character, but gifts within 10 years prior to the death are taxed jointly with inheritances under the *summation rule*. This measure was introduced to counteract tax avoidance. Furthermore, gifts represent a way of transferring wealth to a set of heirs unequally in the absence of a testament. If an heir receives an inheritance, she or he can decide to cede a part or the total amount of the value to direct heirs, e.g. grandchildren of the decedent. When ceding, both the sender and the recipient can make full use of the individual inheritance tax exemption levels. This practice was widely used as a legal form of tax avoidance (Ohlsson, 2007; Escobar *et al.*, 2019).

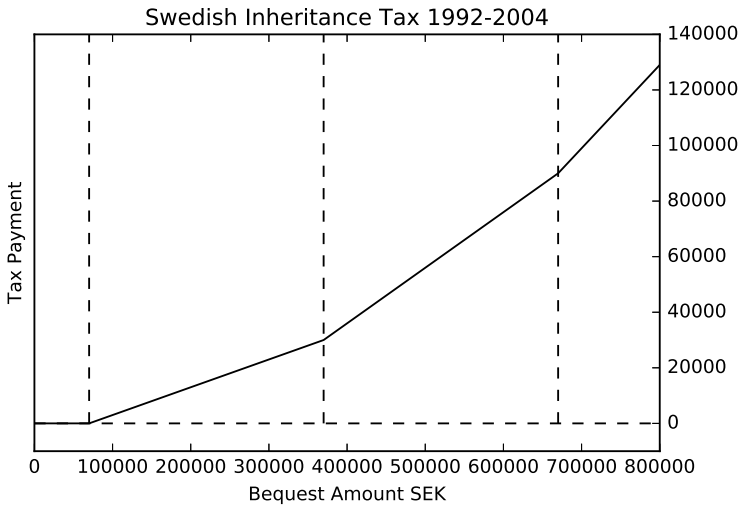


Figure 1: Kinks in the Swedish Inheritance Taxation for Parentelic Group 1

Notes: Tax scheme for the first parentelic group (spouses, children, grandchildren) with an exemption level of 70 000 per heir. Kinks of the marginal tax rate at SEK 370 000 and 670 000.

The tax scheme in our study period is made up of three brackets. The details of the tax brackets are displayed in Table 1. Inheritances to the first parentelic group (except spouses) over 70.000 SEK were taxed with 10%, followed by 20% and 30% rates for bequests exceeding 300.000 and 600.000 SEK, respectively. We focus on the tax scheme for most direct descendants, further schemes for relatives, friends and institutional recipients differ in exemption values, but not in marginal tax rates. Figure 1 depicts how the changes in marginal tax rates result in kinks in the overall tax scheme.

2.3. Potential Responses under Swedish Inheritance Taxation

The Swedish inheritance tax between 1992-2004 allows the donor to respond to the tax in multiple ways. Old-age individuals can adjust their terminal wealth, such that the total tax burden for heirs is reduced or the intended

Table 1: Tax Schedule for Children, Spouses and Grandchildren, 1992-2004

Tax bracket, SEK	Tax (lump sum + tax rate)
0 - 300 000	0 + 10%
300 000 - 600 000	30 000 + 20%
> 600 000	90 000 + 30%
Basic Exemptions, SEK:	**Amount**
Children:	70 000
Gifts:	10 000

Notes: This tax scheme represents the marginal tax rates and exemption levels for the first parentelic group, including an annual inter-vivos gift exemption of SEK 10 000.

after-tax value of bequests is conserved. Changes in terminal wealth are achieved either with higher or lower levels of consumption or with gifts, which have a yearly tax exemption of 10 000 SEK. The sign of the wealth adjustment is theoretically ambiguous and depends on the utility weights that are placed on consumption and bequests. The optimal response to a tax with a change in the level of wealth, however, requires high planning efforts and is costly due to uncertainty regarding the timing of death.

To give an example of a possible wealth response to taxation, consider a donor with wealth SEK 160 000, who wants to equally bequeath to her two children. She can gradually decrease her wealth via gifts or consumption, such that the terminal wealth of 140 000 positions both individual bequests (SEK 70 000 each) below the first tax bracket.

Alternatively to changes in the terminal wealth, an inheritance tax, which is based on the heir level, allows the donor to respond by adjusting individual bequests. By stipulating a will, the donor can change the relative shares to heirs in order to place one or several individual bequests at or below the thresholds of tax brackets. While this strategy may limit distortions in the wealth accumulation, it requires the donor to depart from the preferred split of bequests.

For example, a donor who wants to leave SEK 50 000 and 100 000 to her/his two children, respectively, may want to switch to a SEK 70 000/80 000 split in order to save SEK 2 000 in taxes.

Last but not least, ceding is a modification of the bequest distribution conducted by the heirs. Under the Swedish inheritance law, a bequest can be dissipated downstream within the family line. Ceding is therefore limited to heirs who have descendants of their own. In particular, if ceding can eliminate the entire tax bill, donors may not exhibit any response to taxation.

For example, an heir that receives a bequest of SEK 200 000 may want to cede SEK 70 000 to each of her two children (the donor's grandchildren), such that, due to the individual exemption levels, all three individual bequests then fall below the first tax bracket. Table 2 summarizes all potential donor responses and alternatives for legal tax avoidance.

If the bequest taxation takes the form of the estate tax, adjusting the terminal estate through wealth decumulation and inter-vivos gifts are the only available responses to old-age individuals. In this paper, we focus on wealth adjustment through consumption, gifts, and changes to individual bequests. As we document, these responses are widely used in Sweden 2001-2004 and are available to donors in most countries with bequest taxation.[5] The ceding rule is very specific to the Swedish context and plays a key rule in identifying the interaction of the remaining responses to inheritance taxation. For simplicity and due to extremely low incidence and special tax exemptions, we exclude the strategic component of bequeathing to non-children heirs and assume a constant share per donor that is left to these types of heirs.

[5] It is important to note that theoretically there exists another strategy to avoid bequest taxation based on asset shifting. Wealth can be held in various ways, with different assets in the estate report being evaluated at different proportions of their market values. Although it would require extensive tax planning, individuals could shift their wealth towards low-evaluation assets in view of their imminent death. Escobar (2018) shows that even for spousal bequest in Sweden, for which this strategy should be easier to implement, estate values do not differ between decedents with sudden and disease-caused deaths. This suggests that updated information on the imminence of death did not cause asset-shifting to avoid taxes.

Table 2: Strategic Responses and (legal) Incentives for Bequest Tax Avoidance

	Estate Taxation	Inheritance Taxation
Wealth accumulation	✓	✓
Within family distribution	—	✓
Gifts	✓	✓
Cedes	—	(✓)

Notes: The availability of strategic responses of donors to inheritance and estate taxes depends on the definition of the tax-base. Taxation at the heir level allows for additional reactions by adjusting the distribution of bequests among heirs or, if the legislation provides this possibility, by ceding.

2.4. Undistorted Bequest Distribution

A crucial step to study responses to bequest taxation is the identification of preferences that govern the donor's decision to allocate individual bequests to heirs, i.e. how to split the terminal wealth among potential heirs. Due to the ceding rule in the Swedish institutional set-up, heirs could transfer part or all of their bequests to direct descendants upon receipt and thereby minimize the tax bill. This final bequest distribution in the data is significantly distorted by taxation and does therefore not allow us to assess policy-invariant bequest preferences of donors. By aggregating bequests over family lines that originate at the children of the donor, we can eliminate any such distortions from the ceding rule. The resulting distribution reflects true bequest preferences for children's family lines, if i) all children of the donor had the possibility to cede, ii) these children were, on their own, able to eliminate the entire tax bill of the donor through ceding and iii) after aggregating over family lines, the sample distribution of bequests is smooth, in particular at the kinks of the tax schedule. While conditions i) and ii) ensure that there are no strategic responses of the donor with respect to a subset of heirs, the smooth distribution suggests that donors' choices are not distorted by any other form of bequest adjustment.

Figure 2 shows that before the aggregation, there is a massive bunching of individual bequests at the first tax kinks (70 000 SEK) of 3.5 times the av-

erage height of neighboring distribution bins. After aggregating, it becomes clear that ceding constitutes 90.6% of this excess mass. According to the set of potential legal avoidance mechanisms, the remaining bunching at the kink could originate from wealth adjustment or distortions in the optimal bequest distribution of donors.

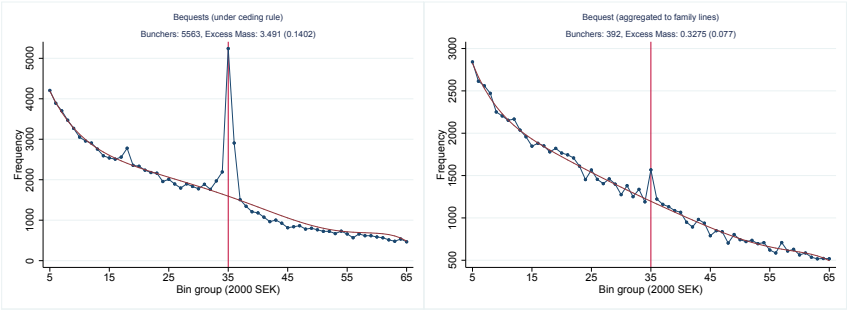


Figure 2: Raw Data vs. Aggregated over Family Lines

Notes: The graph on the left-hand side plots the raw bequest distribution. Bunching at the first kink of the marginal tax rates is mostly attributable to the ceding rule. When aggregated over family lines (to reverse the ceding rule) a much smaller, yet significant excess mass at the kinks remains.

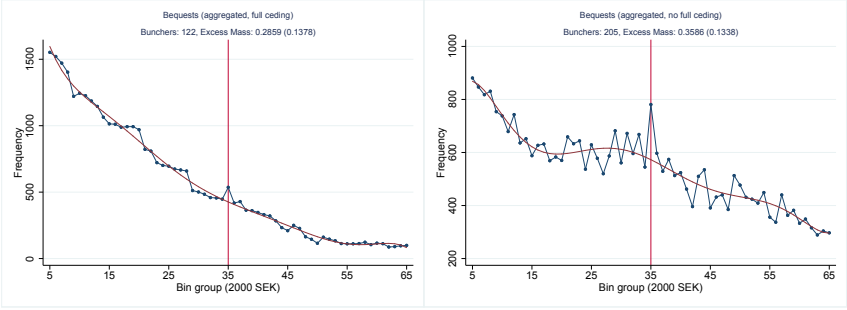


Figure 3: Aggregated over Family Lines and Full Ceding Possible

Notes: The graph on the left-hand side plots bequests aggregated over family lines for donors, whose children can fully eliminate the tax bill through the ceding rule. The complementary subgroup of donors, whose children cannot fully eliminate the tax bill through ceding, is shown on the right-hand side.

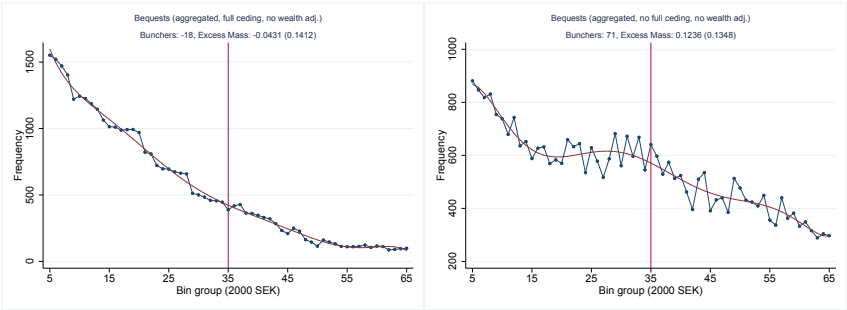


Figure 4: Aggregated over Family Lines, Full Ceding Possible and Estate Adjustment

Notes: The graph on the left-hand side plots bequests aggregated over family lines for donors, whose children can fully eliminate the tax bill through the ceding rule. It further excludes donors whose terminal wealth divided by the number of children results in bequests precisely on the tax kink ($\gtrless$ SEK 500) in case of equal splitting. The complementary subgroup of donors, whose children cannot fully eliminate the tax bill through ceding and do not adjust wealth, is shown on the right-hand side.

Figure 3 shows that donors, whose heirs do not fulfill conditions i) and ii) (right-hand graph), are concentrated over-proportionally at the tax kink compared to the bequest distribution of heirs, who can eliminate the entire donor tax bill through ceding (left-hand graph). The bunching excess mass of 0.358 (0.134) for heirs, who cannot fully cede, exceeds the value of their ceding counterparts of 0.286 (0.138). Furthermore, the right bequest distribution exhibits non-smoothness at several intervals.

Finally, the left-hand graph of Figure 4 provides evidence that any remaining bunching of donors, who can fully cede, is entirely explained by wealth adjustments. These are decedents whose estates divided by the number of children falls within a close range of the tax kink. Since wealth adjustment will be captured in the donor's wealth accumulation part of our model, the bequest distribution aggregated over family lines is undistorted. The right-hand graph of figure 4 shows that the distribution for heirs who cannot fully cede is not smooth, even after accounting for strategic wealth adjustments by donors.

In the remainder, we proceed by estimating *true* undistorted bequest preferences on a subsample which excludes those donors, for which at least one child is unable to cede to a direct offspring. Notice that while we estimate undistorted, optimal preferences with this selected sample, the estimation of the dynamic problem including wealth accumulation and bequest shares as well as all counterfactual simulations are conducted on the full sample of aggregate family line bequests.

2.5. Samples

After restricting the universe of decedents to surviving spouses aged above 65 (to capture intentional bequests) with up to four children, the sample includes 61 044 donors. Summary statistics of decedents and heirs are presented in Table 3. Estates are on average 226 519 SEK while bequests received by a child's family line amount to 115 068 SEK. Around 3% of decedents distribute the inheritance unequally across the children's family lines (the within-family standard deviation greater than 1000 SEK). A fifth of the decedents have stipulated a will and about 9% have transferred wealth to their heirs via inter-vivos gifts within ten years prior to their death.

The subsample used to recover bequest preferences from the undistorted distribution of inheritance is restricted to old-age individuals, of whom all heirs had the possibility to fully cede and eliminate the entire tax bill. We identify these heirs by matching them to their direct offsprings via the Swedish Multi-generational Register. This subsample is selected and shows on average smaller estate and bequest values. This is for two main reasons. First, rich donors would require the heirs to have a large number of descendants to enter this subsample and second, heirs with numerous direct offsprings may receive higher values of inter-vivos gifts. This implies that the true bequest preferences are identified locally on the lower part of the wealth distribution. However, when estimating them we therefore allow for heterogeneity by wealth and number of children. The full and ceding subsample are is well-balanced with respect to all other covariates.

Table 3: Summary Statistics

	Full Sample		Full Ceding Sample (preference estimation)	
Heir Characteristics	Mean	Sd	Mean	Sd
Bequest	121087.8	(298984.7)	59822.0	(73320.8)
Share	0.506	(0.260)	0.561	(0.284)
Heir female	0.495	(0.500)	0.517	(0.500)
Education of heirs	11.52	(2.162)	11.35	(2.096)
Married heir	0.586	(0.493)	0.692	(0.462)
Age of heir	54.11	(9.577)	56.46	(7.936)
Income of heir	2024.9	(2746.6)	1922.0	(2585.1)
Observations	123659		58460	
Donor Characteristics				
Estate size	241106.6	(497310.1)	107260.2	(93262.0)
Will	0.195	(0.396)	0.167	(0.373)
Inter-vivos transfers	0.0942	(0.292)	0.0846	(0.278)
Donor female	0.664	(0.472)	0.716	(0.451)
Education of donor	11.57	(3.826)	11.72	(4.051)
Age at death	84.10	(9.065)	85.91	(7.430)
Wealth at death	597325.9	(2076097.2)	296266.6	(362468.1)
Number of children	2.677	(0.747)	2.610	(0.725)
Unequal split of bequest	0.0315	(0.175)	0.0185	(0.135)
Observations	64707		33970	

Notes: Education denotes years of schooling, coded consistently with Holmlund *et al.* (2011): 9 years for primary school, 9,5 for post-primary school, 11 for short high school, 12 for long high school, 14 for short university, 15.5 for long university and 19 for PhD university education.

3. Wealth Accumulation and Bequest Model

We now introduce a dynamic life-cycle model of a retired individual who plans the wealth path and end-of-life bequests in the spirit of De Nardi *et al.* (2010) and Lockwood (2018). In an environment with a strong welfare state, old-age individuals jointly optimize utility from consumption and bequeathing, i.e. warm glow. The latter is a function of both the total value

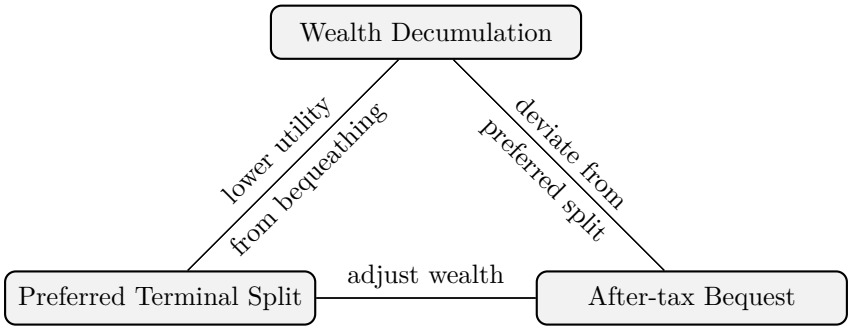


Figure 5: The "Bequest Trilemma" Under Bequest taxation

Notes: The nodes define three objectives of the donor, when making decisions in old-age on wealth accumulation and bequeathing. The edges show the individual's reaction in order to keep the objectives in the two connected nodes constant when a bequest tax is levied on inter-generational transfers. As the preferred terminal split does not play a role under estate taxation, the trilemma is transformed into a dilemma under such a tax scheme.

of the bequest and the split among heirs. Introduction of a tax on inter-generational wealth transfers creates a trade-off between the two sources of utility. In the absence of any response, the tax reduces after-tax bequests. Depending on the tax design, the donor can change the wealth accumulation process or the way the terminal wealth is split among heirs to re-optimize her utility.

Figure 5 shows this 'trilemma' of an old-age individual when the the bequests are subject to taxation. If the individual decides to keep the wealth path and bequest distribution unchanged, the tax will reduce utility from the value of the post-tax bequest. If the preferences for a specific wealth path and the after-tax value of bequests dominate the desire to split the terminal wealth in the specific way, then a deviation from the initially preferred split delivers a tax-relief. Finally, if the preferred split and after-tax bequests ought to be undistorted, wealth adjustments or inter-vivos gifts are the tools to maximize utility.

Consequently, individual behavior is summarized by three groups of parameters. The first group of parameters describes the trade-off outlined

above and represents the main object of interest in this paper. More precisely, these parameters represent the weight an old-age individual places on after-tax bequests and a bequest split among heirs relative to consumption. The second group of parameters is solely related to the donor preferences over how bequests are distributed to children, conditional on donor and heir characteristics. The third group includes parameters of a standard life-cycle model without labor choice, namely a discounting rate and risk aversion.

Essentially there are three building blocks of the model: a dynamic problem of wealth accumulation in old age, utility from bequeathing and policy-invariant preference for giving individual bequests to the potential set of heirs.

3.1. Life-Cycle Problem of Old-Age Individuals

Consider an old-age individual who acts in the model from the time of retirement at 65 ($t = 0$) and up to the age 100.

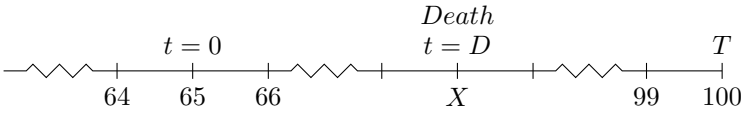


Figure 6: Dynamic Model Time-Line

In each period, individuals maximize expected discounted utility of consumption and bequests by choosing the consumption path $\{c\}_{t=1}^{T}$ and the vector of individual bequest split $s = \{s_1...s_j\}$ to children $1...J$ if the donor dies in the following period. This implies that the model assumes that individuals can adjust the allocation costlessly in every new period. By consumption in this model, we mean either actual consumption or inter-vivos gifts to children using the yearly tax exemption of SEK 10 000 or higher.[6]

[6]Any inter-vivos gifts above the exemption within 10 years prior to death are taxed as inheritance and should, therefore, be inelastic to changes in the tax rate. Uncertainty over future wealth shocks makes transfers above the basic annual exemption for gifts costly for the bequest donor.

The value of holding individual wealth W at $t+1$ depends on the probability of surviving $1-D$ and the utility of bequeathing B in case of death D. The value function of this dynamic programming problem at time t consists of the utility from consumption and gifts and the expected value function at time $t+1$, discounted by a factor δ.

$$V_{it}(W_{it}) = u(c_{it}) + \delta \left[D_{it} \overbrace{B(s, W_{it+1})}^{\text{Bequest Utility}} + (1 - D_{it}) \overbrace{E_{it}[V_{it+1}(W_{it+1})]}^{\text{Utility of Survival}} \right] \quad (1)$$

We assume a CRRA utility function of consumption with risk parameter η:

$$u(c) = \frac{(c)^{1-\eta} - 1}{1 - \eta} \quad (2)$$

Old-age individuals have rational beliefs about survival probabilities in line with mean death probabilities conditional on age and gender (D).[7] The only state variable directly affected by the individual's choice at time t is the next period wealth W_{t+1}, which is either kept as wealth or transformed to estate if the individual dies. Wealth evolves as an auto-regressive process with normally distributed random shocks v. The donor's consumption possibility is restricted to her wealth, which implies that borrowing is not allowed in the model. Income is fairly stable in the data and mainly consists of pension income and social benefits. Therefore, donors are assumed to expect to receive their mean observed income in future periods. The formulation of wealth evolution leaves the possibility of a negative realization of wealth. We allow for a minimalistic uncertainty structure since we do not observe large wealth fluctuations in the data.

$$W_{i,t+1} = W_{it} + (y_{it} - c_{it}) + v_{it} \quad (3)$$

$$v_{it} = \mathbb{N}\left(0, \sigma_W^2\right) \quad (4)$$

[7] We ignore the marginal endogeneity of survival with respect to taxes, as documented in Kopczuk & Slemrod (2003) and Eliason & Ohlsson (2013).

3.2. Bequest Utility

Next, consider the bequest function B, which determines the interplay between wealth accumulation and bequeathing. We adopt the general functional form for bequest utility from Lockwood (2018), which generalizes the approaches used in the literature. It allows capturing a range of components of bequest preferences. For instance, it implies that bequest motives kick in after a consumption threshold c_b. Under this value, individuals do not leave bequests. If $c_b > 0$, bequests are a luxury good, over which individuals are less risk-averse than over consumption. λ_1 denotes the marginal propensity to bequest from left-over wealth after consuming at least c_b.

This functional form is combined with a term with weight λ_2, which represents the donor's preference on how to split bequests among the potential heirs. Essentially, the model punishes the donor for deviating from preferred individual bequest shares $s^* = \{s_1^*, ..., s_j^*\}$. This vector s^* represents the policy-invariant preferences for bequeathing to specific heirs with a specific share of the terminal estate. As discussed above, the donor might deviate and choose a different vector $s = \{s_1, ..., s_J\}$ if it reduces the tax bill by placing individual bequests at lower marginal tax rates.

$$B\left(s, s^*, W\right) = \overbrace{\left(\frac{\lambda_1}{1-\lambda_1}\right)^{\eta} \cdot \frac{\left(\frac{\lambda_1}{1-\lambda_1} \cdot c_b + \sum_{j=1}^{J}(1-\tau_j) \cdot s_j \cdot W\right)^{1-\eta}}{1-\eta}}^{\text{utility from after-tax bequests}} + \lambda_2 \cdot \overbrace{\left(g(s_1^*, ..., s_J^*) - g(s_1, ..., s_J)\right)}^{\text{Disutility from deviating}} \tag{5}$$

Parameters λ_1 and λ_2 represent the weights of this pair of bequest utilities with respect to the utility from consumption and inter-vivos gifts (weight normalized to 1). As λ_2 is sensitive to the number of children, we allow it to vary with this characteristic.

3.3. Bequest Preferences

The preferred split of the terminal estate s^* is specified as the bequest shares that a donor would choose in the absence of the intergenerational wealth. We assume that each donor has a utility function over the bequest shares that her children $j \in 1, ..., J$ receive.

$$g = \sum_{j=1}^{J} \exp(\phi_j) \cdot \log(s_j) \tag{6}$$

The preference parameter ϕ_j determines how large the bequest to child j is relative to the siblings. However, ϕ_j does not include equality preferences, which are captured by switching costs of deviating from the default option of equal shares defined below. Preference parameter ϕ_j is parametrized to be a linear function of observable heir characteristics $\phi_j = \alpha X_j$, where X_j contains age, gender and income. We denote the vector of preferred shares as:

$$\hat{s} = \{\hat{s}_1, ..., \hat{s}_J\} \quad \text{with} \quad \hat{s}_j = \frac{\exp(\phi_j)}{\sum_{k=1}^{J} \exp(\phi_k)} \tag{7}$$

Motivated by the prevalence of exactly equal allocations in the data (the default split in the institutional set-up in the absence of the will), we assume that donors face fixed costs ψ of deviating from a vector of equal shares $1/J$. These fixed switching costs reflect both a preference for equality across children and monetary costs of deviation, such as writing a will. We assume that switching costs are normally distributed with variance σ_ψ^2 and with linear in observables mean:

$$\psi_i \sim N(\beta Z_i, \sigma_\psi^2) \tag{8}$$

where the set of donor characteristics Z_i includes a constant, years of schooling, age at death, estate value and dummies that control for the number of children of the decedent.

If the difference between utilities derived from the vector that maximizes g and equal shares $\frac{1}{J}$ is smaller than these switching costs (ψ), the individual remains with the default of the equal share allocation and chooses to be optimal split otherwise:

$$s^* = \begin{cases} \{\hat{s}_1, ..., \hat{s}_J\} & \text{if} \quad g\left(\hat{s}_1, ..., \hat{s}_J\right) - g\left(\frac{1}{J}, ..., \frac{1}{J}\right) > \psi \\ \{\frac{1}{J}, ..., \frac{1}{J}\} & \text{otherwise} \end{cases} \tag{9}$$

3.4. Solution Method

The model is solved using backward induction from a terminal age 100. The model has two choice variables: consumption and bequest shares. We discretize bequest shares depending on the number of children using steps of 5% in addition to equal split shares. For example, for a family with three children, equal split shares are 33%, which would not be covered by a 5% grid.[8] The discretization yields a number of bequest allocations depending on the number of children. For instance, a donor with two children has the following choices: $(25\%, 75\%)$, $(30\%, 70\%)$, ... , $(50\%, 50\%)$, ... , $(70\%, 30\%)$, $(75\%, 25\%)$. Note that the allocations, in this case, are limited to an individual minimum of 25% per child because of the legal restriction that each heir is eligible to a minimum of 50% of the default allocation.

Introducing both a discrete (shares) and a continuous (consumption) choice variable does not suffer from the problem associated with secondary kinks in the value function (Fella, 2014; Blundell *et al.*, 2016; Iskhakov *et al.*, 2017). The reason is that the time-invariant bequest utility is only a function of terminal wealth and bequest shares and can be pre-computed on a wealth grid. These pre-computed values are then used to solve the dynamic model with linear interpolation if the realized value of wealth is not on the grid point. Hence, the dynamic problem only involves one continuous choice

[8]This discretization could be avoided with continuous shares. However, besides avoiding computational issues, it is likely that individuals think in terms of such discrete shares which is supported by the data.

variable conditional on precomputed utilities of bequests for various wealth levels.

In the estimation, the state variable wealth is discretized and inter- or extrapolation is used when the state variable value is not on the grid. To integrate over wealth shocks, we employ Hermite quadratures. The solution method is roughly the same as in, e.g., French (2005) and Lockwood (2018). The main difference is related to the structure of the bequest function. It includes additional parameters and introduces a richer structure of the donor bequest decision required to study the responses to bequest taxes.

4. Estimation

To estimate the model, we use the Simulated Method of Moments (SMM). It extends the minimum distance estimator to cases when a closed form solution of the problem cannot be obtained. The estimation of life-cycle style models is usually separated into two steps. In the first stage, all parameters that can be identified without solving the model are estimated. In the second stage, these parameters are fed into the estimation process of the remaining parameters, which requires solving a dynamic model. Such a two-step procedure allows reducing the computational costs of repeatedly solving the dynamic model to search for a large set of parameters.

In our model estimation, we use this two-step approach to first estimate bequest preference parameters that define the preferred vector of bequest shares. To identify these parameters, we leverage the *ceding rule*, which is a special institutional feature of Swedish inheritance tax. It provides a unique opportunity to identify these policy-invariant preferences without a need to observe bequests in the absence of taxation. The rule enables heirs to transfers part or all of the received bequest directly to their own descendants, i.e. grandchildren of the deceased. Ceding is therefore only available to those heirs who have children of their own. As discussed in Sections 2D and 2E, we use a subset of decedents for whom all children have the possibility to fully cede and avoid all taxes. As a result, bequest

shares observed for old-age individuals in this sample represent their true preferences and allows us to recover the underlying parameters α, β and σ_ψ.

The estimates of step one are used in the second stage, i.e. the dynamic model. Here we recover the remaining parameters for the wealth accumulation and the bequest utility function $\lambda_1, \lambda_2, \eta, c_b, \sigma_W$. We use a discount factor δ from the literature since it is not well-identified separately from other parameters of interest. The remainder of this section describes the estimation of the first- and second-stage parameters.

4.1. Bequest Preferences - Stage One

We start by estimating preferences for bequest shares. From equation (9), the probability of donor i to deviate from the equal allocation is defined as:

$$P_i = F\left(\frac{g_i\left(\hat{s}_1, ..., \hat{s}_J\right) - g_i\left(\frac{1}{J}, ..., \frac{1}{J}\right) - \psi_i}{\sigma_\psi}\right) \tag{10}$$

where $F(\cdot)$ denotes the normal cumulative density function. It describes the probability that individuals' switching costs are lower than the utility gains from deviating from the equal share default. Consequently, the expected allocation of bequest shares to children is given by the weighted sum of unequal and equal share vectors.

$$\{s_1^*, ..., s_J^*\} = P_i \cdot \{\hat{s}_1, ..., \hat{s}_J\} + (1 - P_i) \cdot \left\{\frac{1}{J}, ..., \frac{1}{J}\right\} \tag{11}$$

There are two important clarifications regarding donor and heir characteristics used in this part of the model. First, the matrix X does not contain a constant. The reason is that bequest preferences are modeled as shares, which implies that only characteristics of heirs in relation to each other matter. Second, Z contains dummies for the number of children to adjust each donor's switching cost to the family structure. We set a constant term in Z to 1 since it is also not identified separately.[9]

[9]More precisely, a constant parameter of switching costs is not identified separately from the level of parameters in Z.

This first-stage model implies that the vector of heir-level coefficients and the parameters of the distribution of switching costs are estimated jointly: $\varphi = \{\alpha, \beta, \sigma_\psi\}$. We use the Generalized Method of Moments to find parameters that match the moments of the observed bequest distribution for the *ceding* subsample.

$$\varphi^* = \arg\max(m(\varphi) - \hat{m}(\varphi))' W (m(\varphi) - \hat{m}(\varphi)) \tag{12}$$

where $m(\varphi)$ are the observed moments of the data that we match, $\hat{m}(\varphi)$ denotes the corresponding moments generated by the model and W, the optimal GMM weighting matrix. We match two groups of moments. First, we match a percentage of non-equal splits by a number of kids and age bins $\{< 75, [75; 85), \geq 85\}$. Second, since the preferences over heirs are primarily informed by those who actually give unequal bequests, we match the distribution of shares for those heirs who deviated from the default.[10]

4.2. Dynamic Model - Stage Two

Upon estimating the first-stage parameters, we proceed to recover the parameters of the life-cycle model in the presence of the Swedish inheritance tax scheme of 1992-2004. More precisely, these are the parameters that give utility weights to bequests, the parameter of standard deviation of the wealth process and a risk preference parameter:

$$\xi = \{\lambda_1, \lambda_2^{2kids}, \lambda_2^{3kids}, \lambda_2^{4kids}, c_b, \sigma_W, \eta\}$$

To identify the parameters of interest, we use a discount factor $\delta = 0.96$ in line with De Nardi (2004) and De Nardi & Yang (2014).[11] Probabilities of survival conditional on age and gender are recovered from the life tables provided by the Statistics Sweden (SCB). Due to the evaluation of the estate by the tax authority at below-market prices, each individual knows with

[10] Equal splits also inform parameters since preferences over heirs also affect how large the fixed costs should be to keep a default choice.

[11] The authors use this calibration for both Swedish and US data.

certainty that the terminal wealth is reduced by a constant percentage before bequests are distributed.[12] In stage two we match two sets of moments: i) quartiles of the wealth distribution by year and ii) the 10/25/50/75/90th percentiles of the terminal bequest distribution. The Simulated Method of Moments (SMM) estimator minimizes the distance between data and model-generated moments:

$$\xi^* = \arg\max(m(\xi) - \hat{m}(\xi))' W (m(\xi) - \hat{m}(\xi)) \tag{13}$$

where W is GMM optimal weighting matrix. To minimize the criterion function, we first run a global stochastic Covariance Matrix Adaptation Evolution Strategy (CMA-ES) optimizer from various starting values (Hansen, 2006). After convergence, we start the local derivative-free simplex optimizer from the best parameters generated by the global optimizer to refine the solution.[13]

[12] Actual asset evaluation (as a percentage of market value) depends on the asset type and therefore on the composition of wealth: 75% for real estate and stocks traded on the main Swedish exchange lists and foreign exchanges, 100% for cash, inventories and debt, 30% for stocks on minor Swedish exchange lists and NASDAQ and 30% of the book value for firms. The evaluation percentage of apartments depends on the net wealth of the housing society. For simplicity, we fix the evaluation percentage at the observed value in the data. Additionally, surviving spouses may hold some estate from the deceased spouse. While they are allowed to consume this wealth, it cannot be bequeathed and does therefore not affect any strategic behavior to avoid taxes.

[13] In fact, the concept of convergence of global optimizers does not exist. Therefore, by convergence, we mean the best value obtained from a stochastic pattern-based search algorithm after a fixed number of iterations.

5. Results

5.1. Parameter Estimates

Table 4 reports the parameter estimates for the undistorted bequest preferences of decedents (estimation stage one). Donors exhibit preferences that reinforce existing differences in income. This behavior is consistent with a wide range of theories, such as evolutionary bequeathing, exchange motives or altruistic theories. The positive coefficient towards female partly reflects the size of the heirs' family line as woman in the heir sample tend to have more relatives.

Table 4 shows plausible coefficients that relate to either the monetary and cognitive costs of deviating from the default split. Male and older donors are more likely to stipulate a will to deviate from the default. Larger families find it more costly to deviate from the default of equal splits. Finally, Figure A.2 in Appendix A confirms that due to the flexible form of the utility function for bequest shares, the model fits the targeted moment of within family bequest deviation from quality well.

For the second stage parameter estimates, Table 5 reports the weights on bequest utility. In line with Lockwood (2018), we find a large propensity to bequeath and a high risk aversion parameter (3.78). The threshold of minimum consumption at which bequest motives kick in is SEK 10 765 and partly reflects the inter-vivos gift tax exemption, which is part of the consumption. The variance of wealth shocks is 884. The model fit is shown in Figure 7. Overall, the model fits the moments reasonably well.

Table 4: First-Stage Model Parameter Estimates

	Coefficient	Std. Errors
Heir Characteristics (ϕ)		
Female	1.044	(0.213)
Age	0.001	(0.004)
Income	0.014	(0.022)
Distribution of Donors' Deviation Costs		
Constant	1	—
Female	-0.523	(0.008)
# Children = 3 (0/1)	0.0003	(0.329)
# Children = 4 (0/1)	-0.362	(0.109)
σ	1.383	(1.232)

Notes: Second column in brackets presents GMM asymptotic standard errors.

Table 5: Main Model (Second-Stage) Parameter Estimates

		Coef.	Std. Err
Propensity to bequeath	λ_1	0.99	(0.001)
Weight of the disutility term from deviation	λ_2^{2kids}	< 0.001	(< 0.001)
	λ_2^{3kids}	< 0.001	(< 0.001)
	λ_2^{4kids}	< 0.001	(< 0.001)
Std. Dev. of wealth shocks	σ	947.96	(14.43)
Consumption threshold for bequest motives	c_b	10765.49	(60.83)
CRRA risk aversion parameter	η	3.78	(0.27)

Notes: Second column in brackets presents GMM asymptotic standard errors explained in more detail in Appendix C.

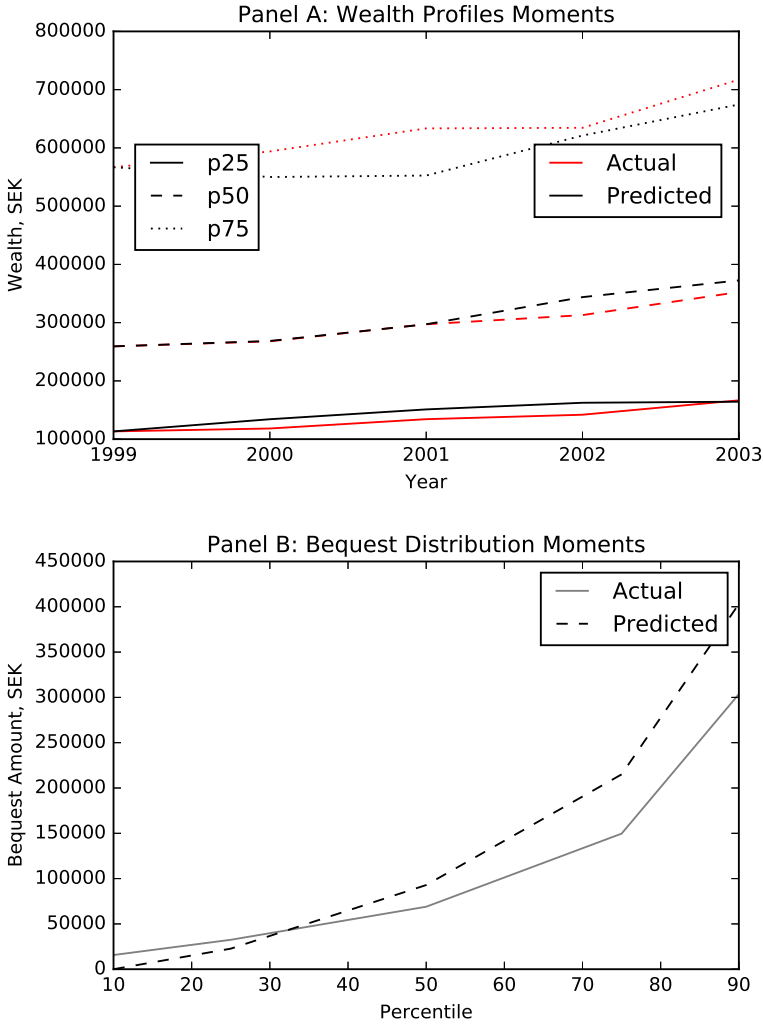


Figure 7: Model Fit

Notes: Actual and predicted moments of the wealth and bequest distributions. Predicted values result from simulating the wealth accumulation model with bequest utilities using the estimated parameters.

5.2. Counterfactuals

To analyze behavioral responses to bequest taxation, counterfactual wealth paths and bequest distributions are simulated for alternative tax designs. It means that we fully simulate donors' decisions and responses to any given tax using our estimates of preference parameters and individual characteristics. The resulting wealth paths and bequest distributions for each alternative tax scheme represent the bases of our further analysis.

0. No taxation of intergenerational wealth transfers (baseline)
1. The 1992-2004 Swedish inheritance tax scheme, excluding the ceding rule
2. Estate tax with marginal tax rates, exemption levels and tax rate kinks comparable to (1)
3. Estate tax with fixed exemption levels and kinks. Marginal tax rates comparable to (1)

The no-tax case (0) is the baseline counterfactual. It describes the wealth path and bequest distribution in the absence of taxation. Alternatively, one can think of this as the potential tax base of any policy if there were no behavioral responses of any kind. In this case, donors would make their decisions as if there was no tax in place. Conveniently, we can anchor various alternative tax designs at this zero-tax counterfactual to make them comparable. This is done by matching/equating the tax revenue of counterfactuals under the hypothetical no-tax/no-response case. In fact, any policy that collects equivalent tax revenues when applied to the no-tax (no response) counterfactual wealth and bequest distributions is comparable from the government's budget point of view. Table 6 shows the tax schedules of comparable counterfactual policies. Counterfactual 2 allows the estate tax to be flexible with respect to the family structure. Similar to the inheritance tax 1 it therefore does not discriminate based on family size, but shuts down the possibility of adjusting the bequest distribution to avoid taxes. Counterfactual 3 represents a more standard estate taxation, where marginal tax

rates are comparable to inheritance taxation 1, but exemption levels are adjusted to anchor the schedule at the same no-response tax revenue as 1 and 2.

Table 6: Tax Schedules of the Policy Counterfactuals

1. Inheritance Tax	
Tax bracket, SEK	Tax (lump sum + tax rate)
0 - 300 000	0 + 10%
300 000 - 600 000	30 000 + 20%
> 600 000	90 000 + 30%
Basic Exemptions: SEK 70 000 per child	
2. Estate Tax with Flexible Kinks	
0 - 300 000 × # children	0 + 10%
300 000 × # children - 600 000 × # children	30 000 × # children + 20%
> 600 000 × # children	90 000 × # children + 30%
Basic Exemptions: SEK 70 000 per child	
3. Estate Tax with Fixed Kinks	
0 - 600 000	0 + 9.76%
600 000 - 1 200 000	58 560 + 19.52%
> 1 200 000	175 680 + 29.28%
Basic Exemptions: SEK 140 000	

Notes: The table presents tax schedules used in counterfactual policy simulations. The first counterfactual is no tax and is not listed in the table. The upper tax schedule presents the existing inheritance tax. The remaining two counterfactual tax schemes mimic similar tax scheme to the inheritance tax with fixed and flexible kinks.

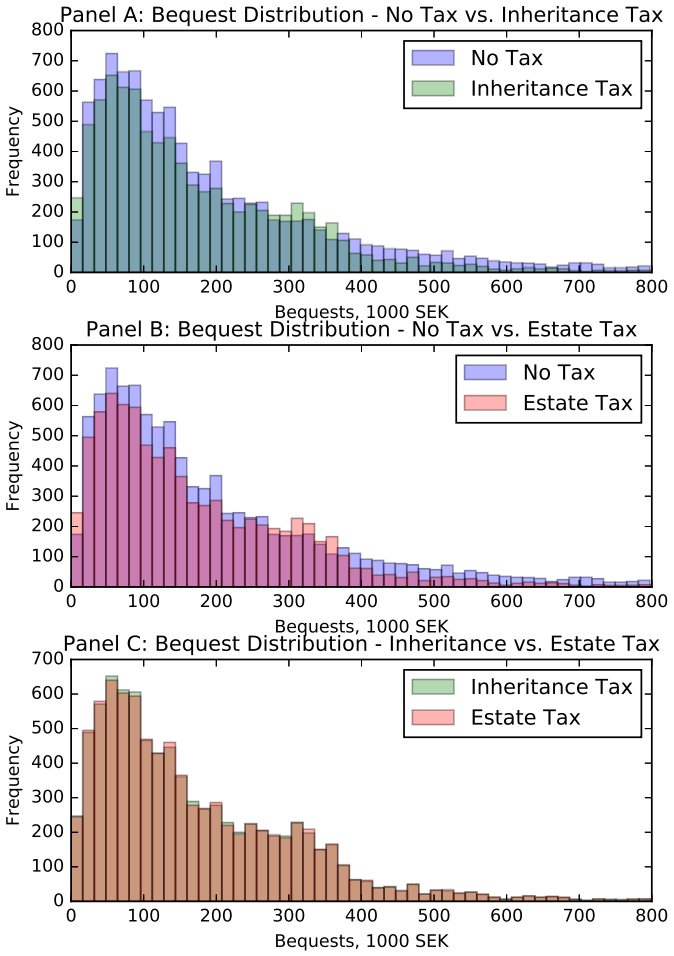
5.3. Effect on the Bequest Distribution

Responses to bequest taxation lead to overall changes in the distribution of terminal bequests. Figure 8 shows the bequest distribution of the Swedish inheritance tax (1) and a comparable estate tax (2) in contrast to the no-tax

counterfactual (0). Panels A and B show that any type of bequest taxation reduces the total mass in the bequest distribution. The taxes provide an incentive to bequeath less in general, and at lower marginal tax rates in particular. The latter incentive is particularly strong in the upper tail of the bequest distribution. The tax kinks in both tax schedules at SEK 70 000, 370 000 and 670 000 create visible excess masses of bequests that are absent in the no tax case. These bequest adjustments highlight the elasticity of bequest to taxation caused by the behavioral responses of donors. Panel C shows that the two alternative bequest taxes (1 and 2) fare similarly compared to each other. Slight differences are due to the additional potential strategy of donors to avoid taxes by changing individual bequest rather than the total estate.

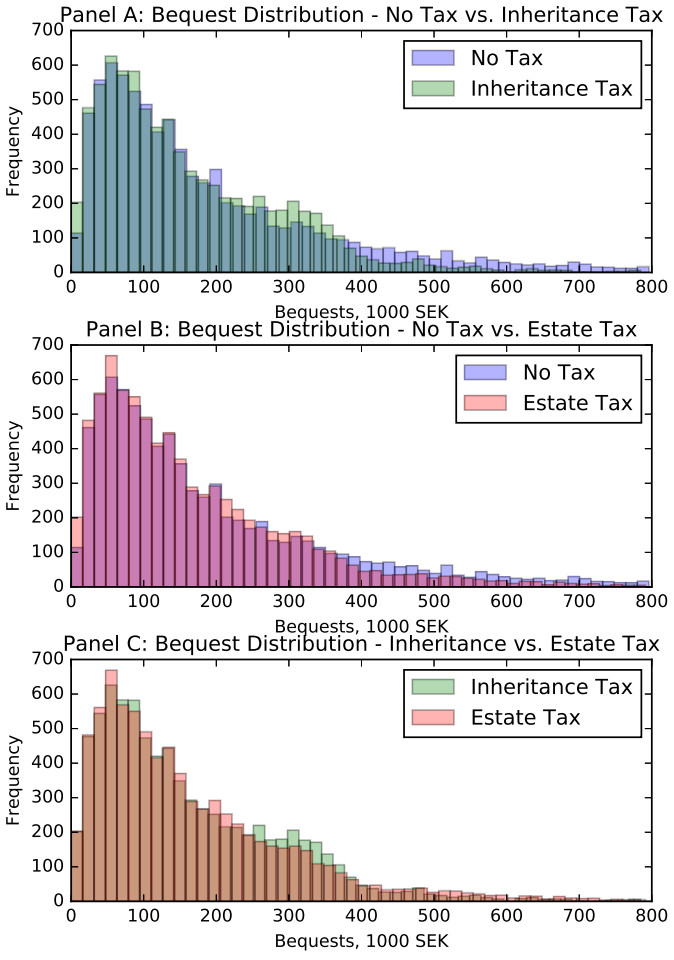
While inheritance and estate taxes with comparable schedules affect the bequest distribution in a very similar way, an estate tax with fixed exemption levels and tax rate kinks (3) may generate a very different distribution. One example of this widely used tax design, which is not affected by family structure, is shown in Figure 9. It suggests that policymakers need to be aware of the incentives that family-specific exemptions provide for donors to avoid paying taxes. In particular, such an estate tax design imposes larger burden on large and wealthy families.

Notice that a tax on intergenerational wealth transfers can create incentives for donors to transfer more wealth via inter-vivos gifts since a SEK 10 000 annual exemption is applied to them. While the model allows for this strategic response, it is ignorant about the exact levels and recipients of such transfers. The bequest distributions in this paper only reflect transfers out of the terminal wealth.



Notes: Bins of the bequest distribution for the inheritance and estate tax counterfactuals (1. and 2.) in comparison to the no-tax counterfactual.

Figure 8: Effect of Taxation on Bequest Distributions, Counterfactual Policies 1 and 2



Notes: Histogram of the bequest distribution for the inheritance and estate tax counterfactuals (1 and 3) in comparison to the no-tax counterfactual (Panels A and B). Panel C compares the distributions under the two taxes to each other.

Figure 9: Effect of Taxation on Bequest Distributions, Counterfactual Policies 1 and 3

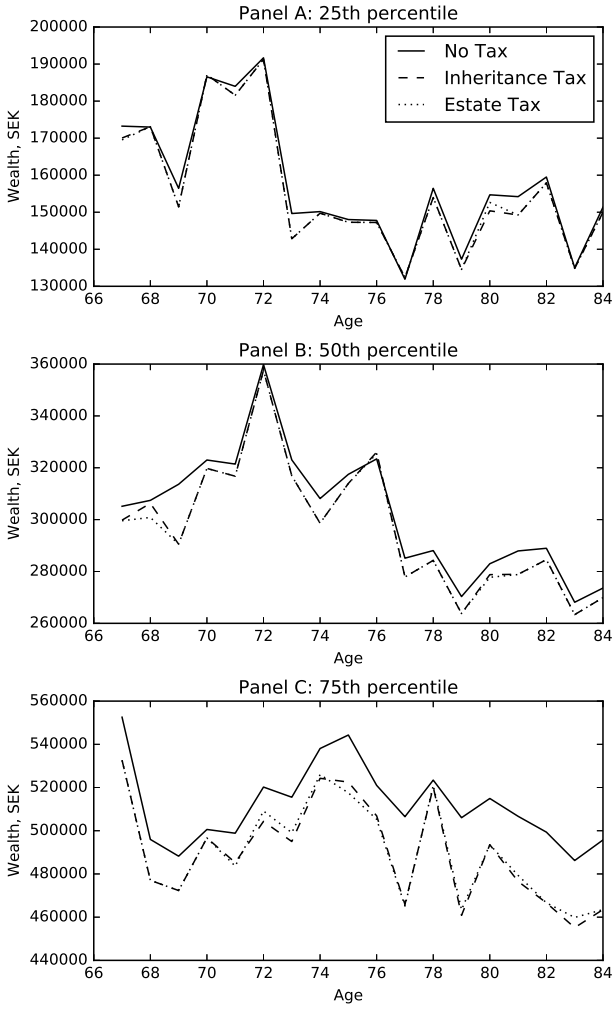
5.4. Effect on the Wealth Accumulation Process in Old Age

A fundamental concern with respect to bequest taxation is whether behavioral responses to the tax lead to distortions in wealth accumulation. Such behavior can lead to a wide range of second-order effects, e.g. a change in the overall saving rate and inequality across families and generations. We find relatively large responses to both inheritance and estate taxation in the wealth accumulation of old-age individuals compared to the no-tax counterfactuals. Figure 10 plots the wealth levels per age for the 25th, 50th and 75th percentile of the wealth distribution for the comparable counterfactual policies 1 and 2.[14] Due to the progressiveness of both taxes, wealthier donors are adjusting their wealth paths to a larger degree. Due to the similarity of policies 1 and 2 in terms of the tax schedule, the inheritance and the estate taxes affect the wealth accumulation process almost equally. These changes in the wealth path in old age translate directly into the distribution of terminal estates in Figure 12.

Once more, if a more common estate tax design with fixed progressiveness is chosen, the behavioral responses may differ significantly, as shown in Figure 11. Non-individual exemption levels and tax rate kinks reduce the incentive for many families to engage in tax avoidance via wealth accumulation and therefore reduces the wealth distortion. This is due to the fact that for many families, lower tax-brackets are out of reach. The caveat of such policy is the tax incidence is shifted particularly towards large families.

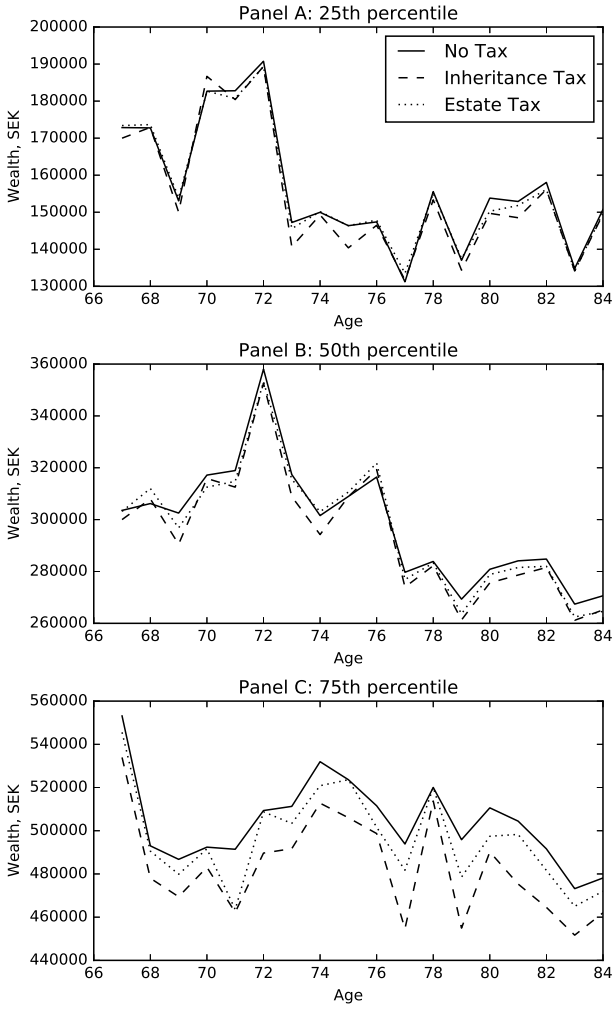
The effects of taxation on terminal wealth are in line with the literature. The elasticity of the terminal estate to a tax of 0.22 generated by our model compares well to the 0.1-0.2 elasticities estimated by Slemrod & Kopczuk (2000), Joulfaian (2006) and Glogowsky (2016) as well as to the 0.09-0.27 elasticity of wealth to the Swedish wealth taxation documented by Seim (2017).

[14] Wealth levels per age group are subject to the cohort composition effect, as they are pooled over different calendar years.



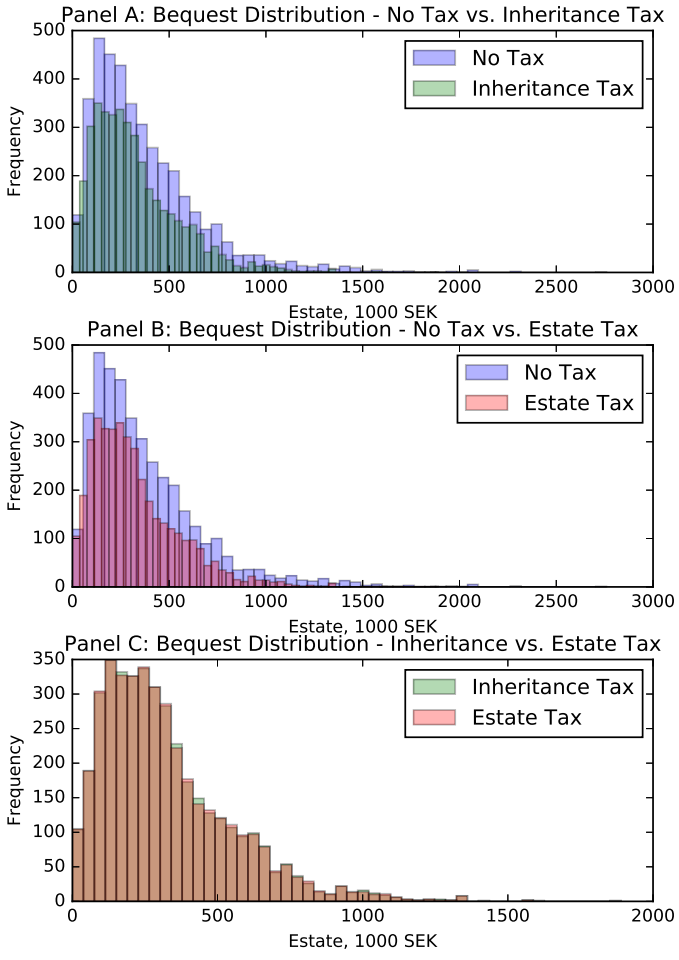
Notes: Wealth distribution for the 25th, 50th and 75th percentiles by age group for the inheritance and estate tax counterfactuals (1 and 2) in comparison to the no-tax counterfactual (Panels A and B). Panel C compares the distributions under the two taxes to each other.

Figure 10: Effect of Taxation on Wealth Accumulation: Counterfactual Policies 1 and 2



Notes: Wealth distribution for the 25th, 50th and 75th percentiles by age group for the inheritance and estate tax counterfactuals (1 and 3) in comparison to the no-tax counterfactual.

Figure 11: Effect of Taxation on Wealth Accumulation: Counterfactual Policies 1 and 3



Notes: Distribution of terminal estates for the inheritance and estate tax counterfactuals (1 and 2) in comparison to the no-tax counterfactual (Panels A and B). Panel C compares the distributions under the two taxes to each other.

Figure 12: Effect of Taxation on Terminal Wealth: Counterfactual Policies 1 and 2

5.5. Response Decomposition and Tax Revenue

The counterfactuals allow decomposing the responses to bequest taxation. As documented above, the wealth reactions to the tax are almost equal if the inheritance and the estate tax have comparable schedules. In addition, we find that for the case of inheritance taxation, 1.4% of the individuals change their bequest distribution among children to minimize the tax bill. Given the low incidence of unequal bequests in the Swedish context (2-5%), this represents a non-trivial fraction of the donors.

Finally, in light of the high administrative costs of bequest taxation, policymakers care about the impact of responses to taxation on the generated tax revenue. As the estate and inheritance tax in our counterfactuals are designed to have an equal tax revenue in the absence of any behavioral responses, it is possible to measure the loss for the government revenues from taxpayers' reactions. We find a significant loss in revenue of 34.4% for inheritance and 29.3 % for estate taxation. While the bulk of this loss is explained by the adjustment in wealth accumulation, in particular of wealthy donors, the difference between the tax designs has two origins. First, under the inheritance taxation, donors can use an additional strategy to avoid taxation, i.e. changing the bequest distribution. Second, strong preferences for unequal bequests under the inheritance tax may lead some donors to not fully use the individual exemption levels, which gives an additional incentive to adjust the wealth path.

While our study is mainly focused on legal avoidance mechanisms in response to bequest taxation, government revenue from such a policy could also be reduced by evasion. In the case of bequests, taxes can be evaded by underreporting terminal wealth in the estate report. In fact, Seim (2017) and Escobar (2018) provide suggestive evidence that under-reporting can explain a large part of wealth adjustments in response to wealth and spousal bequest taxation in Sweden. However, in the case of intergenerational transfers, evasion by underreporting is arguable harder. First, underreporting would have to be conducted by children or grandchildren of the deceased after the death occurred. Although the estate is mostly self-reported, the tax

agency can rely on third-party information to verify the estate report, e.g. banks and financial institutes, the national land agency and previous wealth and property reports to the tax agency. This effectively limits the scope of underreporting to cash, personal valuable belongings and durables like cars. Second, in many cases heirs might have an interest to register the estate correctly, as only reported inheritances allow for a legal claim if any disputes between heirs would arise.

Although not the focus of the present study, it should be noted that bequest taxation can have additional effects on tax revenues. As Kindermann *et al.* (2018) argue, heirs may anticipate lower bequests due to taxation and adjust their labor supply, thereby generating additional income tax revenue.

6. Conclusion

Bequest taxation is often at the center of policy debates because of being a tool for correcting distributional inefficiencies propagated over generations with bequests. In addition, this tax is often viewed as a tax that does not cause any undesirable distortion. For example, the Economist writes: *"In fact, people who are against tax in general ought to be less hostile to inheritance taxes than other sorts. However disliked they are, they are some of the least distorting"*, Economist (2017).

Although this statement is theoretically appealing, this paper shows that bequest taxation implies a range of behavioral responses that should be taken into account by policymakers who aim at minimizing tax distortions, while simultaneously collecting tax revenues. More precisely, progressiveness and exemption levels are the predominant tools to control the incidence of the tax on particular groups in the population. Using a comprehensive structural model that captures the main behavioral responses of old-age individuals, we can compare the impact of various tax designs on wealth accumulation, bequest distributions, and tax revenue, which are main policy outcomes of interest. Our results show that comparable inheritance and estate tax schedules have similar but important effects on individual behavior.

At the same time, due to additional margins of strategic behavior under the inheritance taxation, the estate taxes lead to higher overall tax revenues. Therefore, this paper emphasizes that at the cost of relaxing the control over tax incidence, estate taxation can be designed to further minimize distortions.

Our model is comprehensive and flexible enough to allow for the simulation of counterfactuals for the universe of alternative bequest tax designs. Various tax structures enable policymakers to balance distortions, progressiveness, tax revenues, and tax incidence according to their social welfare functions. The context in which we apply the structural model is ideal, since it, to a large degree, abstracts from precautionary savings, due to a generous social welfare system in Sweden. The results are therefore likely to be applicable to other contexts. Due to strong preferences for equal bequests in our sample, the differences between estate and inheritance taxation are relatively modest. They may be amplified in contexts like the US, where up to 20% (Light & McGarry, 2004), which is ten times the percentage in Sweden, leave unequal bequests to their children and therefore have potentially higher responses through changes in the bequest distribution.

The findings in this paper also open up several paths for future research. One important question is to consider inter-generational wealth taxation in a general equilibrium framework that takes into account wealth taxation and returns to capital. The large wealth effects in our model emphasize that the design of the inheritance tax might have important spillovers on the wealth taxation and capital markets more broadly. Another important area is spousal tax-planning in old ages since distortions due to the tax and responses to it are often realized at the household rather than the individual level. In addition, the relevance of behavioral responses to bequest taxation for inequality should be investigated. Taxes on inter-generational transfers are almost always designed to redistribute wealth from the upper to the lower tail of the distribution. However, if strategic responses benefit specific subgroups, the effectiveness of the tax might be harmed. Finally, although we touched upon the question of within-family inequality, further

works might be needed to study the aggregate implications of changes in the within-family wealth allocation.

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Appendix

A. Additional Figures

Figure A.1: Bequest taxation in Europe and US

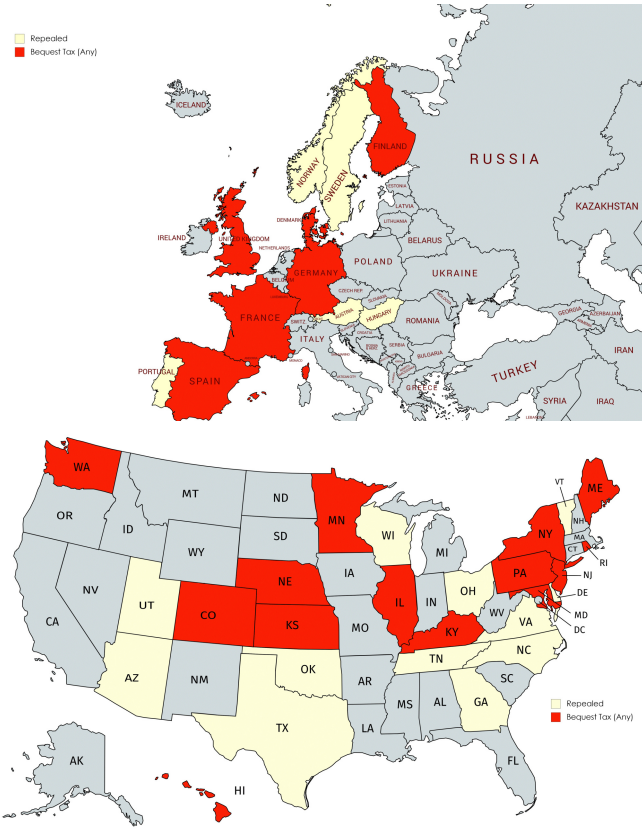
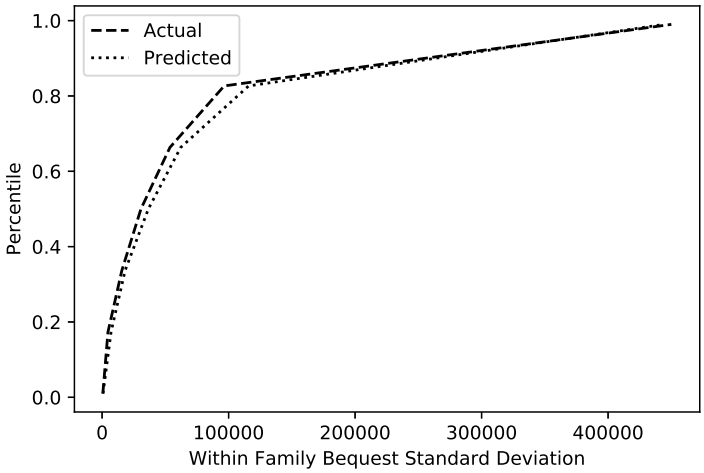


Figure A.2: Model Fit



Notes: Figure illustrates a fit of the first stage model. In particular, we plot a distribution of standard deviation moments of within family bequests.

B. Dynamic Model - Euler Equations

The Euler equations for the two choice variables in the dynamic problem show the fundamental trade-off that the donor faces when deciding on c and s. First, a change in the expected marginal utility of consumption and gift transfers must correspond to a change in the expected marginal utility from bequeathing at death.

$$u_{ct} - (1 - D_{t+1})\delta E_t \left[u_{ct+1}\right] = \delta E_t D_{t+1} \left[B_{Wt+1}\right]$$

Second, the Euler equation for each element j of the bequest share vector s requires optimality for the current wealth level of each period.

$$B_{s_{jt}} = 0$$

Incorporating the functional form of the bequest function yields the following Euler equation for c_t and the first-order condition for the optimal bequest share s to child l:

$$\overbrace{c_t^{-\eta} - (1 - D_{t+1})\delta E_t \left[c_{t+1}^{-\eta}\right]}^{\Delta\text{marginal utility of consumption}}$$

$$= \overbrace{\delta D_{t+1} E_t \left[\left(\frac{\lambda_1}{1-\lambda_1}\right)^{\eta} \left(\frac{\lambda_1}{1-\lambda_1} \cdot c_b + \sum_{j=1}^{J} (1-\tau_j) s_j W \right)^{-\eta} \sum_{j=1}^{J} s_j \left(1 - \tau_J - W\tau_W\right) \right]}^{\text{marginal utility from bequeathing}}$$

$$\overbrace{\left(\frac{\lambda_1}{1-\lambda_1}\right)^{\eta} \left[\frac{\lambda_1}{1-\lambda_1} \cdot c_b + \sum_{j=1}^{J} (1-\tau_j) s_j E_t(W_{t+1}) \right]^{-\eta} E_t(W_{t+1}) \left[1 - \tau_l - s_l \tau_{s_l}\right]}^{\text{marginal utility from sum of after-tax bequests}}$$

$$= \overbrace{2\lambda_2 \left[U^s(s_1 \ldots s_J) - U^s({s_1}^* \ldots s_J^*)\right] \frac{\exp(\phi_l)}{s_l}}^{\text{marginal disutility through share deviation}}$$

with $\sum_{j=1}^{J} s_j = 1$. These two equations guide the optimal behavior of donors and illustrate the identification of λ_1 and λ_2.

C. Estimation Details

As described in the main text, the estimation of the model consists of two steps. First, we estimate true allocation preferences. These parameters obtained on the first-stage are used to estimate the main parameters from the dynamic model. Overall, the model contains seven second-stage parameters and eight first-stage parameters. More parameters required to be estimated leads to more iteration of the optimization algorithm. Therefore, reducing the number of parameters estimated on the second stage while solving computationally intensive dynamic model provides large computational gains.

The estimation of the first-stage parameters is fairly computationally light and is conducted on the full sample of "eligible" individuals from the bequest dataset. To estimate the second-stage model, we draw a 20% random sample. We use 10 cores to solve the model at each iteration of the optimization algorithm. Both estimation procedures match chosen moments that describe features of individuals' behavior. Both models have more moments than parameters. We use a two-stage optimal GMM matrix for both models. Theoretically, our second-stage estimator is consistent and asymptotically normally distributed (Pakes & Pollard, 1989; Duffie & Singleton, 1997).

$$\xi \sim N\left(0, (G_\xi' W G_\xi)^{-1} G_\xi' W \left[(1+\frac{N_d}{N_s})\Omega_\xi + G_\varphi \Omega_\varphi G_\varphi'\right] W G_\xi (G_\xi' W G_\xi)^{-1}\right)$$

where G_φ, G_ξ are the gradient matrices of moments with respect to first-stage and second-stage parameters, correspondingly. $\Omega_\varphi, \Omega_\xi$ denote moment variance-covariance matrices of the first and second stage, correspondingly, and N_d, N_s are sample and simulation sample size. To estimate the parameters of the model, we use a stochastic global optimizer to explore the parameter space. More precisely, we use the CMA-ES algorithm from different starting values. Then, we use the simplex algorithm starting from the best parameters obtained from the global optimizer to refine the solution.

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Chapter III

Distributional Preferences in Adolescent Peer Networks

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Fredrik Carlsson Mikael Lindahl

Abstract

This paper studies distributional ("social") preferences in adolescent peer networks. Using incentivized choices between allocations for themselves and a passive agent, children are classified into efficiency-loving, inequality-loving, inequality-averse, and spiteful types. We find children of similar types to be more likely to exhibit friendships ties, and friends' preferences are aligned in 32% of cases. Further, conditional on being friends, types are significantly correlated. These relationships among peers are almost completely driven by inequality-loving and spiteful types. Further analyses suggest that preference peer networks are mostly driven by selection into the network and, to a smaller degree, by transmission. The role of peer networks in explaining distributional preferences goes beyond composition. A low rank in academic performance and a central position within the network relate positively to spiteful behavior, suggesting a differential relevance of these types of social hierarchies. Empirical evidence for preference peer networks is important to explain heterogeneity in distributional preferences and the selection into friendship and professional networks, as well as into political views later in life.

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1. Introduction

Many people have nonselfish preferences over distributions of economic resources. These preferences are often synonymously called social preferences, other-regarding preferences, or distributional preferences (Fehr & Schmidt, 1999; Bolton & Ockenfels, 2000; Charness & Rabin, 2002; Camerer, 2003; Almås *et al.*, 2010). Their existence and their specific nature are very relevant for economic behavior and outcomes, such as, among many others, cooperation (Boyd & Richerson, 2005; Fischbacher & Gachter, 2010), productivity (Carpenter & Seki, 2011; Bandiera *et al.*, 2005; Dohmen & Falk, 2011), political preferences (Fisman *et al.*, 2017; Kerschbamer & Müller, 2020), and well-being (Becker *et al.*, 2012).[1] Recent studies have documented the evolution of these distributional attitudes in adolescence from more malevolent to more benevolent. They have also stressed the large degree of individual heterogeneity of distributional preferences (Fehr *et al.*, 2013; Almås *et al.*, 2010; Martinsson *et al.*, 2011; Sutter *et al.*, 2018).

There are fewer studies on the effects of one's social environment and peers on distributional preferences (Charness & Kuhn, 2007; Gächter *et al.*, 2013; Fatas *et al.*, 2018; Bicchieri *et al.*, 2019). In particular, we know nothing about peer influence in early life on the emergence of distributional preferences. To fully understand how distributional preferences are shaped in adolescence, it is necessary to take the close social environment into account. An adolescent's social networks and peers could be crucial determinants explaining adult interindividual heterogeneity in distributional preferences and

[1] In particular, Fisman *et al.* (2017) find that individuals' position along the efficiency-equality trade-off corresponds to their political attitude along the right- and left-wing dimension in the 2012 US presidential election. Similarly, Kerschbamer & Müller (2020), using the same experimental design as our study, show that individuals in Germany classified as selfish preference types tend to vote for the extreme right, while inequality-averse subjects favor more left-wing oriented parties. Other relations between social preferences and real life outcomes have more normative implications: Kerschbamer *et al.* (2019) document that altruistic (efficiency-maximizing) types in their lab-experiment in Austria are more likely to by averse to lying. Carpenter & Seki (2011) find that cooperative and efficiency-maximizing fishermen in Japan are more productive, when their production requires cooperation. Finally, Kerschbamer *et al.* (2016) show that sellers with partially or fully selfish preferences can lead to inefficiency in creedence good markets.

selection into friendship/professional networks and political views later in life, on top of biological determinants (Balafoutas *et al.*, 2012; Fisman *et al.*, 2017).

Children may select into social networks that are similar to their preferences, and peers can shape distributional preferences through transmission (peer effects). Besides composition, an adolescent's position within the social network could itself be related to specific distributional preferences transmitted through various mechanisms. The potential impact of peer networks that are based on other-regarding attitudes goes beyond differential evolution of these preferences. If children are surrounded by like-minded peers, cognitive and noncognitive abilities could also develop on different trajectories as a result of differences in cooperation and support within the network (Cunha *et al.*, 2010; Thöni & Gächter, 2015).

This paper investigates the distributional ("social") preferences of children at primary schools in urban Tanzania and the role of peers in shaping these distributional preferences. We conduct a lab-in-the-field (artifactual) experiment and analyze to what extent distributional preferences of children are related to those of their peers at school, and what roles peer networks, school performance, and popularity play in explaining distributional preferences. The experiment involves choices of allocations that vary systematically how much to allocate to oneself and to an anonymous passive agent (Kerschbamer, 2015). The variation in inequality between agents' payoffs across allocations in the choice sets allows us to classify children into four broad distributional preference types: efficiency-loving, inequality-loving, inequality-averse, and spiteful. To study the prevalence of these types in peer networks, we ask children to name and rank their three best friends. Background characteristics from a survey and school grades from administrative data sources provide additional information.

The four distributional preference types that are used here capture a large set of potential distributional preferences under very mild assumptions (see Kerschbamer, 2015). Efficiency-loving preferences pertain to utility functions that put emphasis on the maximum of the sum of payoffs

(also called "surplus maximizing motives"). Inequality-averse preferences put disutility on inequality, whereas inequality-loving preferences put positive utility on inequality. Finally, spiteful preferences capture a disutility that is increasing in the payoffs of others (also called "competitive preferences").

Our findings show that the majority of children exhibit choices consistent with inequality-averse (30.6%) and spiteful (42.5%) preferences. This pattern stems from a reluctance to accept disadvantageous allocations for themselves, even if they are Pareto improving. If two children chosen at random are of the same preference type, they are 24% more likely to be friends than otherwise. Conditional on being friends, distributional preference types of children are consequently correlated even more strongly. About 32% of friendships are between children of the same preference type, and having a friend of a specific type increases the likelihood of exhibiting the same preference by 9%. Even after controlling for a range of observable characteristics, having one additional friend of the inequality-loving or spiteful type increases the likelihood of a child being of the same type by 4.5% (0.1 SD) and 5.2% (0.2 SD), respectively. Hence, preference types are assorted along friendship ties.

Similarity in distributional preference types in peer networks differs by gender, with boys showing higher correlation coefficients for spitefulness and girls for inequality-loving preferences. Using several empirical strategies that exploit the direction (degree centrality) of friendships, differences in exposure to peers, and best-friend pair fixed effects, we provide tentative evidence for the causal mechanism behind our main results: both selection into networks and transmission through peers contribute to the observed effects, with the former seemingly being more important for the effects.

Finally, our analysis shows that besides composition, the importance of the role of peers in explaining distributional preferences is linked to the position within the network. Worse relative performance in school relates positively to spiteful and inequality-loving attitudes, while these types are more common when the child is central or popular within their peer net-

works. This suggests an importance of both social hierarchy and relative *economic* (human capital) position.

The paper makes at least three contributions. First, we investigate the role peer networks play in shaping children's distributional preferences. Thus, our results contribute to a better understanding of the evolution of preferences with age, as well as their impact on (economic) outcomes. If they exist, *social preference networks* might reinforce individual predispositions for distributional preferences and, subsequently, affect later-life outcomes, such as in the labor market (Balafoutas *et al.*, 2012; Kocher *et al.*, 2013). Balafoutas *et al.* (2014) show in an experiment with adult participants that individuals and small unitary teams that are assembled randomly exhibit different distributional attitudes and that the composition of groups in terms of individual preference types determines the group type. Also, with children, educational and social outcomes may be affected by the composition of distributional preferences in their peer groups. Leider *et al.* (2009) show that altruism of university students is correlated with that of their peers.[2] Although we cannot answer conclusively the question regarding the relative impact of ex ante ("selection effects") versus ex post ("transmission effects") similarity in social preferences of groups with our setup, we provide solid evidence for the presence of both transmission of and selection according to preferences within social networks. This is in line with the findings of Girard *et al.* (2015), who document that risk and time preferences, as well as cooperativeness, are robust predictors of network formation and structure for newly admitted undergraduate students in Germany. It also matches the findings of Leider *et al.* (2010), who show that peer correlations in preferences cannot be explained by individuals' actual awareness of their friends' attitudes in college.

Second, we investigate the relationship between social hierarchies in networks and social preferences at a young age. An individual's relative position

[2]Both Fehr *et al.* (2013) and Leider *et al.* (2009) document the existence and emergence of parochialism — that is, benevolent attitudes toward members of one's social group. In the present study, we do not distinguish between directed and undirected other-regarding concerns.

within the social network may itself be related to distributional attitudes. We complement the view that parents' socioeconomic status relates to the child's social preferences (Benenson *et al.*, 2007; Falk *et al.*, 2019) by exploring the structure of the child's own social network and its effects. If children who are disadvantaged in terms of school performance or who are less popular among peers adopt antisocial attitudes toward peers, such attitudes could be reinforced and persistently shape outcomes of future interactions. Alternatively, in line with Girard *et al.* (2015), social structure and centrality in the social network can originate from individual preferences of children.

Third, the documentation of nuanced measures of distributional preferences at a young age in a low-income context complements a series of studies that examine other-regarding preferences of children in high-income contexts (Fehr *et al.*, 2013; Almås *et al.*, 2010; Martinsson *et al.*, 2011; Sutter *et al.*, 2018). By adopting the design proposed by Kerschbamer (2015), we elicit and nonparametrically identify all previously discussed archetypes of other-regarding preferences, using a single allocation experiment. Distributional preferences in a setting of scarce financial resources, ethnic and religious diversity, and absence of a welfare state may be of particular interest. Additionally, in an environment with high overall gender inequality, gender-specific preference formation at a young age may play an important role in explaining persistent outcomes.[3] Fehr *et al.* (2013) elicit egalitarian, altruistic, and spiteful attitudes in 8- to 17-year-old pupils in Austria and find strong concerns for equity (39%) and toward others (40%) in the age group of our study. They further show that particularly at a young age, girls favor equality, while boys show an overproportional tendency toward spitefulness. In their studies among students in Austria from a similar age group to that in this paper, using a series of allocation games, Martinsson *et al.* (2011) and Sutter *et al.* (2018) also find higher equality concerns in

[3]Tanzania ranks 125 out of 155 countries in the United Nations Development Programme's Gender Inequality Index. At primary school level, the Southern and Eastern African Consortium for Monitoring Educational Quality (SACMEQ) stated for Tanzania that girls tend to underachieve compared to boys, especially in reading and mathematics (SACMEQ, 2011).

girls and efficiency orientation in boys. Finally, Almås *et al.* (2010) show that efficiency concerns and inequality acceptance develop in adolescence. Studying children at an even younger age, Fehr *et al.* (2013) provide evidence for the emergence of equality preferences from selfishness in early life, and Benenson *et al.* (2007) document lower levels of altruism for children with low socioeconomic status in the UK, a finding confirmed by Falk *et al.* (2019) for Germany.

Combining distributional preferences and social networks might ultimately provide a workable theory of reference groups. Standard models of distributional preferences remain silent on how reference groups are formed. Our results are a first step, and they show that empirical inference on reference group (network) formation is not easy, but that it can be achieved in an environment in which there is enough control. Schools are almost perfect laboratories in this sense, allowing us not only to study the emergence of distributional preferences, but also to learn more about general aspects of network formation along distributional preferences. The rest of our paper is structured as follows. Section 2 discusses the sample that we use, Section 3 describes the experimental design in more detail, Sections 4–5 present our results, and Section 6 concludes the paper.

2. Sample and Data

We elicited distributional preferences of students through a lab-in-the-field experiment at public primary schools in Ilala District, Dar es Salaam, Tanzania, at the beginning of the new school year in early 2018. In collaboration with the District Educational Office, we randomly chose 3 out of 112 schools for participation.[4] The experimental sessions took place on a single day per school during lecture hours. All present standard 6 (out of 7) students (age 12–13) participated.[5] The total sample contains 650 students, representing

[4]The sample schools are average sized in terms of the number of classrooms and students. The sample contained participants from Kibaga (177 standard 6 students), Mtakuja (271), and Maarifa (264) primary schools.

[5]Primary school education in Tanzania is mandatory and free of tuition. Students attend for seven years (standards 1–7) at ages 7–14.

more than 90% of eligible students. In contrast to experiments in previous studies conducted with children after school hours, we had very little to no attrition and no selection effects into the experiment.

At the beginning of each session, students were randomly allocated to classrooms by drawing numbers. After a short survey to collect background characteristics and elicit the students' friend networks, pen-and-paper choice list experiments for distributional preferences and a money-earlier-or-later experiment were conducted.[6] The preference experiments took place in random chronological order and were accompanied by randomly rotating teams of enumerators.[7] Students could earn money from experimental payoffs. At the end of the session, either the distributional or the time preference experiment was randomly chosen for payout, which led to guaranteed earnings between TZS 3,000 (US$1.35) and 8,000 (US$3.59), a significant amount of pocket money for these students, particularly given the low opportunity costs.[8]

In the short survey, students were asked to list and rank their three best friends within their cohort at the school. Using this information, we can construct the self-reported social networks of students. Within this network structure, various centrality measures, such as degree or eigenvector centrality, can be defined according to standard measures.

Table 1 presents descriptive statistics of student and network characteristics for the experimental sample. Approximately half of the participants are female and a large proportion are Muslim, with the remaining 40.4% mostly of Christian faith. Reassuringly, the mean normalized student rank based on the overall grade by school is 0.5, which suggests we did not oversample students with good or bad grades. Social networks in the sample consist on average of 5.6 peers, and an average student is named 2.8 times by friends.

[6]The child survey and experimental session were embedded in a larger study that included a family survey and decision-making experiments conducted with parents of some the children in the sample.

[7]The team of enumerators consisted of graduate students from the University of Dar es Salaam who are experienced in conducting surveys in the area and are native Swahili speakers. All survey and experiments were conducted in Swahili.

[8]Exchange rate: US$1 = TZS 2,230 (December 2017).

Table 1: Summary statistics

Background Characteristics	Mean	SD
Age of child	12.67	(1.078)
Female	0.523	(0.500)
Household size	5.346	(1.999)
Number of of children in hh	2.616	(1.304)
Muslim	0.596	(0.491)
School grade	458.6	(123.3)
Rank in school	0.496	(0.288)
Peer Networks		
Number of total friends	5.614	(2.128)
Number of out-degree friends	2.803	(0.463)
Number of in-degree friends	2.811	(2.016)
Number of reciprocal friends	1.137	(0.949)
Observations	650	

Notes: This table reports summary statistics of the experimental sample. School grade and rank come from the results of the national exam for grade 5, taken one month before the study. The school grade represents the grade point sum for all ten subjects: Swahili, English, mathematics, science, geography, civic education, history, art/handicraft, communication/informatics/ICT and physical education. Rank in school is the ranking of a student of grade 6 at a given school divided by the number of grade 6 students at that school. Out-degree denotes the number of friendships reported by a student. In-degree denotes the number of friendship ties directed toward a student (i.e., reported by peers). Reciprocal friends imply that two students independently listed each other as friends.

The friendship measures are bounded by the fact that only three friends per student were elicited. High standard deviations in these variables suggest that there is large heterogeneity in popularity across students.

3. Experimental Design and Definitions

The experimental design to elicit distributional preferences is based on Kerschbamer (2015).[9] The exact design of the experiments and the empirical strategy were registered as a preanalysis plan prior to the fieldwork.[10] Students were asked to make 10 binary choices between two payoff allocations.

[9]The design allows for the identification of nine nuanced preference types. For simplicity, we focus on four broader types, as in Balafoutas *et al.* (2014).

[10]Available online at www.socialscienceregistry.org/trials/2682. Any changes from the registered preanalysis plan are discussed in Appendix E.

Each allocation consists of a payoff for the decision-maker (the active agent) and a randomly matched anonymous person (the passive agent). One of the two allocations in each choice situation always gives equal payoffs to both agents (symmetric allocation). The other allocation is asymmetric, with higher payoffs for the active agent in half of the choices (advantageous block) and vice-versa in the other half (disadvantageous block). The symmetric allocation remains constant in all ten choices, while the asymmetric allocation in both blocks increases in the payoff for the decision-maker (the active agent). The changes in the asymmetric payoffs represent a change in the cost of giving to (taking from) the passive agent.

Table 2 shows the chosen 10-item choice list design. The translated version used in the experiment is found in Appendix C. The constant symmetric (egalitarian) allocation (right) is fixed at TZS 2,500 for both agents for the 10 choices. In the five rows of the disadvantageous inequality block (DIB), the decision-maker faces lower payoffs than the passive agent (TZS 4,000) in the asymmetric allocation (left). Over the five choices, the payoff to the active agent increases monotonically from TZS 2,000 to 3,000. In the five rows of the advantageous inequality block (AIB), the decision-maker faces greater payoffs than the passive agent (TZS 1,000) in the asymmetric allocation (left). Over the five choices, the payoff to the active agent increases monotonically from TZS 2,000 to 3,000, as in the DIB.

Since the payoff to the decision-maker on the left side increases from row to row, a rational participant should switch only from *right to left* and only once per block. It is possible that individuals always choose left or right. The pattern of choices in the blocks determines the classification to distributional preferences. In particular, the choices reveal benevolence or malevolence toward the passive agent in the disadvantageous and advantageous domains.

Benevolence means that the decision-maker is giving up his or her own payoff to *increase* the passive agent's payoff. For example, choosing *left* already for choice 1 in the DIB reveals that the decision-maker is willing to pay at least TZS 500 to increase the passive agent's payoff by 1,500 compared

Table 2: Choice list

Disadvantageous Inequality Block (DIB)						
	Left		Choice		Right	
	You get	Passive agent gets			You get	Passive agent gets
1	2,000	4,000	◯	◯	2,500	2,500
2	2,400	4,000	◯	◯	2,500	2,500
3	2,500	4,000	◯	◯	2,500	2,500
4	2,600	4,000	◯	◯	2,500	2,500
5	3,000	4,000	◯	◯	2,500	2,500
Advantageous Inequality Block (AIB)						
	Left		Choice		Right	
	You get	Passive agent gets			You get	Passive agent gets
6	2,000	1,000	◯	◯	2,500	2,500
7	2,400	1,000	◯	◯	2,500	2,500
8	2,500	1,000	◯	◯	2,500	2,500
9	2,600	1,000	◯	◯	2,500	2,500
10	3,000	1,000	◯	◯	2,500	2,500

Notes: This table presents the choice list provided to subjects (for the actual version used in the experiment, see Figure C.1 in Appendix C). In each of 10 rows, subjects are asked to choose between two pairs of allocations (left or right). These pairs denote payoffs to the subject and to an anonymous passive agent from the same school. Payoffs are in Tanzanian shillings (TZS), US$1=TZS 2230

with the symmetric allocation. In the AIB, switching from right to left at row 9, 10, or never also implies benevolence.

Malevolence means that the decision-maker is willing to give up own payoff to *decrease* the passive agent's payoff. Switching to the *left* in the DIB at row 4 or 5 reveals malevolence. For example, never switching implies a willingness to pay of at least TZS 500 to decrease the passive agent's payoff by TZS 1,500. In the AIB, switching to left at row 6, 7, or 8 also implies malevolence.

More precisely, the definitions of benevolence and malevolence in the two domains lump together strict and weak forms. A weakly benevolent decision-maker increases the passive agent's payoff by choosing *left* in row 3 at no cost, while a weakly malevolent individual renounces doing so by choosing *left* at row 8.

Table 3 clarifies how a choice sequence translates into the active agent's willingness to pay (WTP) to increase/decrease the passive agent's payoff

by TZS 1. Since the choice list structure of the experiment only allows us to identify WTP intervals, the midpoint is used as a proxy. The signs of the WTP in the AIF and DIB classify an individual's choices in these domains as benevolent or malevolent. Benevolence and malevolence are used to categorize subjects into four major distributional preference types. An individual who makes benevolent choices in both domains is labeled as "efficiency-loving" (EL) — that is, the decision-maker maximizes total payoffs. A subject who chooses to switch to the asymmetric allocation early in both domains reveals a preference for inequality; thus the label "inequality-loving" is used (IL). In contrast, switching to the asymmetric allocation late or never in both domains displays "inequality-averse" (IA) individual. A subject with malevolent choices in both domains is assigned to the "spiteful" preference type (SF).

At the beginning of the experiment, the instructions of the experiment and an example choice list to illustrate the choices were read to all participants.[11] In particular, students were informed that the passive person was a randomly chosen participant in the same session. Subsequently, student's remaining questions were answered personally by the team of enumerators.

It was made clear that if a student drew the distributional preference experiment for payout at the end of the session, one of the 10 items on the choice list would be randomly chosen and realized. Due to random matching of active and passive agents, apart from actively choosing allocations, each child was guaranteed to be a passive agent for some other student. The passive payoff from the randomly matched participant was added to the active payoff of the decision-maker.

[11]The experimental instructions were translated into Swahili and tested prior to the experiment. The English version of the instructions can be found in Appendix D.

Table 3: Revealed willingness-to-pay and distributional preference types

Disadvantageous Inequality Block (DIB)				
Subject chooses *left* for first time in row	WTP w	WTP proxy	WTP sign	Revealed attitude
1	$0.33 \leq w < \infty$	0.33	>0	Benevolent
2	$0.06 \leq w < 0.33$	0.2	>0	Benevolent
3	$0 \leq w < 0.06$	0.03	>0	Benevolent
4	$-0.06 \leq w < 0$	-0.03	<0	Malevolent
5	$-0.33 \leq w < -0.06$	-0.2	<0	Malevolent
Never	$-\infty < w < -0.33$	-0.33	<0	Malevolent
Advantageous Inequality Block (AIB)				
Subject chooses *left* for first time in row	WTP	WTP proxy	WTP sign	Revealed attitude
6	$-\infty < w < -0.33$	-0.33	>0	Malevolent
7	$-0.33 \leq w < -0.06$	-0.2	>0	Malevolent
8	$-0.06 \leq w < 0$	-0.03	>0	Malevolent
9	$0 \leq w < 0.06$	0.03	<0	Benevolent
10	$0.06 \leq w < 0.33$	0.2	<0	Benevolent
Never	$0.33 \leq w < \infty$	0.33	<0	Benevolent
Preference types				
DIB		AIB		Revealed preference type
Benevolent		Benevolent		Efficiency-loving (EL)
Benevolent		Malevolent		Inequality-loving (IL)
Malevolent		Benevolent		Inequality-averse (IA)
Malevolent		Malevolent		Spiteful (SF)

Note: This table shows how a choice sequence translates into the active agent's willingness to pay (WTP) to increase/decrease the passive agent's payoff by TZS 1.

4. Results

4.1. Distributional Preferences

The first step of the analysis is to document the prevalence of distributional preference types in the sample. Figure 1 plots the metric willingness-to-pay measure to increase the passive agent's payoff in the DIB (y-axis) and AIB (x-axis) and assigns preference types per quadrant. For most children, their choices can be clearly attributed to one of the four broad preference types. Only in the range between spiteful and inequality averse types do some subjects show more nuanced preferences, as they reveal neutrality if advantaged and neutrality or malevolence if disadvantaged. These types are consistent with *kick-down* or *selfish* preferences (Kerschbamer, 2015). The visualization also highlights that while fairly balanced across the advanta-

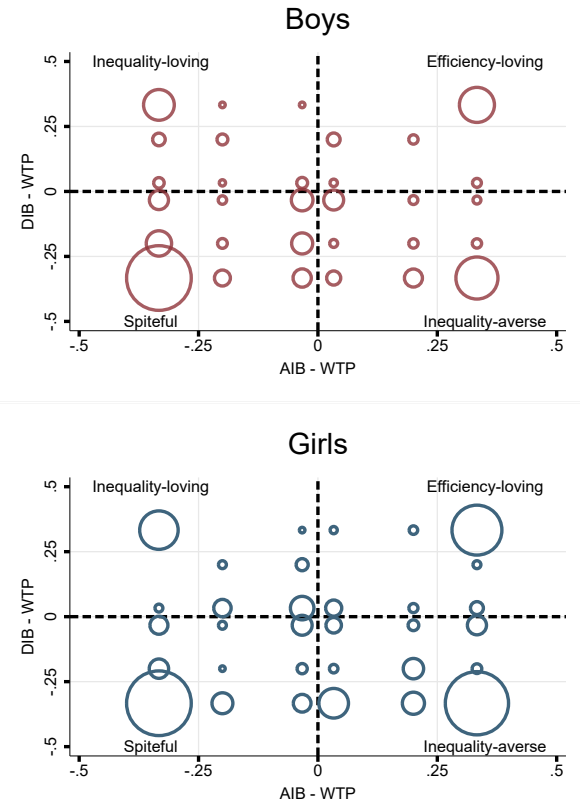


Figure 1: Distribution of distributional preferences by gender

Note: Distribution of distributional preferences based on willingness to pay (WTP) to increase passive agent's payoff in disadvantageous domain (DIB, y-axis) and advantageous domain (AIB, x-axis) domains. Left: boys (293 observations); right: girls (321 observations)

geous domain, choices in the disadvantageous domain are skewed toward malevolence.

Table 4 shows that a high percentage (42.5%) of children reveal spiteful behavior in the experiment. Less than half of the subjects show either

efficiency-loving (14.5%) or inequality-averse (30.6%) preferences.[12] A large share of students exhibit malevolent behavior in either the DIB (73.1%) or the AIB (54.1%), meaning that they sacrifice resources to improve their relative position. If advantaged, they choose to preserve the inequality, and even more strongly, if disadvantaged, they decide to equalize payoffs.[13] Although Fehr *et al.* (2013) use a somewhat different experimental design, the shares of revealed preference types from our experiment mirror almost one-to-one the distribution of 8- to 9-year-olds in their study of Austrian students. Compared with 12- to 13-year-old children in their sample, we document approximately three times higher frequencies of spitefulness and three times lower frequencies of efficiency-loving or altruistic types.

Distributional preferences vary significantly by gender. Girls are substantially more likely to be inequality-averse (35.8% to 24.9%) and less likely than boys to exhibit spiteful preferences (34.6 to 51.2%). This gender difference at a young age is the result of more benevolent choices of girls for both disadvantageous and advantageous allocations. In particular, when the allocation is in their favor (AIB), female students are statistically significantly more willing to sacrifice resources in order to increase the passive agent's payoff. In fact, 13.8% more girls do so in the advantageous than in the disadvantageous domain, while for boys this difference amounts to only 5.1%.

[12] We dropped 36 observations from the sample because of inconsistent (double switching) or erroneous (incomplete, double choices) answers.

[13] Children's distributional preferences differ significantly from those of a comparable sample of adults (362 parent couples recruited from eight randomly chosen primary schools in Dar es Salaam), who participated in a related study conducted by one of the coauthors (see Table A.1 in Appendix A). In particular, the efficiency-loving type is about 2.5 times less prevalent in the sample of children (14.5% to 38.6%). Instead, adolescents show a high frequency of spiteful preference types (42.5%), about 2.5 times the percentage of adults. Similar shares of the samples revealed inequality-loving (12.4% to 13.7%) or inequality-averse (30.6% to 31.2%) preferences. This suggests that with age, individuals adopt more efficiency-oriented preferences, rather than prioritizing their own absolute and relative payoffs. These findings are consistent with the age-trends in other-regarding preferences documented by, among others, Almås *et al.* (2010) and Sutter *et al.* (2018).

Table 4: Distribution of distributional preferences

	(1) Children	(2) Boys	(3) Girls	t-test
Efficiency-loving (EL)	14.5%	13.0%	15.9%	
Inequality-loving (IL)	12.4%	10.9%	13.7%	
Inequality-averse (IA)	30.6%	24.9%	35.8%	**
Spiteful (SF)	42.5%	51.2%	34.6%	***
WTP (DIB) > 0 (benevolence)	26.9%	23.9%	37.9%	
WTP (AIB) > 0 (benevolence)	45.9%	29.6%	51.7%	***
Observations	614	293	321	

Notes: Columns 1, 2 and 3 of this table show summary statistics of distributional preferences of the whole sample of children and the subsample of boys and girls. WTP denotes willingness to pay of a subject to increase (decrease) the payoff of the passive agent in the disadvantageous (advantageous) inequality block.

4.2. Peer Networks

The peer network constructed from the three best friends of each child provides information on the quantity and the types of peers. We define "friendship" as a unilateral- or bilateral link in the network. Figure 2 summarizes some of the main characteristics of these networks. By design, our network measure limits out-degree (naming a friend) to a maximum of three, which corresponds to the number of friends that we elicited via the survey. However, within the observable range, the distribution does not have large tails of very unpopular or popular students (i.e., in-degree, being named as a friend). The median of the number of peers is only slightly lower (5) than the mean (5.6), and the standard deviation (2) is moderate. Almost every third friendship is reciprocated. Not surprisingly for this age-group, friendship networks are extremely segregated by the gender of students. Of our sample of children, 77.5% have only same-gender friends, and only 9% have more than one peer from the opposite sex in their friendship networks.

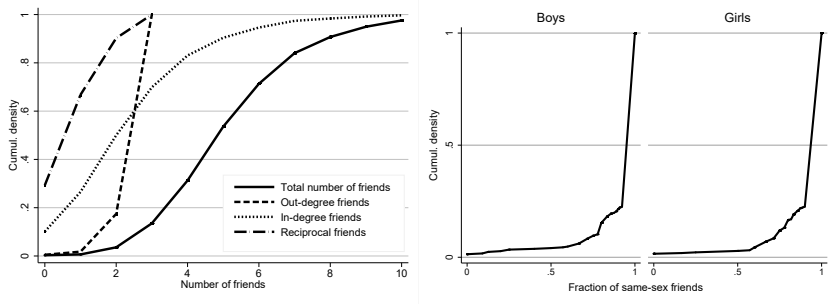
The peer networks in the sample are dense and well connected. This implies that each student could reach out to any other student via relatively

few friendship connections. There are also virtually no isolated peer networks, even taking into account the segregation by gender. However, as we analyze and discuss further in Section 4.5, there are differences in popularity and centrality of children within their networks.

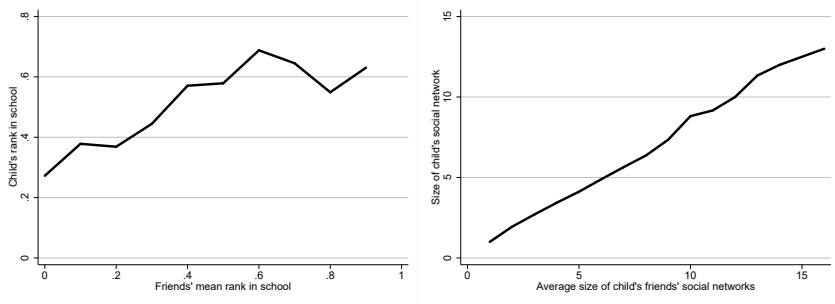
Despite the focus on understanding whether and why peer networks are based on distributional preferences, it is worth noticing that members of these networks are similar in other characteristics. Graph (b) of Figure 2 shows that students with high test scores also have high-performing friends (corr.0.34***), and popular children socialize with peers who are part of large networks themselves (corr.0.90***). Preference-based peer networks could reinforce these peer correlations through cooperation and social interaction based on distributional attitudes.

4.3. Distributional Preferences in Peer Networks

We start by exploring the link between preference types and the existence of peer networks. The hypothesis is that two given children with the same distributional preferences are more likely to form a friendship link than children that are of different types. Panel (a) in Figure 3 depicts the increase in probability of being linked in a pair by friendship if they have the same preference type. On average, observing the same type in two given individuals is related to a 0.6% higher likelihood that they have formed a friendship. This is a 24% increase at the unconditional mean of 2.5% of a possible connection being reported as a friendship tie. Interestingly, this correlation is mainly driven by inequality-loving and spiteful preference types, as can be seen in Figure 3. Table 5 reports coefficients from a probit regression evaluating this relationship. It confirms that the correlations are robust to the inclusion of school fixed effects and individual characteristics of the child. If two children reveal the same preference type, the likelihood that they have formed a friendship link increases by 0.16%. Inequality-loving and spiteful types account for the majority of this relationship with 0.83% and 0.25%, respectively. The raw correlation per standard deviation (0.0005) is in the range of Girard *et al.* (2015)'s results for the relationship between risk and



(a) Distribution of size and network segregation by gender

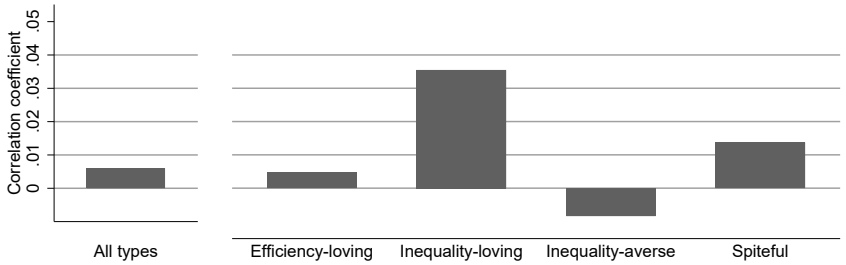


(b) Within-network correlation of school performance and popularity

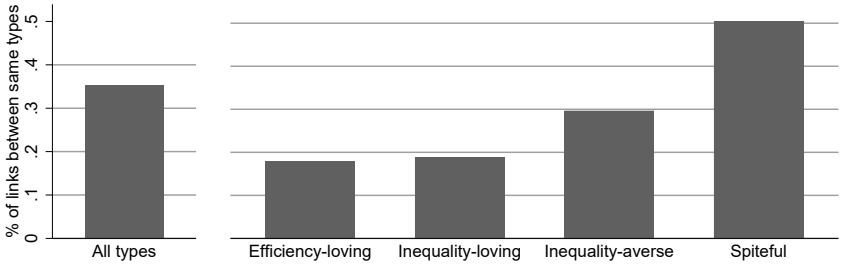
Figure 2: Characteristics of peer networks

time preferences and cooperativeness among friends in a German college setting (0–0.003 per standard deviation).

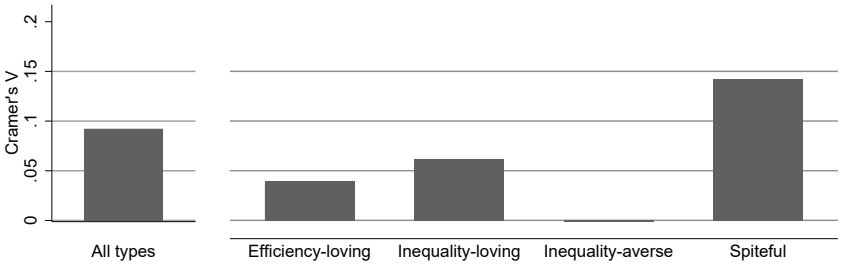
After studying a priori probabilities of friendship ties assorted by types, we address the question of whether children who have formed a friendship link share the same distributional preferences. Panel (b) of Figure 3 shows that 32% of friendship dyads (2,600 unilateral links) are between children with the same revealed distributional preference type. This result is mainly driven by inequality-averse and spiteful types. If a child is classified as a spiteful type, on average, almost half of his or her friends are spiteful types



(a) Correlation between a pair of children having the same type (0/1) and forming a friendship link (overall and by type). Baseline probability of friendship link between two random children: 2.5%



(b) Percentages of friendship links between children of the same preference type (overall and by type). Baseline probability of two random children: based on prevalence of types: 31%



(c) Cramer's V association coefficient between preference types in friendship links (overall and by type)

Figure 3: Association between preference types in peer networks

too. Although very indicative for the existence of social preferences peer networks, such a measure does not take into account the distribution of friendship pairs with all different types. Therefore, panel (c) of Figure 3 presents

Table 5: Similarity in preferences and friendship links

Friendship Link (0/1)	All Types	EL	IL	IA	SF
	(1)	(2)	(3)	(4)	(5)
Friend is same type	0.00162*	-0.00302	0.00832***	-0.000239	0.00249*
	(0.000655)	(0.00267)	(0.00240)	(0.00113)	(0.00103)
Outcome Mean	0.0252	0.0270	0.0271	0.0243	0.0247
Controls	Yes	Yes	Yes	Yes	Yes
Observations	127,879	17,468	15,674	39,433	55,304

Notes: Column 1 of this table presents marginal effects from a probit regression for the likelihood of having the same type. The outcome variable is a binary variable that determines whether a child reported a friendship link with a peer. Columns 2-5 report the results for subsamples of the child's preference type (EL = efficiency-loving, IL = inequality-loving, IA = inequality-averse, SF = spiteful). Standard errors are clustered at child level, and controls include the student's school grade, household size, religion, age, gender and school fixed effects. The number of observations reflects all possible links among students within their school. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

the raw correlations between types over all possible friendship dyads. For the overall relation between the categorical types variable, the Cramer's V measure of association is used. Conditional on having a friendship link with another child of a given type relates, on average, to a 9% likelihood that the child is of the same type. The strong correlation is largely driven by spiteful (14%) and inequality-loving (6%) types.

We now take a closer look at the correlations of the different distributional preference types by controlling for observable child characteristics and uncovering some of the heterogeneity in preference peer networks. Table 6 displays correlations in preference type between a child and her or his close friends. Each cell corresponds to the marginal effect of the variable of interest in a probit estimation of the following specification: A friendship dyad-level specification investigates the relation between a peer d's and the child i's types.

$$\mathbf{1}[\text{type} = t]_i = \alpha_0 + \alpha_1 \mathbf{1}[\text{friend type}_d = t] + X_i'\delta + \epsilon_{i,d} \tag{1}$$

where t denotes the vector of preference types $\{EL, IL, IA, SF\}$. Controls X include school fixed effects, total number of friends, school grade, age,

gender, religion, and household size. Standard errors are clustered at the child level.[14] We find that being an inequality-loving or spiteful preference type is related systematically to the number of friends of these same types. An additional friend of either of these two types significantly increases the likelihood of the child being either inequality-loving (+4.58%) or spiteful (+4.56%). Overall, the evidence suggests that peer effects are large for malevolent but not for benevolent choices, and thus preference types, in both domains of our experiment.

Panel B of Table 6 shows that the peer correlations across distributional preference types remain fairly constant when the directed nature of the network is taken into account. Whether a child names a friend (out-degree), is named by another child (in-degree), or both (reciprocal) makes little difference for preference type relations. Girls are slightly more likely to share reciprocal friendships, and therefore the correlations are slightly higher for the inequality-loving type, which is more prevalent in female students.

With distinct preference distributions for boys and girls, as well as relatively segregated peer networks, one could think that peer correlations are gender-specific. In panel C of Table 6, we therefore introduce heterogeneity by gender of children. Overall, the patterns in peer correlations in distributional preferences are similar for boys and girls. However, network results for spiteful types are strongly driven by boys, with a marginal effect of 5.5%, while girls show significantly higher correlations in inequality-loving types (7%), though these coefficients are not statistically different from each other.

The correlations with same-type friends differentiated for the gender of friends are similar to the overall results (see Table A.3 in Appendix A). On the one hand, they suggest that peer correlation for spitefulness is larger

[14]Notice that although we estimate separate specifications for all preference types, the simultaneous change of both outcome and explanatory variables does not warrant adjustments for multiple hypothesis testing. Furthermore, because of the exhaustive nature of the outcome variable (one regression for each possible preference type) and the clustering at child level, a joint estimation (SUR) does not yield significant efficiency gains. In Table A.2 in Appendix A we present results from an alternative specification that regresses a child's preference type on all four types of friends simultaneously. Wald-tests confirm the main result that inequality-loving and spiteful types are correlated significantly with their friends' types.

Table 6: Peer correlations in distributional preferences

Preference Type	EL	IL	IA	SF
	(1)	(2)	(3)	(4)
Panel A: *All Peers*				
Peer is same type	-0.000239	0.0458**	-0.0284	0.0456*
(obs. 2,600)	(0.0195)	(0.0173)	(0.0193)	(0.0194)
Panel B: *By Degree of Peer*				
Out-degree	0.000029	0.0557**	-0.0350	0.0458+
(obs. 1,630)	(0.0225)	(0.0214)	(0.0237)	(0.0252)
In-degree	0.00170	0.0638*	-0.0376	0.0373
(obs. 1,631)	(0.0283)	(0.0284)	(0.0235)	(0.0247)
Reciprocal	-0.00442	0.0850**	-0.0761*	0.0114
(obs. 1,322)	(0.0387)	(0.0315)	(0.0348)	(0.0379)
Panel C: *By Gender of Child*				
Friend of same type × Boy	0.0214	0.0263	-0.0314	0.0554+
(obs. 2,600)	(0.0264)	(0.0239)	(0.0267)	(0.0285)
Friend of same type × Girl	-0.0173	0.0703*	-0.0435+	0.0332
(obs. 2,600)	(0.0314)	(0.0312)	(0.0270)	(0.0284)
Mean	0.148	0.130	0.297	0.424
Controls	Yes	Yes	Yes	Yes

Notes: This table reports marginal effects from a probit regression for the likelihood of having the same-type friend. The outcome variable is a binary variable indicating whether a student is of a specific distributional preference type (EL = efficiency-loving, IL = inequality-loving, IA = inequality-averse, SF = spiteful). Panel A reports overall correlations per type. Panel B reports correlations by type for subsamples by degree centrality. Panel C reports correlations by type interacted with the subject's gender. Standard errors are clustered at child level and controls include student's school grade, household size, religion, age, gender, and school fixed effects. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

for boys than girls, while it is lower for inequality-loving types. On the other hand, it is noteworthy that social networks in general are extremely segregated by gender, which is a main driver of these results.

When the metric measure of the distributional preference experiment is considered, a positive correlation emerges in both the disadvantageous and advantageous domains, as shown in Figure 4. In particular, having benevolent friends in the DIB is positively correlated with a child's benevolence in that domain.

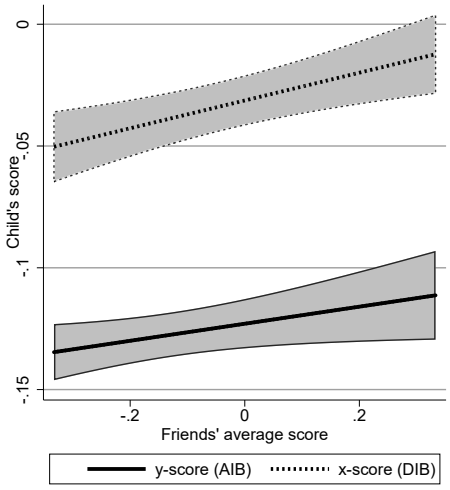


Figure 4: Correlations in WTP to increase the passive person's payoff between child and peers: disadvantageous (y-score) and advantageous (x-score) domains.

4.4. Ex Ante versus Ex Post Similarity

Our measures for correlations of preference types among friends suggest that social attitudes such as distributional preferences already shape interactions between individuals at a young age. Children may choose their close friends by, among other characteristics, matching on distributional preferences (ex ante similarity). In this case, the networks that we measure are

likely to be endogenous. On the other hand, children might be influenced by the attitudes of their peers, such that distributional preferences could be transmitted through friends (ex post similarity). When measuring social preferences for children old enough to participate in experimental sessions, the elicited networks are likely to be endogenous, as pupils have attended the same school for the previous five years. Therefore, the above-presented peer correlations represent the joint effect of selection and transmission, and further attempts to distinguish between the two channels seem warranted.

First, using the network data in more detail, we find suggestive evidence that both selection into networks and transmission play a significant role. If correlations among friends in preferences were driven by transmission, one should expect differential correlations across the various dimensions of degree centrality. In particular, the out-degree friends show higher correlation in types than in-degree peers if transmission is active, and actively naming a peer signals higher importance to or influence on the child than being nominated passively. Selection based on distributional preferences would lead to constant margins across degree centrality measures.

In our case, correlation coefficients of peers for different degree centrality subsamples are not significantly different from each other, suggesting that selection plays a large role in explaining (see Table 6) *social preference peer networks*. Similarly, the exposure to same type friends shows smaller correlations on the intensive (marginal effect at the mean) and extensive (having at least one same-type friend) margins (see Table 7). In the presence of strong ex post similarity one should expect the intensive margin to have higher importance.

Second, we do not find that friends who were in the same class in the year prior to the preference elicitation have differential correlation to the child's type than friends who simply go to the same school (see the panel A of Table 8). The idea behind this exercise is that a higher exposure to these friends in class would create a larger correlation if preferences are transmitted ex

Table 7: The role of peers: intensive vs. extensive margin

Preference Type	EL	IL	IA	SF
	(1)	(2)	(3)	(4)
Panel A: *Intensive Margin*				
# of friends of same type	0.00981	0.0133*	-0.00626	0.0157**
	(0.00566)	(0.0173)	(0.00631)	(0.00587)
Mean (indep. var.)	0.783	0.714	1.582	2.258
Panel B: *Extensive Margin*				
Friend of same type (0/1)	0.0400	0.0888**	-0.0818*	0.0889+
	(0.0303)	(0.0274)	(0.0416)	(0.0505)
Mean (indep. var.)	0.443	0.425	0.735	0.819
Mean (dep. var.)	0.148	0.130	0.297	0.424
Controls	Yes	Yes	Yes	Yes
Observations	592	592	592	592

Notes: Each cell shows the marginal effect of having a same-type friend (number of friends and a dummy variable for having at least one same-type friend) in probit model estimation. The outcome is a binary variable that determines whether a student is of a specific distributional preference type (EL = efficiency-loving, IL = inequality-loving, IA = inequality-averse, SF = spiteful). Standard errors are robust, and controls include total size of social network, student's grade, household size, religion, age, gender, and school fixed effects. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

post. However, class compositions in the study context change every year, such that the exposure to same-class friends might not be long enough.[15]

The most relevant evidence to distinguish selection from transmission comes from an attempt to control for observable and unobservable characteristics that best (first-ranked) friends share with each other. We implement a best-friend fixed effect (ϕ_b) specification at the friendship dyad level (d). This means that we construct best-friend pairs (b) and regress the types of their unshared friends on the index of child i's type. If two students named

[15]Every year the class compositions are newly formed by a quasi-random procedure. Depending on the grade point sum students are iteratively assigned to class A or class B.

each other as best friends reciprocally, the pair is kept only once in the estimation sample.

$$\mathbf{1}[\text{type} = t]_i = \beta_0 + \beta_1 \mathbf{1}[\text{friend type}_d = t] + X_i'\delta + \phi_b + \epsilon_{i,d,b} \qquad (2)$$

The idea behind such an approach is that if close friends share characteristics that lead to endogenous network formation, the fixed effects would capture such confounds and one can identify the ex post peer effect from the pair's unshared friends. The regression results reported in panels B and C of Table 8 show that correlations for the spiteful types, as well as for inequality-loving and averse children, survive the inclusion of best-friend fixed effects. The reduction in point estimates suggest that 55.8% and 62.3% (ratio of FE to OLS estimates) of the peer correlations between inequality-loving and spiteful types are explained by observable and unobservable characteristics shared with the best friend. Given that transmission might be larger between best friends compared with second-best or third-best friends and that selection could be driven by factors not shared with the best friend, these results have to be interpreted with caution. Nevertheless, they suggest the presence of both a high degree of selection and a positive, but low impact of transmission in social preference peer networks.[16]

4.5. Relative School Performance and Popularity

Next, we investigate other important questions related to the distributional preferences of children: Are the attitudes toward inequality and altruism regarding the allocation of resources related to an individual's position within the closer social network? Using the detailed data on friend networks, as well as administrative information on test scores, we investigate the relationship between a child's relative position and preference type for the dimensions of school performance and social hierarchy. In particular, we test the hypothe-

[16] As can be seen in Table 8, the results of the fixed effects and OLS estimation are robust to using (conditional) logit specification. Since marginal effects cannot be consistently estimated for the logit fixed effects model, p-values are reported.

Table 8: Ex ante versus ex post similarity

Preference Type	EL	IL	IA	SF
	(1)	(2)	(3)	(4)
Panel A: *Exposure in Class*				
Same type friends in class	0.0178	0.0488^{+}	-0.0318	0.0378
	(0.0244)	(0.0262)	(0.0227)	(0.0239)
Same type friends not in class	-0.0400	0.0510	-0.0200	0.0617^{+}
	(0.0343)	(0.0338)	(0.0337)	(0.0348)
Panel B: *Friendship Fixed Effects (569 best-friend pairs)*				
Friend of same type	-0.00592	0.0228*	-0.0165^{+}	0.0172^{+}
	(0.0132)	(0.0111)	(0.0109)	(0.00941)
FE logit p-values	0.659	0.088	0.15	0.034
Panel C: *Ordinary Least Squares*				
Friend of same type	-0.00395	0.0516*	-0.0289	0.0456*
	(0.0225)	(0.0217)	(0.0195)	(0.0200)
Logit p-values	0.921	0.007	0.149	0.026
Controls	Yes	Yes	Yes	Yes
Observations	2,600	2,600	2,600	2,600

Notes: Columns 1–4 of this table present alternative regression results for the likelihood of having the same-type friend. Panel A reports results from a linear probability model estimated with friendship fixed effects. Each pair of best friends represents a fixed effect and each pair is used only once in the estimation sample. *P*-values for the alternative fixed effects logit estimation are added. Coefficients of the linear specification without fixed effects are shown for comparison in panel B. The outcome of all specifications is a binary variable that determines whether a student is of a specific distributional preference type (EL = efficiency-loving, IL = inequality-loving, IA = inequality-averse, SF = spiteful). Standard errors are clustered at best-friend pair and child level. Controls include total size of social network, student's school grade, household size, religion, age, gender, and school fixed effects. Panel C reports marginal effects from a probit estimation for which the preference types of friends are separated between those within the same class and others from the same school but in a different class. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

sis that a higher relative position in terms of school outcomes and centrality within the social network is related to more benevolent preferences.

Relative position in school performance is measured by the rank in standard 6 of a specific school.[17] Within the social network, we use the number of higher-ranked friends, whether friends are on average higher-ranked, and a continuous variables of the mean rank difference to capture the relative standing in performance of the child.

Popularity is assessed by measures for centrality widely used in network analysis. The simplest one, in-degree centrality, denotes the number of incoming friendships, meaning it counts the number of times that other students have named a child as their friend. Taking it a step further, the Katz-Bonacich centrality additionally captures aspects of popularity that go beyond the direct friends. It counts all the shortest paths to reach any other friend node in the close and extended social network, while discounting those connections farther away from the child. Finally, the eigenvector centrality, in an extension to degree centrality, treats connections to friends differentially by their respective importance in the network.[18]

Empirically, the correlation between relative position or popularity and distributional preferences is estimated using the following specification at the student level. To correct the robust standard errors for correlation at the school level, we report clustered standard errors and clustered wild bootstrap standard errors with Webb distribution (Webb, 2014; Cameron & Miller, 2015). The latter corrects for overrejection bias due to the very low number of clusters (three schools).

$$\mathbf{1}[\text{type} = t]_i = \gamma_0 + \gamma_1 \begin{Bmatrix} rel.\ \ rank_i \\ centrality_i \end{Bmatrix} + X_i'\beta + \epsilon_i \tag{3}$$

[17] The rank is based on the grade point sum over all 10 subjects of the final national exam at the end of standard 5, normalized by the total number of students at the school. The exam took place approximately one month prior to the experimental sessions.

[18] For a detailed description of network summary and centrality statistics, see Jackson (2008)

Table 9 shows that especially the large prevalence of spiteful preference types is connected to the relative position of students in terms of educational outcomes. Note that the specification controls for the numeric school grade and therefore identifies the relation relatively locally. Taking the estimates at face values, this implies that of two students who ranked one standard deviation apart, the lower-ranked student is about 29% more likely to have spiteful preferences. Ranking one standard deviation lower than a peer increases this likelihood by 2.3%. Inequality- and efficiency-loving types are negatively correlated with our measures of relative position, though this is not statistically significant. This suggests tentatively that low standing in terms of relative school performance decreases benevolence in both DIB and AIB. Although intuitive, the estimates do not prove a causal relationship between relative position and spiteful distributional preferences. Students may perform worse than their peers because of their distributional preferences (reverse causality) or because of observable or unobservable confounds. We rely on survey information to tentatively argue against these channels, see Table A.4 in Appendix A. To the extent that malevolent social preferences hinder a student's success at school, we do not find spiteful types to be less popular among other students or show lower self-reported frequencies of studying or doing homework with their friends. With respect to observable confounders, such as social and financial status of the child's family, potential proxies we control for, such as household size, religion and impatience (a proxy for credit constraints), are not or negatively related to spitefulness.

Figure 5 depicts the social networks in one of the sample schools. It shows, on the one hand, that preference types, varied by color, appear in clusters, and on the other hand, that spiteful types (green) are dominant in popularity, represented by size. Zooming in on this malevolent type, a central cluster located around several popular *influencers* emerges. This pattern is confirmed by panel B in Table 9, which shows that all measures for centrality and popularity are related positively, though not significantly, to the likelihood of being a spiteful type. This correlation is robust to controlling for the total number of friends and therefore is not merely a reflection

Table 9: Distributional preference and relative position

Preference Type	EL	IL	IA	SF
	(1)	(2)	(3)	(4)
Panel A: *Relative Position in School*				
Rank in school	0.0216	-0.307	-0.741*	0.997**
(normalized at school level)	(0.267)	(0.229)	(0.352)	(0.369)
clustered p-values	0.935	0.180	0.1111	0.0921
Rank difference to friend (dyad level)	-0.0409	-0.0289	0.00501	0.0651^{+}
(normalized at school level)	(0.0270)	(0.0264)	(0.0344)	(0.0374)
Observations	2,744	2,744	2,744	2,744
Panel B: *Social Hierarchy*				
In-degree	0.00154	0.0113	-0.0133	0.000435
	(0.00690)	(0.00774)	(0.00925)	(0.00999)
clustered p-values	0.8419	0.1191	0.3231	0.9728
Eigenvector centrality	-0.0724	0.530	-0.682^{+}	0.224
	(0.418)	(0.481)	(0.361)	(0.594)
clustered p-values	0.8427	0.5465	0.2865	0.7042
Katz-Bonacich centrality	-0.177	-0.448	-0.182	0.807^{+}
	(0.492)	(0.343)	(0.463)	(0.479)
clustered p-values	0.3616	0.1756	0.7786	0.0376
Controls	Yes	Yes	Yes	Yes
Observations	611	611	611	611

Notes: Columns 1–4 of this table report marginal effects from probit regressions of preference types regressed on a student's relative position (panel A) and social hierarchy (panel B). The outcome variable is a binary variable that determines whether a student is of a specific distributional preference type (EL = efficiency-loving, IL = inequality-loving, IA = inequality-averse, SF = spiteful). Standard errors are robust, and clustered p-values reflect standard errors clustered at school level (3), computed via wild bootstrap using the Webb distribution. Controls include total size of social network, student's school grade, household size, religion, age, gender, and school fixed effects. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

of large numbers of this preference type. Popular students might feel less intrinsic pressure to show benevolence toward others. In the spirit of reverse causality, an alternative explanation might be that it requires spiteful types to establish and conserve hierarchies at school. Concerning this channel, Girard *et al.* (2015) provide some evidence that preferences, such as risk, trust, and cooperativeness can predict an individual's centrality in a newly formed social network. A look at the relationship between popularity and

choices in the DIB and AIB reveals that the correlation operates mainly through malevolence when the asymmetric allocation is advantageous for the decision-making child. This suggests that these students are likely to prefer establishing hierarchies in the school environment that are favorable to them.

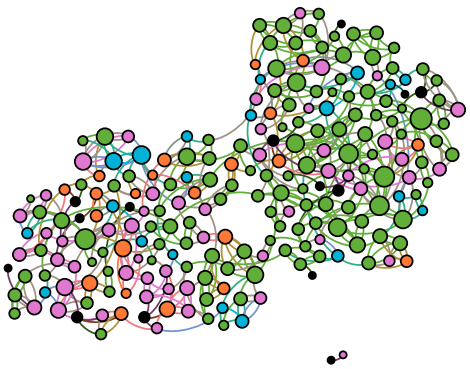
The distinction between benevolence in the DIB and AIB can also help one understand why low ranks in outcomes and popularity show different correlations to distributional preference types. Disadvantaged children in terms of school grades may take the situation as exogenous — that is, not affected by their distributional attitudes toward peers —, and tackle the disadvantage through malevolent choices in the DIB. Unpopular children may consider their social position malleable and signal benevolent behavior.

5. Additional Results

While the main focus of this paper is to study the role of the close social environment of peers in understanding distributional preferences of children, our study additionally represents the first instance of experimentally eliciting these attitudes in a low-income context. Not surprisingly, we find that the country context also matters for other-regarding preferences in adolescence. As mentioned earlier, although we use a different experimental design, the shares of revealed preferences types in our sample of 12- to 13-year-old Tanzanian children resemble the distribution of 8- to 9-year-olds in the sample of Austrian students studied by Fehr *et al.* (2013). The gender gap in children's distributional preferences is identical to the shares of preference types among 8- to 9-year-olds in that study. Thus, it appears as if a 2- to 3-year delay exists in the evolution of distributional preferences, though individuals could be on different paths altogether. Surprisingly, this delay corresponds to the deficits in human capital formation in Sub-Saharan Africa compared with developed countries. Bold *et al.* (2018) find that after 3.5 years of school, primary schoolchildren in Kenya and Mozambique have gathered knowledge of only 1.5 years' effective learning. If economic underdevelopment is related

to a low rate and slow formation of benevolent other-regarding preferences, cooperation and growth could be further affected, a hypothesis to be tested in future research.

(a) *All preference types*



(b) *Spiteful type*

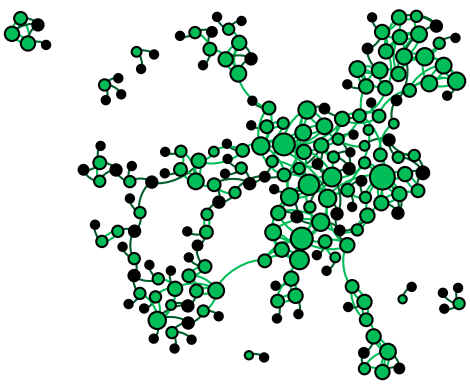


Figure 5: Degree centrality and preference types (Maarifa Primary School)

Notes: Efficiency-loving = blue, inequality-loving = orange, inequality-averse = pink, spiteful = green. Black circles in the Figure 5(a) denote individuals with missing preference measures; in Figure 5(b), they denote all nonspiteful preference types. Figure 5(a) depicts all standard 6 students in the school, with colors and size denoting preference types and degree centrality. Figure 5(b) filters the network for children of the spiteful type.

It is worth mentioning that the broad and close social environment may interact in determining preference formation at a young age. For example, peer networks in low-income, poverty-prone contexts could have stronger influences on economic behavior, given their role for providing crucial insurance and support in the lack of efficient formal institutions, even at a young age.

This potential preference gap between low- and high-income contexts seems to persist over time. Results for comparable adults sampled in our low-income setting also differ significantly from distribution of types in developed countries (see Figure B.1 in Appendix B for the distribution of preferences in the adult sample). For example, a study in Austria by Balafoutas *et al.* (2014), using the same design as our study, shows up to twice as many efficiency-loving types and a significantly lower occurrence of inequality-averse attitudes among adults. In fact, the distribution of adult preference types in our sample is strikingly close to the findings of Fehr *et al.* (2013) for 14- to 17-year-old high school students in a high-income setting. Again, this observation warrants future research designed to address these aspects directly.

6. Conclusions

Previous literature in economics has documented that distributional preferences - also called social preferences or other-regarding preferences - are important in explaining a number of economic decisions such as cooperation, productivity, and political decisions. How does peer influence in early life shape distributional preferences? In this paper, we attempt to shed light on this question using a lab-in-the field experiment. We recruited a sample of adolescents (aged 12-13) and let them make 10 binary choices between two payoff allocations between the decision-maker (the active agent) and a randomly matched anonymous person (the passive agent). We then use these allocation patterns to categorize children into efficiency-loving, inequality-loving, inequality-averse, and spiteful types. We also collect de-

tailed information on friendship networks and investigate the relationship between distributional preferences and relative standing within the friendship network.

Results suggest that a large percentage of children exhibit spiteful behavior (42.5%) or equality-oriented (30.6%) preferences. This means a large share of students reveals a malevolent behavior in their allocation decisions, i.e. they sacrifice resources to improve their relative position. If advantaged, they choose to maintain the inequality, and even more strongly, if disadvantaged, they opt to equalizing payoffs. There is also a clear difference between boys and girls in distributional preferences. Girls tend to be more likely to be inequality-averse than boys and less likely to reveal spiteful preferences.

The detailed friendship network data we collected allows us to uncover a significant correlation in distributional preferences within the peer networks of adolescents. In particular, children of the same preference types are more likely to be linked by self-reported friendship. Conditional on an existing friendship, children are alike with respect to malevolent behavior toward others, especially in disadvantageous situations. A large fraction of this peer effect is driven by selection into networks with the remaining correlation stemming from transmission through peers. Additionally, the relative position within a network is related to preference types to a lesser extent than the network composition.

We believe that our study offers several novel and interesting insights on distributional preferences of adolescents and their peers. First, it provides a structured view on the role of social networks in shaping adolescents' social preferences. We show that social preferences types are assorted along friendship ties. Second, our study can be considered as a relevant starting point to study the emergence of reference groups that are at the heart of models of social preferences, but have not been endogenized in these models so far. Third, we show that there is a potential relationship between distributional preferences and one of the most important outcomes at a young age, school performance.

Given the importance of distributional preferences for many aspects of life, we regard it as an interesting task for future research to explore how early social preference networks shape group outcomes later in life. Our findings also speak to the potential importance of exposing children to attitudes that differ from the prevalent views of their close social environment. Children in a weak relative position or in a peer network based on malevolent preferences may not evolve with age toward benevolent other-regarding attitudes. Tracking or reshuffling of classes at school may be a policy that can induce exposure to other attitudes, while simultaneously changing relative positions within the social environment.

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Appendix

A. Additional Tables

Table A.1: Revealed distributional preferences of adults

	Adults	Men	Women
Efficiency-loving (EL)	38.63%	32.87%	44.41%
Inequality-loving (IL)	13.67%	15.04%	12.29%
Inequality-averse (IA)	31.10%	31.20%	31.01%
Spiteful (SF)	16.60%	20.89%	12.29%
WTP (DIB) > 0	52.31%	47.91%	56.70%
WTP (AIB) > 0	69.75%	64.07%	75.42%
Observations	717	359	358

Notes: WTP denotes a subject's willingness to pay to increase (decrease) the payoff of the passive agent in the DIB (AIB). Nine adults are dropped from the sample because of inconsistent (double switching) or erroneous (incomplete, double choices) answers.

Table A.2: Peer correlations in distributional preferences (alternative specification)

Preference Type	EL	IL	IA	SF
	(1)	(2)	(3)	(4)
Friend is type 1 (baseline)				
Friend is type 2	-0.0120	0.0579*	-0.0000417	-0.0530
	(0.0260)	(0.0267)	(0.0350)	(0.0372)
Friend is type 3	0.0143	0.0292	-0.0477+	0.00503
	(0.0217)	(0.0208)	(0.0277)	(0.0292)
Friend is type 4	-0.00551	0.00143	-0.0353	0.0349
	(0.0224)	(0.0212)	(0.0286)	(0.0295)
Wald test: type 2=type 3=type 4	1.53	12.44**	4.56	8.81*
P-value	0.6759	0.006	0.2073	0.0319
Mean	0.148	0.130	0.297	0.424
Controls	Yes	Yes	Yes	Yes

Notes: This table reports marginal effects from a probit regression of a child's preference type on the friend's type. The outcome variable is a binary variable that indicates whether a student is of a specific distributional preference type (EL = efficiency-loving, IL = inequality-loving, IA = inequality-averse, SF = spiteful). Panel A reports overall correlations per type. Panel B reports correlations by type for subsamples by degree centrality. Panel C reports correlations by type interacted with the subject's gender. Standard errors are clustered at child level, and controls include student's school grade, household size, religion, age, gender, and school fixed effects. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.3: The role of peers by gender

Preference Type	EL	IL	IA	SF
	(1)	(2)	(3)	(4)
By Gender of Peer:				
Boys				
Friend of same type	0.0252	0.0529^{+}	-0.0458^{+}	0.0422
	(0.0295)	(0.0320)	(0.0257)	(0.0299)
Girls				
Friend of same type	-0.0155	0.0688*	-0.0435^{+}	0.0316
	(0.0295)	(0.0299)	(0.0254)	(0.0292)
Mean	0.148	0.130	0.297	0.424
Controls	Yes	Yes	Yes	Yes

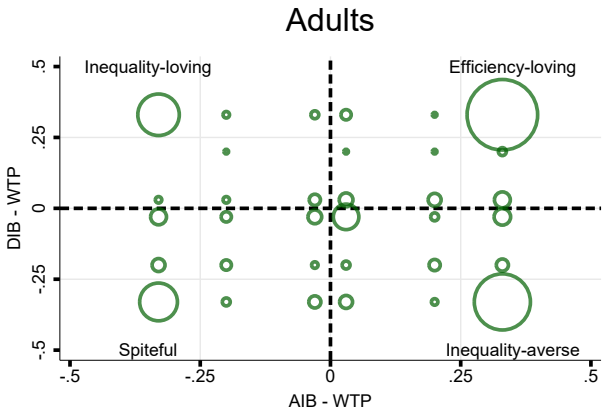
Notes: Each cell shows the marginal effect of having a same-type friend in a probit model estimation. The outcome is a binary variable that determines whether a student is of a specific distributional preference type (EL = efficiency-loving, IL = inequality-loving, IA = inequality-averse, SF = spiteful). Standard errors are clustered at child level, and controls include total size of social network, student's grade, household size, religion, age, gender, and school fixed effects.$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.4: Child characteristics by preference type

	(1) All Types	(2) EL	(3) IL	(4) IA	(5) SF	ANOVA
Study with friends (days per week)	1.951 (0.991)	2.034 (1.055)	1.987 (0.993)	1.771 (1.053)	2.042 (0.906)	*
Do homework with friends (days per week)	1.563 (1.137)	1.398 (1.120)	1.720 (1.180)	1.489 (1.135)	1.627 (1.127)	
Play with friends (days per week)	2.339 (0.915)	2.318 (0.929)	2.467 (1.251)	2.245 (0.999)	2.377 (0.881)	
Household size	5.346 (1.999)	5.472 (1.913)	5.280 (2.197)	5.282 (1.847)	5.368 (2.080)	
Number of children in hh	2.616 (1.304)	2.892 (1.465)	2.451 (1.251)	2.564 (1.215)	2.606 (1.316)	
Muslim	0.596 (0.491)	0.494 (0.503)	0.737 (0.443)	0.617 (0.487)	0.575 (0.495)	*
Observations	614	89	76	188	261	

B. Additional Figure

Figure B.1: Distributional preference of adults



Note: Distribution of social preferences based on willingness to pay (WTP) to increase passive agent's payoff in disadvantageous domain (DIB, y-axis) and advantageous domain (AIB, x-axis) domains (717 observations).

C. Choice List for Distributional Preferences Experiment

Figure C.1: Choice List for Distributional Preferences Experiment (translated from Swahili)

	LEFT		Decision		RIGHT	
	You get	Passive person gets			You get	Passive person gets
1	2000	4000	O	O	2500	2500
2	2400	4000	O	O	2500	2500
3	2500	4000	O	O	2500	2500
4	2600	4000	O	O	2500	2500
5	3000	4000	O	O	2500	2500

6	2000	1000	O	O	2500	2500
7	2400	1000	O	O	2500	2500
8	2500	1000	O	O	2500	2500
9	2600	1000	O	O	2500	2500
10	3000	1000	O	O	2500	2500

D. Instructions for Distributional Preferences Experiment

Start by reading the following instructions to the participants: We will now proceed with the next part of today's session. It consists of 10 decisions. You are matched with another person of your age in today's study. The identity of this person will remain unknown to you. We will call the person matched with you "your passive person" from now on. We will explain later, why this participant is called "passive person".

Each of your 10 decisions is a choice between the options LEFT and RIGHT. Each option has consequences for how much money you and your passive person can earn (show example choice).

Left		Choice		Right	
You get	Passive agent gets			You get	Passive agent gets
1900	3000	◯	◯	2000	2000

In this example you are asked whether you prefer the alternative LEFT, in which you get 1900 TZS and your passive person gets 3000 TZS, or the alternative RIGHT, in which you earn 2000 TZS and your passive person gets 2000 TZS as well. You will have to decide for one of the two alternatives by crossing the circle next to the alternative. Are there any questions?

All in all, you will make 10 such decisions. Your earnings from this part will be determined as follows:

If you draw this part for payout, one decision is chosen randomly by drawing a numbered card from 1 to 10. The alternative that was selected in the decision situation will be paid out. For instance, in the decision situation described above, if you chose the alternative RIGHT, you would receive 2000 TZS as active person, whereas your passive person would receive 2000 TZS as passive person.

In the same way your passive person receives earnings from your decision without doing anything for it. At the end of today's session you will be informed about which part of the session and which of your 10 decisions

determines your earnings. Importantly, you are also a passive person for one of the other participants. Again, that person does not know your identity. You will get additional payout from your role as passive person according to that participant's choices. Are there any questions?

E. Comment on Preanalysis Plan

There are two main departures of this paper from the registered preanalysis plan: (i) The present study focuses purely on distributional preferences, leaving aside children's time preferences. This is mainly due to presentational considerations. Time preferences were collected as planned and may feature in additional studies. (ii) The paper is focused mainly on peers. While we attempted to collect preference measures for all children, this was hindered by high rates of orphans and children who do not live with both biological parents in their current homes in Dar es Salaam. The resulting sample of parents of the sample children is too small for robust inference.

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