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PREFERENCES OVER LEISURE AND CONSUMPTION OF SIBLINGS AND INTRA-HOUSEHOLD ALLOCATION

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PREFERENCES OVER LEISURE AND CONSUMPTION OF SIBLINGS AND INTRA-HOUSEHOLD ALLOCATION

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ABSTRACT

Children are increasingly treated as active members in the household. However, their preferences over consumption and leisure are rarely modelled. This paper considers heterogeneity in siblings' preferences over leisure and consumption and builds a theoretical and empirical model for children's time and consumption allocations in a household. We test the predictions of the model with unique data from Ethiopia, India, Peru and Vietnam which contain detailed information on time use and allocations of assignable goods for sibling pairs. We find that conditioning on observable variables, the residuals of these simultaneous decisions are significantly negatively correlated. This suggests that differences in siblings' relative time and consumption allocations are driven by their relative preferences over leisure and consumption rather than differences in parents' relative altruism. Families seem to function as market economies in which children trade off leisure and consumption, select their optimal bundle, and are rewarded by their parents accordingly.

Keywords: Intra-household allocation, children.

JEL Classification: D1, J1, J2.

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1 Introduction

Economists increasingly consider children as active members in the household[1] who affect household expenditure allocations (Moehling 2005; Lundberg et al. 2009; Kapan 2009; Dauphin et al. 2010) and their own time allocations (Berry 2013; Bursztyn and Coffman 2012; Kremer et al. 2009). Recent evidence from lab experiments highlights heterogeneity in children's risk taking, attitudes towards ambiguity, time preferences, and competitiveness (Castillo et al. 2011; Andersen et al. 2013; Sutter et al. 2013)[2]. Most parents will also agree that children growing up in the same household can be very different in their personality traits and preferences (Daniels and Plomin 1985; Dunn and Plomin 1990)[3]. Still, economic models traditionally do not take into account heterogeneity in children's preferences within families and how these shape consumption and leisure allocations. When considering children as economic agents with preferences over consumption and leisure, it becomes natural to employ standard models employed in the labor economics literature in which agents maximize utility from consumption and leisure subject to a budget constraint. The objective of this paper is to understand whether children's preferences over consumption and leisure determine allocations of consumption and leisure among siblings.

The central contribution of the paper is twofold. First, it develops a unitary model of the household focusing on the role of heterogeneity in preferences of children and intra-sibling allocation of consumption and leisure[4]. The model assumes parents to be social planners taking into account children's preferences over leisure and consumption when making allocation decisions. The paper focuses on how allocations are driven conditional on children being in school rather than the tradeoff between work and school, so we abstract from schooling decisions[5]. The model provides insights into how heterogeneity in

[1]The psychology literature has long recognized the role of children in household decision making and studies on child development suggest a process of gradual increase of shared decision making towards decision autonomy from childhood into adolescence (Grotevant 1983; Dornbusch et al. 1985; Yee and Flanagan 1985). Harbaugh et al. (2003) play dictator and ultimatum games with children and find that they are good bargainers by the age of 7, in the sense that they are aware of their own and their partner's pay-offs in a specific situation. Evidence from an experiment conducted by Harbaugh et al. (2001) suggests that by the age of 11, children's choices are roughly as rational as choices by adults, so that their choices satisfy the Generalized Axiom of Revealed Preference. Choices made by about 60% of 11 year old children and undergraduates are consistent with utility maximization, compared to about 25% of 7 year old children. Lundberg et al. (2009) show that there is a sharp increase in children's reported involvement in the decision making process between age 10-14.

[2]Castillo et al. (2011) and Sutter et al. (2013) show how differences in preferences elicited in experiments significantly correlate with differences in observed behaviors in real life, such as school referrals, smoking, alcohol consumption and saving of pupils in Georgia (United States) and Tyrol (Austria). Orkin (2011) presents qualitative evidence from children in rural Ethiopia supporting the idea that even within one village children have different preferences with regard to work as well as make decisions regarding their time.

[3]One of the earliest studies documenting the low correlation of personality inventories between siblings was Crook (1937) using the Bernreuter personality inventory.

[4]Our approach is most closely related to Browning and Gørtz (2012) who model the allocation of consumption and leisure between husband and wife.

[5]Our model therefore does not view child work and schooling as substitutes, which is in line with evidence found by Attanasio et al. (2010). They show that increases in schooling hours caused by the Familias en

children's preferences and parental altruism affect allocations and yields testable propositions. The intuition is straightforward. Assume there is a family with two children, child A and child B, who face equal pay. If relative parental altruism towards child A and B drives allocation decisions and children's relative preferences over leisure and consumption are independently distributed, we expect relative expenditure and relative leisure to be positively correlated, controlling for observable exogenous characteristics. The favorite child gets allocated a higher expenditure share and higher leisure share. On the other hand, if relative preferences over leisure and consumption drive allocations, relative preferences for leisure and consumption are negatively correlated, and there is no variation in parental altruism, controlling for observable exogenous characteristics, relative leisure and relative consumption should be negatively correlated. Children who work longer hours get rewarded accordingly[6].

Second, we use detailed data on time use and assignable goods of a panel data set of children in Ethiopia, India, Peru and Vietnam to test the theoretical implications of the model. Data on both time use of children in the household and assignable expenditures from household surveys is rare for adults (Browning and Gørtz 2012), and even more so for children. We use data on the amount of time children spend on leisure and work activities, and child-specific clothes expenditures. To our knowledge, this is the first paper that explicitly models within sibling variation in preferences over leisure and consumption and tests the predictions of the theoretical model with a data set of children who are in full time schooling and haven't entered the formal labor market yet in the context of four developing countries.

We find that conditioning on observable variables, relative leisure and relative consumption are significantly negatively correlated. This suggests that differences in siblings' relative time and consumption allocations are driven by their relative preferences over leisure and consumption rather than differences in the relative altruism of parents vis-à-vis their children. This correlation is robust to excluding younger children and non-biological siblings. When we use a different measure of relative time allocation, relative work hours instead of relative leisure, we find further evidence consistent with the hypothesis that preferences are driving allocations rather than altruism toward a particular child. We also show that this finding persists when we only explore variation in the hours worked in the household, ruling out that the positive correlation between relative work and relative expenditure is due to children working outside the house and therefore needing more work-related clothes expenditures. Finally, we do not find evidence that the relationship is driven by age-gender-location specific productivity differences, non-linear age effects, different levels of education and schooling hours, and a range of alternative hypotheses. Children seem to trade off

Acción program in Colombia did not map one to one into reductions in work hours; rather, the results suggest that leisure time of children decreased.

[6]These are the extreme cases. In reality, both relative altruism and relative preferences might play a role in determining allocations. The empirical analysis allows us to examine which of the two dominates.

leisure and consumption and are rewarded accordingly. As a result, the data is consistent with a model in which families behave as if they were an internal market in which children select their optimal consumption-leisure bundle.

This is important for two at least two reasons. First, the model shows that if siblings have different preferences over leisure and consumption, it is efficient for parents to take these into account when making allocations in the household. Parents might possess information on preference heterogeneity among their children not available to policy makers. An implication is that blanket policies might be welfare reducing as they prohibit parents to take into account children's preferences over leisure and consumption. Further, we abstract the focus from the schooling-child labor trade-off traditionally employed in the literature, as we only look at children who are in full time schooling. The fact that we find heterogeneity in children's leisure and work allocations despite their full time enrolment status suggests that there are other factors that affect their time allocation apart from schooling[7].

The approach adopted in this paper is based on the assumption that household allocations are efficient, an assumption embodied in unitary as well as collective household models, which explicitly assume the existence of an efficient intra-household decision making process (Becker 1981; Chiappori 1988; Browning and Chiappori 1998). Among the first to explicitly consider parent-children interactions was Becker (1981) with his well known Rotten Kid Theorem. Within the literature on intra-household allocations, the presence of children and their effect on household economic behavior has received increasing attention over the past 20 years (Browning 1992; Browning and Lechene 2003; Browning and Ejrnæs 2009; Bonke and Browning 2011; Blundell et al. 2005; Cherchye et al. 2012). A recent paper by Dunbar et al. (2013) uses semi-parametric restrictions to identify the resource shares in a household allocated to children with the goal of estimating children's poverty levels in Malawi. The data employed in this chapter allows us to investigate how child-specific expenditures relate to children's time allocations.

Our focus on within sibling allocation of resources by parents also relates to the literature on child quantity and quality trade-offs, parental investment, and parental preferences for equality among their children. Becker and Lewis (1973) highlight the interaction between the quantity and quality of children: a larger number of children increases the marginal cost of quality, and vice versa. Becker and Tomes (1976) show that when children have different endowments, and the return to human capital investment is higher for high-endowment children, parents exacerbate these differences by investing human capital more heavily in the child with the higher endowments[8]. Whether parents reinforce or com-

[7]Empirically we are not able to distinguish whether our findings are generated by children's primitive or derived preferences; in other words, whether the observed behavior is due to children's intrinsic preferences or a reaction to incentives offered by parents; what is important is that both implications remain valid in either case.

[8]Behrman et al. (1995) highlight that this finding requires equal concern of parents, sufficiently high levels of resources allocated to children, and higher marginal as well as average returns to education for the more able child.

pensate endowments is still an open question in the literature[9]. Our paper differs from this literature in that we focus on a consumption good (clothes) rather than investment goods (i.e. education, health) and abstract from differences in initial endowments of children[10]. In our model, inequality in leisure and consumption among siblings can be due to differences in parental preferences as well as differences in children's preferences over leisure and consumption[11]. Finally, we do not explore the effect of family size due to limitations in the data: as we are able to identify expenditure shares and leisure time only for children with one other sibling in the age range of 5-17, we limit our sample to families with two children in this age group without younger siblings.

A few studies have departed from modeling children via caring preferences or as a household public good to consider them as agents in the household. Moehling (2005) shows that adolescents' labor force participation is positively correlated with their clothing expenditures using data from the Cost of Living Survey of 1917-1919 in the United States. Dustmann and Micklewright (2001) use data from sixteen year old adolescents from the British National Child Development Study and find that adolescents' labor force participation reduces parental transfers[12]. This focus of this paper differs from these studies in that we are interested in how relative preferences of siblings and relative altruism of parents affect relative expenditures between siblings.

Dauphin et al. (2010) examine the demand systems of families with one child aged sixteen and over living with his or her parents using data from the United Kingdom; they find that the data are consistent with three decision makers for the complete sample, the sample of children aged 16-21 and for daughters (irrespective of their age). Kapan (2009) uses data from Turkey and finds that while the unitary model is not rejected for families in which the wife does not earn an income, it is strongly rejected when a son aged 12 and above is present in the household (but not for daughters). Instead of examining properties of demand systems to test whether the data are consistent with more decision makers when older children are present, our approach is to develop a model which delivers testable propositions on relative preferences and relative expenditures of siblings. Finally, this paper also relates to the literature on child labor. Edmonds (2008)[p. 3668] points out that "fu-

[9]There is evidence for compensatory behavior of parents (Behrman et al. 1982; Griliches 1979), as well as reinforcement (Behrman et al. 1994; Rosenzweig and Zhang 2009). Parents might also be both reinforcing and compensating differences in different dimensions. Conti et al. (2010) use data from Chinese twins and find that parents make compensating investments in health and reinforcing investments in education, and there is no effect on the time parents spend with children. Barcellos et al. (2014) find that parents treat boys favorably in almost every dimension of child investment in India.

[10]Ideally we would like to test for the role of ability as well; unfortunately, our data only contains information of ability for the panel child but not the siblings.

[11]We do not make assumptions over what determines heterogeneity in parental altruism towards their children.

[12]Moehling (2005) argues that during the time of their data income of children entered the household budget so that it increased the bargaining power of children, while Dustmann and Micklewright (2001) argue that for their sample earnings of adolescents remain directly in the hands of the adolescent, so that parents respond by reducing transfers.

ture research understanding the child's own role in her time allocation is perhaps the most pressing need in the child labor literature". If children have agency over their decisions even in relatively poor settings, considering their preferences is instrumental to understanding households' behavior in low income countries.

The paper is structured as follows: section 2 presents the context and data. Section 3 develops a theoretical model. Section 4 focuses on identification and estimation of the model parameters. Section 5 discusses the results and section 6 concludes.

2 Data

Detailed data on allocations of time and goods within families is very rare. In the majority of household surveys we observe total household expenditures for particular goods, where at most it is possible to assign a few goods to husband, wife and children after making assumptions about the characteristics of goods. Detailed data on time allocations across household members is even sparser. Having both pieces of information in the same survey is crucial for studying their interaction. We use data from the Young Lives Survey, a study of childhood poverty tracking two cohorts of children in Ethiopia, India, Peru and Vietnam. For the purpose of this paper, we use data from the older cohort which is 7-8 years old when first interviewed in 2002. The second and third rounds took place in 2006/2007 and 2009/2010 and collected detailed information on expenditures as well as information on what activities all household members aged 5-17 spent time on during a usual workday.

The survey contains one 'panel' or 'index' child per family (which determines the panel dimension of the survey), but also collects detailed information on other family members in the household. Focusing on a cohort over time has the advantage that we can inspect how a relatively homogenous sample of children at two points of time interacts with siblings. From the whole data set we select our sample along four dimension: (i) as we can assign expenditures with certainty only to children with one other sibling, we use the sample of children with one other child below 18 years old in the household; (ii) since the time diary is available only for children between 5 and 17, we limit the sample to panel children with siblings between 5 and 17 years; (iii) given that we are interested in time allocations for children who are in school, we raise the age cutoff to 6 years; (iv) we then only keep children which are in full time schooling to abstract from the child labor-schooling tradeoff. Given that in both rounds, about 89% of the children in our sample are in full-time schooling, this restriction is not particularly reducing our sample. This leaves us with a total of 1,652 sibling pair observations for both rounds across four countries[13].

[13]Table 4 in the appendix shows the relationship of the second child in the household to the panel child. Ninety percent or more children are the biological siblings of the panel child in India, Peru and Vietnam and this is true for 76 percent in Ethiopia. The second largest group are half-siblings, who are mainly maternal,

2.1 Time Allocation

The household questionnaire asks the main caretaker of the panel child how household members aged 5 to 17 years allocated their time across the following activities on a typical weekday in the last week[14]: sleeping, caring for others, household chores, non-paid activities outside the household, activities for pay/sale outside the household or for someone not in the household, at school, studying outside of school time and playtime/general leisure[15]. Asking allocations on a typical weekday has the advantage that it provides a better picture of everyday activities of a child and is less vulnerable to particularities of the survey day than referring to activities the day before the survey[16].

Table 5 in the appendix shows the characteristics of the panel child in 2006 and 2009. The panel child is between 11 and 13 years old in 2006. The proportion of male panel children in 2006 is highest in Peru with 62 percent, compared to 53, 51 and 45 percent in Vietnam, India and Ethiopia. All children in our sample are in school, but there are differences in the number of hours children spend in school. Children in Vietnam spend the fewest number of hours at school with 4.59 hours, while kids in India spend 6.89 hours per day on average in 2006. When taking into account differences in studying hours, children in Ethiopia, Peru and Vietnam spend about 8 hours on school and study, compared to 10 hours in India. Play time is highest in Vietnam with an average across the two years of almost 5 hours, as opposed to 2.97 hours in Ethiopia, 3.72 hours in India and 2.86 hours in Peru. There is also substantial variation across children in the hours of leisure, with about 40% of panel children spending 3 or 4 hours on playing per day.

About 80% of children spend at least one hour per day contributing to the household economy by performing household chores, child care, non paid work and paid work. Aggregated across these categories, kids in Ethiopia work about 3.5 hours a day in 2006 and 4 hours a day in 2009, thereby working the longest number of hours. Children in Peru work

uncles/aunts and cousins. In the rest of the paper we refer to the co-habitating child as the sibling, recognizing that a small proportion of the children in the sample are half-siblings or other relatives. In the robustness section we present the results only using sibling pairs with the same mother and the same father.

[14]We do not have data on the caretaker's reported time allocation for the panel child in India for 2009, so we use the child's reported time allocation. We tested the correlation between the caretaker's and the panel child's reported time allocation when both are available. Excluding data for 2009 for India, the correlation is 0.76 (with a p-value of 0.000) for leisure and 0.8180 (with a p-value of 0.000) for work. The results are stronger if we use the child's reported time allocation for the panel child. Given that we only have these for the panel child but not the sibling, we prefer to use the caretaker's reported time allocation for the main results.

[15]Caring for others relates to younger siblings and ill household members; household chores include fetching water, firewood, cleaning, cooking, washing, shopping; non-paid activities outside the household include tasks on family farm, cattle herding, other family business, shepherding, piecework or handicrafts done at home; school includes traveling time; studying outside of school time includes studying at home and extra tuition; playtime/general leisure includes time taken to eating, drinking and bathing.

[16]It has the disadvantage that it does not convey information on a usual weekday when children are in school during the day if the survey took place during holidays. As we are interested in time allocations of children who are spending part of their day at school, we only kept children in the sample who have positive school hours recorded.

for about 1.5 hours in 2006 and 2.2 hours in 2009, similar to children in Vietnam. Children in India work on average about one hour per day. In all countries the time allocated to working is higher in 2006 than in 2009. Sleeping accounts for about 8.5 to 9 hours and children sleep less when they get older.

Table 6 in the appendix presents the characteristics of the siblings of the panel child in 2006 and 2009. Siblings are between 6 and 17 years old, with an average between 12 and 13 years. The average age is not strictly increasing as we don't have a balanced data set: some children exit the data set when their parents have a third child, and some children enter the data set through as their siblings when their siblings are above 18 years. About half of the siblings are male. The sibling data reflect the same patterns emerging from the panel children. Children in India spend the most hours on school and study, and work hours are highest in Ethiopia. Play time of siblings is about 4 hours in India and Vietnam, and 3 hours in Ethiopia and Peru.

2.2 Expenditure Allocation

The household questionnaire collects data on expenditures within the last 12 months. The 12 month recall has the disadvantage of recall bias but this is likely to be outweighed by the advantage of more complete reporting compared to diary-based data collection that only records expenditures over a few weeks. We focus on children's clothes in this analysis[17] which account with an average of 6.2% for a sizeable share of total nonfood expenditures of households[18]. Parents are asked to state the total amount of expenditure on boy's and girl's clothes. If they are not able to recall the gender, they indicate the total amount spent on a good. Within these categories, they indicate the approximate fraction of expenditure on the index child (nothing, less than half, about a half, more than half but not all, and everything). To recover child specific expenditures we assume the following conversion: 0 if the stated share is "nothing", 0.25 if the stated share is "less than half", 0.5 if the stated share is "about a half", 0.75 if the stated share is "more than half but not all", and 1 if the stated share is "everything"[19]. Since we focus on families with two children, knowing the allocation share to the index child, we can assign the remainder to the sibling for same sex sibling pairs[20]. Table 7 in the appendix shows that there is large variation children's clothes expenditures[21].

[17]Other assignable expenditures include clothes, footwear, school uniform, school fees, private classes, books, transportation to school, doctors, medicine and entertainment.

[18]The median is slightly lower with 4.6%.

[19]We have tried alternative assumptions such as an allocation of one third if the stated share is "less than half" and two thirds if the stated share is "more than half but not all" and these do not affect our results.

[20]Ruling out corner solutions, we only use the sample of children with some positive clothes expenditures for both siblings. This implies that we exclude 160 observations for whom either one or both children have zero clothes expenditures.

[21]Given that the interview is centered around the panel child, one might worry that parents report significantly higher amounts for the panel child compared to their siblings. We do not find evidence in support of

2.3 Relative Leisure and Expenditure

Figures 2 to 5 in the appendix show relative expenditures and relative leisure of siblings for each country. A large proportion of parents is egalitarian, with the lower and upper bound given by 32.7 percent in Ethiopia and 58.7 percent in Peru of sibling pairs who have equal allocations of clothes expenditures[22]. Leisure is less equally distributed than expenditures with the children in Peru having equal hours of leisure in 41.3 percent of sibling pairs, compared to 23.3 percent of sibling pairs in Vietnam. Unequal allocations are distributed between a factor of 0.1 and 20 for clothes and 0.125 and 8 for leisure.

The pairwise correlation coefficient of relative expenditures and relative leisure is equal to -0.16 for Peru and Vietnam (with p-values of 0.007 and 0.0001), -0.81 for India (with a p-value of 0.0560) and -0.755 (with a p-value of 0.2890) for Ethiopia. We therefore do not reject that relative leisure and consumption are significantly and negatively correlated in the data in India, Peru and Vietnam, as illustrated by the graph in the South West corner which shows a significant and negative relationship between relative leisure and relative expenditures for these countries[23]. The next section presents the theoretical model.

3 Theoretical Model

This section develops a simple unitary household model in which parents are social planners and allocate time and consumption within the household. We allow for heterogeneity in preferences over leisure and consumption of household members as well as heterogeneity in parental altruism towards a particular child. The model yields testable predictions on optimal relative consumption and leisure allocations across siblings.

Assume that a family consists of parents P and children K where we assume that $K = A, B$[24]. Children are assumed to be egoistic. Parents have a joint welfare function Ω^P with caring preferences which aggregates the utilities of household members, taking into account individual's preferences. Ω^P is therefore a function of the parents' own utility, U^P, child A and B's utilities, U^A and U^B, and how much weight the parents attribute their own utility, measured by α[25], as well as how much they care about their offspring through the caring

systematically higher reporting for the panel child. Rather, we find that expenditures are on average significantly higher for the sibling for Ethiopia in 2006 and for India in both rounds. We come back to this issue when discussing sources of measurement error in the identification section 4.

[22]The fact that households might over-declare equal sharing likely biases the correlation between relative leisure and relative expenditure towards zero.

[23]When we exclude observations who have ratios of 5 or more (this reduces the sample by a maximum of 4 observations per country), the negative correlation is even stronger for Peru and Vietnam with correlation coefficients of -0.22 and -0.21 and remains substantially unchanged for Ethiopia and India. We do not exclude these observations in the estimation, but it is important to check that the result is not driven by them. If anything, our results are stronger without outliers.

[24]Behrman (1997) refers to this as *consensus parental preferences*.

[25]This differs from *child-neutral preferences* as employed by Becker and Tomes (1976) or *equal concern* of parents as employed by Behrman et al. (1982) where parents attribute equal weights to children.

parameter δ so that

$$\Omega^P = \alpha U^P + \delta U^A + (1-\delta) U^B \tag{1}$$

where we include δ and $(1-\delta)$ to allow for differences in child A and B's weight in the parents' utility function[26]. Ω^P can therefore be seen as a social welfare function $\Omega^P = \omega(U^P, U^A, U^B)$ in the spirit of Samuelson (1956), where the weighting function ω depends on α and δ[27]. We assume that α and δ are independent of prices and incomes and that $0 < \delta < 1$ and $0 < \alpha < 1$. Further, we rule out that children can affect the level of altruism of the parents[28]. The parents' welfare function is thus strictly increasing in the utility of household members $m = P, A, B$ which is defined as

$$U^m = U^m(x_m, l_m) \tag{2}$$

where x is a private good and l is leisure[29].

We assume that $U^m_{x_m} > 0$, $U^m_{l_m} > 0$, U^m is continuous, and strictly quasi concave for $m = P, A, B$. We assume that individual utility functions are additive over consumption and leisure

$$U^m = \theta^m \ln x_m + \tau^m \ln l_m \quad \text{for } m = P, A, B \tag{3}$$

[26]From the literature on intrahousehold allocation it has become clear that classical properties of demand systems (Slutksy symmetry and income pooling) are generally violated when households are composed of a husband and wife (Browning et al. 2011), suggesting that they rarely act as a unit. Our model can be generalized to allow for two parents and two children and with different bargaining weights among parents (which depend on prices and incomes). For example, as discussed in Browning et al. (2011), we could assume a household welfare function Ω'^P of the form

$$\Omega'^P = \mu(U^M + \kappa^M U^C) + (1-\mu)(U^F + \kappa^F U^C)$$

where U^M is the mother's utility, U^F is the father's utility, μ is the pareto weight, κ^M is the mother's weight for children, κ^F is the father's weight for children, and $U^C = \delta U^A + (1-\delta) U^B$ as above. This can be rewritten as

$$\Omega'^P = \mu U^M + (1-\mu) U^F + (\mu \kappa^M + (1-\mu)\kappa^F) U^C$$

which as shown in Appendix B leaves the predictions of our model unchanged. This allows for the bargaining power of mother and father to affect the weight of children in the household's problem, as often modeled theoretically and found empirically in studies investigating intra-household allocation outcomes as a function of the identity of the income earner (Attanasio and Lechene 2002; Basu 2006; Bobonis 2009; Duflo 2000; Duflo 2003; Lundberg et al. 1997; Reggio 2011; Thomas 1990; Ward-Batts 2008). What we still require is that the *relative* weights of child A and B are independent of the parents' pareto weights but this is significantly less restrictive than assuming that both parents have the same weights for children. To maintain a focus on the core mechanisms, which is within-sibling allocation, we keep the model as parsimonious as possible.

[27]We can not distinguish whether the differences in the weight are due to differences in parental altruism because parents have a higher level of love for one child, or whether this is because one child is better at terrorizing the parents, thereby increasing her or his bargaining weight. For the purpose of the theoretical and empirical model we interpret δ as the parents' level of altruism for child A.

[28]This is relaxed in the literature on strategic behavior of adult children competing for transfers from parents (Chang 2009; Chang and Luo 2011). In Chang (2009) adult children are modeled as homogenous, while in Chang and Luo (2011) adult children differ in their wages; children's preferences over leisure and consumption are not modeled in these two papers.

[29]Preferences and utility functions are denoted with superscripts, choice variables with subscripts.

so that θ measures household member m's preferences for consumption and τ measures his or her preferences for leisure; without loss of generality we set $\tau^P = 1$. The use of a log linear utility function for parents P and children A and B has two desirable properties. First, it builds a concern for equity into the utilitarian welfare function Ω^P, without explicitly modeling it through an additional parameter. Second, it allows us to obtain closed form solutions which we can take directly to the data, establishing a clear link between the theoretical model and the estimated parameters.

The household faces the budget constraint

$$x_P + x_A + x_B = I + h_P\, w_P + h_A\, w_A + h_B\, w_B \tag{4}$$

where the price of the consumption good is normalized to one, w denotes wage income and I is non wage income; household members face the time constraints

$$l_m = T - h_m \quad \text{for } m = P, A, B \tag{5}$$

where T is the time endowment and h are hours worked[30]. The utility function and budget and time constraints make a number of assumptions. First, any activity apart from work is considered as leisure. If children do not consider schooling as leisure, the total time endowment of children could therefore be defined as $T = 24 - s_m$ for $m = A, B$, where s represents time at school[31]. Alternatively, we could have an additional term for schooling s so that $l_m = T - s_m - h_m$ for $m = A, B$. Schooling valued at wages would appear as an additional term in the value of consumption, but leave the optimality conditions between leisure and consumption unchanged, and thus the main results of the model equivalent. Second, individuals do not derive any utility from working. Third, parents have deferential preferences, in that they care about children's utilities but allow them to decide on their optimal consumption bundle based on their preferences. An implication is that parents do not derive any direct utility from seeing their children consume goods or participate in work, other than through an increase in the child's utility. To render the model more realistic, following Browning and Gørtz (2012) we could have included household production of a public good. This would leave the core predictions of our model unchanged. Since both modifications, schooling as a separate term and production, do not affect our result, we opted for keeping the model as parsimonious as possible.

Parents function as social planners and maximize overall household welfare by solving

[30] Children's wages can be seen as either through working outside the household where income earned enters the household budget, or through doing housework which in turn allows the parents to participate in activities outside the household. In light of the descriptive statistics of the previous section, it is reasonable to assume that these children contribute to household income by carrying out work inside and outside the household.

[31] In the empirical section we only look at children who are in school. However, we also test whether treating hours spent at school as an additional choice variable affects the results.

the following maximization problem

$$\max_{x_P,x_A,x_B,l_P,l_A,l_B} \alpha\, U^P + \delta\, U^A + (1-\delta)\, U^B \text{ subject to} \tag{6}$$

$$x_P + l_P\, w_P + x_A + l_A\, w_A + x_B + l_B\, w_B = I + T(w_P + w_A + w_B)$$

Deriving the utility function with respect to x_P, x_A, x_B, l_P, l_A and l_B, combined with the first order conditions, we get

$$\frac{x_A}{x_B} = \frac{\delta}{1-\delta}\,\frac{\theta^A}{\theta^B} \tag{7}$$

$$\frac{l_A}{l_B} = \frac{\delta}{1-\delta}\,\frac{w_B}{w_A}\,\frac{\tau^A}{\tau^B} \tag{8}$$

for siblings A and B, where $\delta/(1-\delta)$ measures parents' altruism towards child A compared to child B, θ_A/θ_B measures children's relative preferences for consumption, τ_A/τ_B measures children's relative preferences for leisure, and w_B/w_A measures children's relative wages. We can also see that individual members' optimal consumption labor choice, $U_x^m/U_l^m = 1/w_m$, can be achieved through a two stage budgeting process in which in the first stage income is distributed appropriately, and in the second stage household members maximize $U^m(x_m, l_m)$ subject to $x_m + l_m\, w_m = I_m + T\, w_m$ where I_m is determined by the sharing rule of non-labor income (Browning et al. 2011). Therefore, following the second welfare theorem a competitive outcome can be reproduced given appropriate redistribution of initial incomes[32]. Equations 7 and 8 illustrate that if $\delta > 0.5$, and $\theta^A = \theta^B$ as well as $\tau^A = \tau^B$, parents will find it efficient to allocate relatively more consumption as well as relatively more leisure to child A compared to child B. On the other hand, if $\delta = 0.5$ and $\theta^A > \theta^B$ (or $\tau^A > \tau^B$) parents find it efficient to allocate more consumption (leisure) to child A compared to child B[33].

4 Identification and Estimation

We now discuss substantive and functional form assumptions required to translate our theoretical model into estimable equations. Before presenting the results, we also outline how we deal with measurement error, and discuss fixed effects and the non-linearity of the rel-

[32]The theoretical model can be readily extended to n children, yielding $n(n-1)/2$ optimality conditions per family. However, the estimation becomes substantially less straightforward due to diads at the family level as will be clear in the next section. Further, we can only identify resource allocation shares for a subset of families with three children. We therefore keep the model with 2 children and leave the application to larger families for future research.

[33]Note that, holding everything else constant, a proportional increase ϱ of θ^A and τ^A leads to an increase in x_A and l_A by ϱ, while an increase in δ by the same amount leads to an increase in x_A and l_A by $\varrho\,\delta/(1-\varrho\,\delta) > \varrho$ for $0 > \varrho\,\delta < 1$.

ative expenditures variable.

4.1 Substantive Assumptions

Equations (7) and (8) describe the relative expenditure and leisure allocations of sibling A and B which depend on relative preferences θ^A/θ^B and τ^A/τ^B, as well as on relative parental altruism $\delta/(1-\delta)$ and relative wages w_B/w_A at a particular point in time. Since we look at preferences of children, we want to relax the assumption that preferences are stable. We assume that relative parental altruism is fixed over time[34]. Let's therefore rewrite equations (7) and (8) with time subscripts on the child specific preference variables as well as the time and consumption allocations

$$\frac{x_{At}}{x_{Bt}} = \frac{\delta}{1-\delta}\,\frac{\theta_t^A}{\theta_t^B} \tag{9}$$

$$\frac{l_{At}}{l_{Bt}} = \frac{\delta}{1-\delta}\,\frac{w_{Bt}}{w_{At}}\,\frac{\tau_t^A}{\tau_t^B}. \tag{10}$$

We now denote sibling pair A and B in a family with subscript i and get

$$x_{it} = \delta_i\,\theta_{it} \tag{11}$$

$$l_{it} = \delta_i\,\kappa_t^{-1}\,\tau_{it} \tag{12}$$

where $x_{it} = x_{At}/x_{Bt}$ is sibling pair i's relative consumption of a particular good at time t; in other words, sibling A's consumption of a particular good divided by sibling B's consumption of a particular good at time t. Similarly, we define $l_{it} = l_{At}/l_{Bt}$, $\theta_{it} = \theta_t^A/\theta_t^B$, $\tau_{it} = \tau_t^A/\tau_t^B$ and $\delta_i = \delta/(1-\delta)$ as parents' relative altruism towards child i. We have assumed that relative wages of sibling A and B are constant across children, so that $\kappa_t = w_{At}/w_{Bt}$[35]. Equations (11) and (12) illustrate that relative altruism δ_i affects both relative consumption and relative leisure of sibling pair i positively, so that parents with $\delta > 0.5$ will allocate a higher consumption as well as more leisure to child A, holding θ_{it} and τ_{it} constant. Further, as becomes clear from the theoretical model, the consumption and work decisions are simultaneous decisions; therefore, regressing relative leisure on relative consumption, or vice versa, would lead to biased estimates. We use an approach employed by Browning et al. (1994) and instead are interested in the correlation of the residuals of these two simultaneous equations, conditional on observable exogenous variables. In other words, conditioning on basic observable characteristics, we test whether unobservables from the

[34]There are reasons to believe that relative parental altruism might be time-varying, i.e. parents having at birth stronger relative altruism towards boys, but reverting to stronger relative altruism for girls when the boys are in puberty. For simplicity, we assume that relative altruism is stable across time.

[35]We relax this assumption in the empirical section where we proxy wages with years of education.

time allocation decision are correlated with unobservables from the consumption decision.

4.2 Functional Form Assumptions

We model children's relative preferences for consumption and leisure at time t as a function of a vector of observable household and child characteristics $\boldsymbol{Z}_{it}$ which include age, gender, rural or urban location, and a time fixed effect; further, we assume the presence of unobservable time invariant individual fixed effects $\lambda_{\theta i}$ and $\lambda_{\tau i}$, as well as time-varying idiosyncratic error terms $\varepsilon_{\theta it}$ and $\varepsilon_{\tau it}$ unobserved by the econometrician, yielding

$$\theta_{it} = \exp\{\beta_{\theta_0} + \beta'_{\theta}\, \boldsymbol{Z}_{it} + \lambda_{\theta i} + \varepsilon_{\theta it}\} \tag{13}$$

$$\tau_{it} = \exp\{\beta_{\tau_0} + \beta'_{\tau}\, \boldsymbol{Z}_{it} + \lambda_{\tau i} + \varepsilon_{\tau it}\}. \tag{14}$$

Birth order or relative birth order have proven to be important determinants of within household allocation (Black et al. 2005; Chesnokova and Vaithianathan 2008; Ejrnæs and Pörtner 2004; Patrinos and Psacharopoulos 1997). It would therefore be a natural candidate to model relative altruism. However, it is highly correlated with the age difference. Second, it does not satisfy the exclusion restriction that the effect of birth order R_{it} is equal to zero in a regression of the difference between relative expenditure and relative leisure on birth order[36][37]. We therefore assume that parents' relative altruism for child A versus child B is a function of an unobservable time invariant individual fixed effect $\lambda_{\delta i}$

$$\delta_i = \exp\{\beta_{\delta_0} + \lambda_{\delta i}\}. \tag{15}$$

4.3 Measurement Error

Until now we assumed that we know the true level of expenditures and leisure. However, in addition to recall bias, due to the nature of the data there is a second source of likely measurement error, illustrated in detail in the appendix in section C. We know the allocation to the panel child as a fraction of the expenditure category (boys or girls clothes). We therefore always denote the panel child as child A. However, expenditures allocated to the sibling of the panel child are vulnerable to measurement error, since we assume that parents list clothes for household members 18 and over in the adult clothes category. Therefore,

[36]The exclusion restriction emerges from taking the ratio of equations (11) and (12), and taking logs. This removes δ_i so that we require $\beta_{\delta 1} = 0$ in

$$\ln x_{it} - \ln l_{it} = \beta_{\delta 0} + \beta_{\delta 1} R_i + \boldsymbol{\beta}'_{\delta 2} \boldsymbol{Z}_{it} + \varepsilon_{\delta it}.$$

In other words, conditional on $\boldsymbol{Z}_{it}$, a variable R_i proxying for altruism should not affect $\ln x_{it} - \ln l_{it}$.

[37]We have also tested including a dummy variable which is equal to one if the oldest sibling is a boy (unconditional on whether he has a younger brother or a sister) and if the oldest sibling is a boy with a sister, but the variables do not pass the exclusion restriction or only marginally pass it, so we do not include them.

we assume that expenditures on child A are correctly measured so that $x_A = x_A^*$ where x_A denotes the data and x_A^* the true expenditure. For child B, we have $x_B = e^{\rho} x_B^*$ where x_B indicates the data, x_B^* the true expenditure and ρ is the difference between the recorded and the true log expenditure. Plugging our definition of x_B into equation (7) and taking logs we can see that ρ will be contained in the error term, biasing the constant. When the dependent variable is measured with error, consistency requires that the measurement error ρ is not correlated with the explanatory variables (Wooldridge 2002). This seems plausible in our case, so that the age of children, gender, and location is not correlated with the presence of adolescents aged 18-25 in the household who parents consider as children. Further, we know when measurement error is going to be more likely. The cases particularly prone to measurement error are (i) when both children are of the same sex, and there are further siblings aged 18 and over of the same sex in the household who parents consider a child (denoted as case 1); (ii) when children are of the opposite sex, but there is a further member of the same sex as child B in the household aged 18 and over who the parents consider a child (denoted as case 2)[38]. Relative expenditures x_A/x_B are therefore a lower bound estimate of true relative expenditures, since $x_B = \max\{0, x_B\}$ for those with older siblings. We can use this information to model measurement error ρ as

$$\rho = \beta_{\rho 0} + \beta_{\rho} O_{it} + \varepsilon_{\rho it} \tag{16}$$

where O_{it} is equal to the number of older siblings according to case (i) or (ii) in either round and $\varepsilon_{\rho it}$ is an idiosyncratic error.

Plugging (13), (14), (15) and (16) into (11) and (12) while taking measurement error into account, and taking logs we get the following structural equations

$$\begin{aligned} \ln x_{it} =& (\beta_{\theta 0} + \beta_{\delta_0} + \beta_{\rho_0}) + \boldsymbol{\beta}_{\theta}' \boldsymbol{Z}_{it} + \beta_{\rho}' O_{it} \\ &+ (\lambda_{\theta i} + \lambda_{\delta i}) + \varepsilon_{\theta it} + \varepsilon_{\rho it} \end{aligned} \tag{17}$$

$$\begin{aligned} \ln l_{it} =& (\beta_{\tau_0} + \beta_{\delta_0}) + \beta_{\tau}' \boldsymbol{Z}_{it} \\ &+ (\lambda_{\tau i} + \lambda_{\delta i}) + \varepsilon_{\tau it}. \end{aligned} \tag{18}$$

We can not separately identify the effect of $\ln \kappa_t$ and the coefficient on the time trend contained in $\boldsymbol{Z_{it}}$, due to our assumptions on the constant ratio across sibling pairs, so that it is

[38] On the other hand, measurement error is going to be less likely for same sex siblings whenever the over 18 year old sibling is of the opposite sex, and for mixed sex siblings whenever the over 18 year old sibling is of the opposite sex of sibling B.

part of $\boldsymbol{Z_{it}}$. We then get the two linear reduced forms

$$\ln x_{it} = \Pi_{x0} + \boldsymbol{\Pi}'_{x\theta}\, \boldsymbol{Z}_{it} + \Pi'_{x\rho}\, O_{it} + \epsilon_{xit} \tag{19}$$

$$\ln l_{it} = \Pi_{l0} + \boldsymbol{\Pi}'_{l\tau}\, \boldsymbol{Z}_{it} + \epsilon_{lit}. \tag{20}$$

Identification of $\Pi_{x\theta}$, $\Pi_{l\tau}$, and $\Pi_{x\rho}$ requires that $\boldsymbol{Z}_{it}$, and O_{it} are uncorrelated with the composite error terms ϵ_{xit} and ϵ_{lit}. This is not an implausible assumption given that age, gender and location are out of the control of the child. We test the two following propositions adopted from Browning and Gørtz (2012):

Proposition 1 (Differences in children's preferences) *If θ_{it} and τ_{it} are negatively correlated, there is no variation in δ_i and $w_{Bt} = w_{At}$, then x_{it} and l_{it} will be negatively correlated.*

Proposition 2 (Differences in parental altruism) *If there is variation in δ_i while θ_{it} and τ_{it} are independent of each other and $w_{Bt} = w_{At}$, x_{it} and l_{it} will be positively correlated.*

The empirical model shows that if *differences in parental altruism* drive allocations and preferences for leisure and consumption are independent, we expect the residuals to be positively correlated due to the fact that they both contain $\lambda_{\delta i}$ and altruism affects consumption and leisure positively. If heterogeneity is due to *differences in children's tastes*, so that if relative preferences for leisure and consumption are negatively correlated and the there is no variation in relative altruism, then we expect the residuals to be negatively correlated as they contain $(\lambda_{\theta i} + \varepsilon_{\theta i})$ and $(\lambda_{\tau i} + \varepsilon_{\tau i})$. Propositions 1 and 2 present the extreme cases. It is reasonable to assume, and we can not rule out, that both relative altruism and relative preferences play a role in determining outcomes. For example, if we find a strong negative correlation of the residuals in the empirical application this does not imply that parents do not have different weights for their children. It only indicates that results are consistent with a model in which differences in preferences are the dominant driver of allocations rather than differences in parental altruism. The empirical section also presents a battery of robustness tests to distinguish between alternative explanations that might be driving the results.

4.4 Estimation: Fixed Effects and Non-Linearity of the Expenditure Variable

Despite having a panel, a consistent estimation of the fixed effects $(\lambda_{\theta i} + \lambda_{\delta i})$ and $(\lambda_{\tau i} + \lambda_{\delta i})$ is not feasible. First, with two time periods, it is not possible to obtain a consistent estimate of the fixed effect (Wooldridge 2002). Second, several of the preference parameters are time invariant; even for more time periods we would only be able to identify a combination of the fixed effect and the coefficient on the time invariant variables. Instead of using the

natural logarithm, we follow Browning et al. (1994) and transform x_{it} and l_{it} using the inverse hyperbolic sine[39]. Inspection of the distribution of x_{it} and l_{it} in figures 2 to 5 also showed that these variables are clumped at specific values, which is particularly true for x_{it}. The nature of the questionnaire is the reason for this clumping at various points. As discussed in the previous section, parents were asked to indicate the approximate fraction of expenditures that went to the index child, measured by a variable ranging from 1 to 5. In order to take into account the non-continuous nature of the variable, we also model relative expenditures and relative leisure as ordered variables, taking on three values

$$v_{it}^{*} = \begin{cases} 0 & \text{if } v_{it} < 1 \\ 1 & \text{if } v_{it} = 1 \\ 2 & \text{if } v_{it} > 1 \end{cases} \tag{21}$$

for $v = l, x$. We present estimates for treating both variables as continuous, x_{it} as an ordered variable and l_{it} as continuous, and both variables as ordered. For all models, we jointly estimate equations (19) and (20) with full information maximum likelihood, assuming that the errors have a bivariate normal distribution, and then test the correlation of the error terms of the two equations. The estimation is performed using the command `cmp` as developed by Roodman (2009).

5 Empirical Results and Discussion

5.1 Base Results

We start by looking at the unconditional distribution of leisure and consumption. Figure 1 shows the joint distribution of relative expenditure and leisure overlaid with a linear and a local polynomial regression and a 95 percent confidence interval. The figures show that there is a significant, negative, and fairly linear relationship between siblings' relative consumption and leisure for India, Peru and Vietnam. For the empirical model, we present results for the different specifications of the dependent variables. Column (1) presents the results for both variables modeled as continuous, column (2) models x_{it} as ordered and l_{it} as continuous, and column (3) models both variables as ordered. We present the correlations of the residuals as this allows us later to purge relative leisure and relative consumption from the effects of age and gender. The correlation of the residuals is shown following the estimated coefficients.

[39]The main advantage of this transformation is that the inverse hyperbolic sine is always positive and linear for low values, but very similar to the natural logarithm for high values. This avoids having highly negative values when relative expenditure and relative leisure are very low. Even though it is defined for the whole real line, so including zero, we do not include relative expenditure or leisure that is equal to zero. Our results are substantively unchanged when using the natural logarithm instead of the inverse hyperbolic sine; the choice between the inverse hyperbolic sine and the natural logarithm is therefore not fundamental for the results.

The correlations of the residuals of a model including an intercept only are shown in table 1 for each of the countries, supporting what figure 1 already suggested. To take into account correlation across errors for panel children which are in the sample in two rounds (about 50% of the sibling pairs), all standard errors are clustered at the panel child level. There is a significant negative correlation between the residuals of the leisure and the consumption equations for India, Peru and Vietnam, and this negative correlation is robust across the three estimation methods[40]. The last row of table 1 shows that the correlation is significant for all three models when the data is pooled across countries. The results are virtually identical when including a time trend, but there is no a priori reason to expect that the ratios change significantly over time. These findings lend support to proposition 1 which states that if θ_{it} and τ_{it} are negatively correlated, there is no variation in δ_i and $w_{Bt} = w_{At}$, then x_{it} and l_{it} will be negatively correlated. In other words, differences in children's preferences drive allocations. If differences in parental altruism δ_i were driving allocations while θ_{it} and τ_{it} are independently distributed and $w_{Bt} = w_{At}$ as outlined in proposition 2, we would expect x_{it} and l_{it} to be positively correlated.

For the main empirical model we pool the data across the four countries, while staying fully flexible by including a range of interaction effects to allow for differences in the slope of the parameters by country and time. The main advantage of pooling the data is that we have more power when testing the correlation of the residuals.

Table 8 in the appendix shows the basic results for equations (19) and (20) where we include separate intercepts for each of the countries and a time dummy variable. The upper panel shows the relative expenditure equation, and the lower panel shows the relative leisure equation. Before interpreting the coefficients, we test for a number of restrictions to arrive at a more parsimonious specification. The theoretical model does not prescribe the functional form through which gender affects preferences. Additionally, the gender of the denominator and nominator child switches according to the sibling pair, where child A always denotes the index child. To impose as few restrictions as possible on sibling-interactions, we first entered dummy variables for all gender combinations, leaving a female-female sibling pair as the base category. We then jointly test for both, the leisure and expenditure equation, whether the coefficient on the male-female dummy variable is equal to the negative of the coefficient on the female-male sibling dummy variable. This restriction is not rejected by the data when modeling both dependent variables as linear, but it is rejected when we model relative expenditures as an ordered variable and relative leisure as a continuous variable, and when we model both dependent variables as ordered. For ease of exposition, we therefore do not impose it in the three models, but this does not affect our results. With regard to age, we tested jointly for both equations whether the

[40]The fact that the correlation in Ethiopia is less significant could be due to the smaller sample size, or due heterogeneity, which would be consistent with the fact that children in Ethiopia state that they feel substantially less agency over their choices compared to the other three countries when asked about activities they have done in the last few days and whether it was their choice.

coefficient on the age of child A is equal to the negative of the coefficient on the age of child B which is not rejected in any of the models. We can therefore impose the restriction that age affects relative expenditure and leisure through the difference in age of child A and B[41].

We now discuss the parsimonious specification presented in table 2. The results show that the coefficients on relative age are statistically significantly different from zero in both the leisure and the expenditure equation, and this holds for any specification of the dependent variables. We find that the larger the age difference between child A and B, the higher is relative expenditure and the lower is relative leisure. For mixed sibling pairs, an interesting pattern arises. When the index child is female and has a brother, she enjoys significantly higher expenditure and significantly lower leisure compared to a female index child with a sister. The effect is significant also for male index children who have a sister, who enjoy significantly higher leisure compared to female index children with a sister. The control for whether the child lives in an urban area is insignificant which suggests that there are no systematic differences across urban and rural settings that would lead to more or less equal relative expenditure or relative leisure patterns. The coefficient on the variable capturing measurement error is negative, in line with our conjecture, indicating that our measure of relative expenditure is systematically lower when one of the two outlined cases of measurement error takes place.

The negative correlation in the relative leisure-consumption relationship we observed in the unconditional distribution graphs could have been driven simply by the fact that older children have less leisure if they get a younger sibling due to longer hours of caretaking, but they get higher expenditures since they are the oldest and parents need to build up a stock of children's clothes and other child-related items. In the same logic, younger children could get more leisure (playing time) as they are younger and less clothes expenditures due to the fact that their older sibling passes them on clothes. However, this does not appear to be the case as even after controlling for the age difference and gender composition, the negative correlation of the residuals persists. The last row in table 2 shows that the correlation of the residuals is substantially lower with a correlation of about -0.05 compared to -0.2 in table 1 but it remains negative, and is statistically significantly different from zero when estimating the model as a an ordered probit with a linear model in column (2), or as two ordered probit equations in column (3). The correlation in the residuals is negative as well in column (1) when both variables are modeled as continuous variables, although statistically not significantly different from zero. Given the discontinuous distribution of in particular the expenditure variable, it is not surprising that the model performs better when taking the structure of the data into account. Thus, our preferred specification is column (2). The results, modeling both variables as ordered variables, are very similar.

[41]When testing these restrictions with a set of likelihood ratio tests, we are not able to cluster standard errors at the child level. We have also estimated the models without imposing any restrictions and the results remain robust.

5.2 Robustness

We perform a battery of robustness checks testing specifications, assumptions, samples and alternative explanations. Table 3 presents the correlation of the residuals for each of the robustness tests. The first row repeats the correlation found in the parsimonious specification. First, given that we are pooling countries with a range of political, economic and ideological beliefs, we also test whether the results are robust to a fully flexible specification in which we interact all explanatory variables with the country fixed effects. We find that our findings remain substantively the same for the three columns.

Second, in the theoretical model we assumed that the relative wage of child A and child B is constant across children, so that the term $\ln \kappa_t$ is captured by the time dummy variable. We now relax this assumption and rewrite κ_t as κ_{it} where we assume that the relative wage of child B to child A is determined by the relative number of years of schooling of child A and B at time t. We then re-estimate the model including the level of schooling of child A and B separately in the analysis, which does not affect the negative correlation in the residuals[42]. Third, differences in the amount of hours spent on schooling might be correlated with unobservables determining relative leisure and relative consumption. These differences are rather small[43]; as a robustness check, we nevertheless include a third simultaneous equation for schooling, which does not affect the estimated correlation between relative expenditure and relative leisure.

Fourth, the model so far imposed linearity in the age difference effect which embeds two assumptions: first, the effect of an age gap of two years is half the effect of an age gap of four years; and second, the effect of age differences is independent of when the age gap occurs, so that the age gap between an 11 and 13 year old child is the same as the age gap between a 15 and 17 year old child. Given the importance of the age variable, we test whether the results are sensitive to inclusion of up to a third order polynomial, as well as a model in which we include the age of child A and B separately, as well as interaction terms between the age difference and the age of child A and B. We find that both robustness checks do not affect the residual correlation. Fifth, family dynamics might be systematically different when non-biological siblings are part of the family. We test whether it is these cases that are driving the results by limiting the sample to siblings with same mother and same father, excluding 87 observations.

Sixth, our findings could be due to a more mechanical relationship in which children are more or less productive at different ages and therefore perform different activities, rather

[42] Given that schooling choice is likely to be correlated with factors unobserved by the econometrician, we prefer to include the schooling variable only in the robustness check. The base model only includes variables exogenous to the sibling pair such as age, age order, gender composition and location of the household.

[43] About 67 percent of sibling pairs spending equal amounts of hours in school. Eighty percent of sibling pairs have not more than a 20 percent difference, and 92 percent of children have a maximum of a 30 percent difference.

than to do with the model's assumptions of differences in preferences[44]. Although we control for the age difference between siblings, unobserved heterogeneity due to interactions between the age difference, gender and location could be substantial[45]. We include interaction terms between location (whether the household lives in an urban area), age difference and gender combinations as well as the cross interaction terms in the relative leisure equation to test whether the correlation of the residuals is driven by gender-age-location specific combinations which are driving relative leisure. The residual correlation remains so that we can reject that unobserved heterogeneity due to interactions between gender, age and location leading to differences in productivity drive the results. Next, one could argue that for children below age 10 the type of activities they can undertake is likely to be more limited as their productivity is very low, and we would expect differences in preferences to be less developed at an earlier stage. We therefore limit the age range of siblings by excluding children below the age of 10 years. The results suggest that our findings were not driven by sibling pairs with large age gaps which are now excluded, as they are stable even when we drop a large number of children from the sample.

Eight, we undertake the whole analysis using relative work hours instead of leisure hours as the dependent variable. For this, we aggregate the number of household chores, child care, non-paid work and paid work of children into a work variable. We would now expect the opposite effects. If differences in children's preferences are the dominant driver, then the residuals would be positively correlated. Whoever works longer hours, receives higher consumption. On the other hand, if differences in parental altruism determine allocations and there is no correlation in preferences, then the residuals would be negatively correlated. The preferred child would work less but enjoy higher consumption. The results are consistent with the previous findings of differences in children's tastes being the dominant force. The residuals of the work and expenditure equations are positively correlated and are very similar in magnitude, so that children who work relatively more hours are rewarded with higher relative expenditures. The next row estimates the model with gender-age-location interaction terms to capture productivity differences but now with relative work as the dependent variable, and the correlation of the residuals persists. If we use work hours we lose 572 observations (about 20 percent of index children do not work, and about 34 percent of siblings do not work and we can not use a sibling pair if one of the two siblings does not work), which given our sample size is a loss of more than a third of the observations. We therefore prefer to use leisure in the analysis because of the higher number of non-zero observations.

Finally, an alternative explanation generating the positive correlation between work and clothes expenditure could be that children who work outside the house need more

[44] Edmonds (2006) finds that child labor in Nepal is consistent with comparative advantage of children.

[45] For example, older girls might be substantially more productive caretakers than older boys, which would point towards an interaction effect between gender and age difference.

clothes to perform the work. To test whether this is the case, we redefine work only as household chores and child care (excluding non-paid work and paid work), both tasks which we would not expect to significantly raise clothes requirements. We estimate two specifications: first, we keep all children, simply replacing the work variable with zero unless children performed work in the household. Thereby, we only compare the workload of siblings in the household. The correlation of the residuals is not driven by this mechanical relationship. Second, we drop from the sample children who work outside the household, and estimate the model again, only examining variation in the hours worked by children in the household. This specification is most costly in that we lose about half of the sample. Despite the substantially smaller sample size and use of a completely different subsample, the magnitude of the correlation and significance level are almost unchanged. Overall, the correlation of the residuals is remarkably robust to different samples, and testing for different alternative explanations which could generate the results.

6 Conclusion

This paper considered children as agents with their own preferences over leisure and consumption and built a theoretical and empirical model for children's time and consumption allocations. To our knowledge, this is the first paper that theoretically and empirically models within sibling distribution of preferences over leisure and consumption. The simple theoretical model allowed for heterogeneity in parental altruism as well as children's preferences over leisure and consumption and develops testable propositions. We kept the model as parsimonious as possible to highlight predictions generated simply by differences in relative preferences of children and relative altruism by parents. This comes at the cost of imposing sometimes fairly strict assumptions. For example, we imposed that parents' relative bargaining weights in the family do not affect the weight of specific children (i.e., girls versus boys) in the household's problem. We also assumed that children's work hours do not affect their parents' altruism.

We tested these propositions with a panel data set of children from Ethiopia, India, Peru and Vietnam which contains detailed information on time use and allocations of assignable goods for sibling pairs. We found that after conditioning on observable variables, the residuals of these simultaneous decisions are significantly negatively correlated. This correlation is robust to excluding younger children, non-biological siblings, and using relative work allocations instead of relative leisure. We also do not find evidence that the relationship is driven by age-gender-location specific productivity differences, non-linear age effects, different levels of education and schooling hours, and a range of alternative hypotheses. This suggests that differences in siblings' relative time and consumption allocations are driven by their relative preferences over leisure and consumption rather than differences in parents' relative altruism. Children seem to trade off leisure and consumption and are rewarded

accordingly. As a result, the data are consistent with a model in which families behave as if they were an internal market in which children select their optimal consumption-leisure bundle.

One implication of this finding is that in order to understand households' behavior in low income countries, it is important to consider heterogeneity in children's preferences. Given the stringent data requirements, we were able to undertake this analysis for families with two children between the ages of 6-17 years in four developing countries. To investigate the generalizability of the results, future research should focus on extending the analysis to families with more than two children and application to further countries.

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7 Tables

Table 1: Correlation ρ of Residuals of an Intercept-only Model

	$\ln x_{it}$ continuous $\ln l_{it}$ continuous	x_{it} ordered $\ln l_{it}$ continuous	x_{it} ordered l_{it} ordered
	(1)	(2)	(3)
Ethiopia (n=199)	-.1072	-.125	-.1581
	(.0778)	(.0847)	(.0939)*
India (n=554)	-.077	-.1180	-.114
	(.0379)**	(.0470)**	(.0543)**
Peru (n=271)	-.238	-.2901	-.2937
	(.0569)***	(.0646)***	(.0782)***
Vietnam (n=628)	-.2243	-.2955	-.3798
	(.0346)***	(.0416)***	(.0466)***
Pooled (n=1652)	-.1594	-.2064	-.2471
	(.0242)***	(.0273)***	(.0305)***

Notes: Robust standard errors in parenthesis, clustered at child level; *, **, *** denote significance at 10%, 5% and 1% levels.

Table 2: Parsimonious Model

	$\ln x_{it}$ continuous $\ln l_{it}$ continuous	x_{it} ordered $\ln l_{it}$ continuous	x_{it} ordered l_{it} ordered
	(1)	(2)	(3)
Relative Expenditure			
Relative Age	0.034***	0.119***	0.119***
	(0.003)	(0.009)	(0.009)
A=male, B=male	-.012	0.007	0.007
	(0.03)	(0.068)	(0.068)
A=male, B=female	-.004	0.07	0.07
	(0.03)	(0.085)	(0.085)
A=female, B=male	0.043	0.3***	0.3***
	(0.028)	(0.08)	(0.08)
Urban	0.027	0.093	0.093
	(0.022)	(0.066)	(0.066)
Measurement Error	-.129***	-.371***	-.373***
	(0.032)	(0.1)	(0.1)
Obs.	1652	1652	1652
$R^{2\dagger}$	0.1406	0.0817	0.0817
Relative Leisure			
Relative Age	-.034***	-.034***	-.148***
	(0.002)	(0.002)	(0.009)
A=male, B=male	0.0008	0.0008	0.085
	(0.021)	(0.021)	(0.085)
A=male, B=female	0.07***	0.07***	0.339***
	(0.022)	(0.022)	(0.088)
A=female, B=male	-.071***	-.071***	-.259***
	(0.021)	(0.021)	(0.082)
Urban	-.005	-.005	-.002
	(0.017)	(0.017)	(0.068)
Obs.	1652	1652	1652
$R^{2\dagger}$	0.1822	0.1822	0.1101
Correlation ρ	-.0401	-.0587**	-.0683**
	(.0265)	(.0290)	(.0339)

Notes: All models include country and time intercepts. †Pseudo R^2 for ordered probit. Robust standard errors in parenthesis, clustered at child level; *, **, *** denote significance at 10%, 5% and 1% levels.

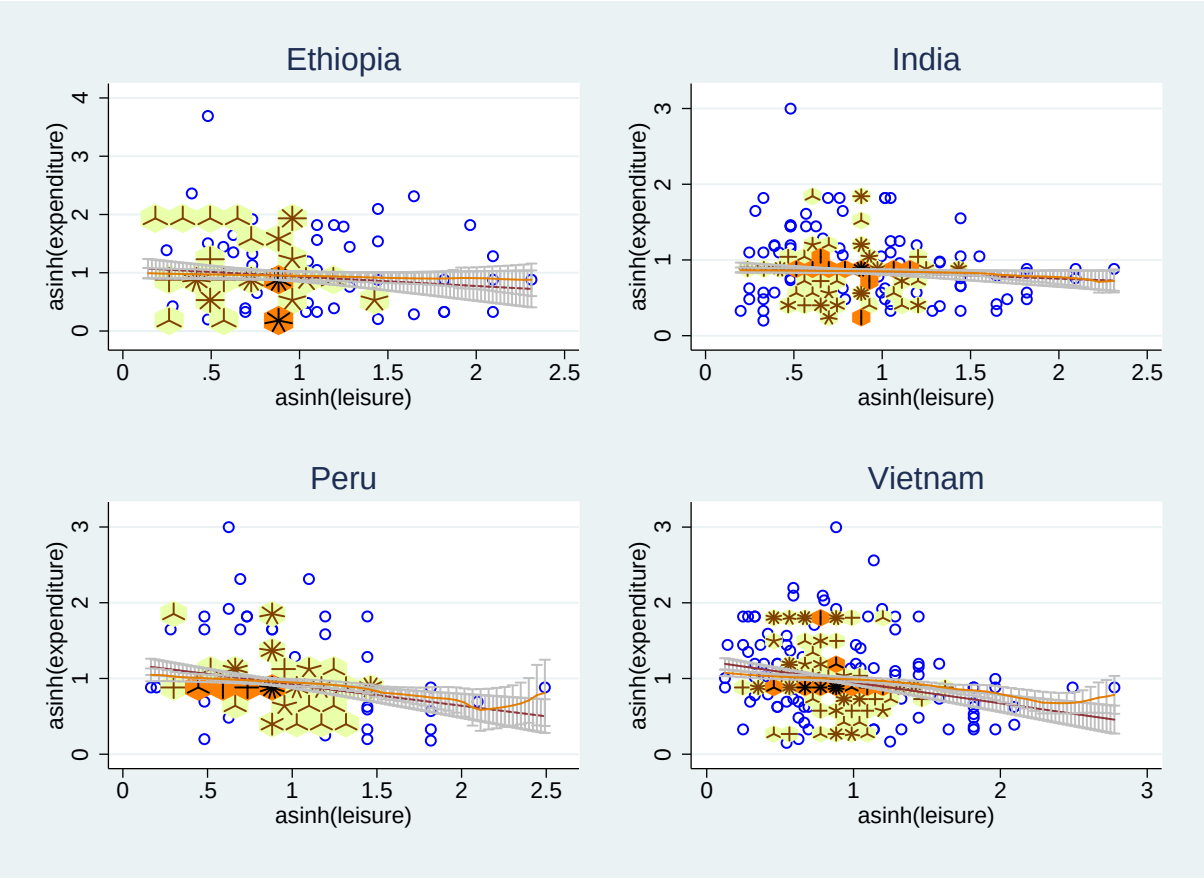
Table 3: Robustness Checks

	$\ln x$ con $\ln l$ con	x ord $\ln l$ con	x ord l ord
	(1)	(2)	(3)
Correlation parsimonious model	-.0401	-.0587**	-.0683**
	(.0265)	(.0290)	(.0339)
Full set of interaction effects (n=1652)	-.0280	-.0494*	-.0493
	(.0263)	(.0289)	(.0342)
Education included (n=1623)	-.0337	-.0542*	-.0662**
	(.0266)	(.0293)	(.0336)
Schooling as simultaneous choice (n=1652)	-.0406	-.0571**	-.0670**
	(.0264)	(.0290)	(.0337)
Non-linear age effect (n=1652)	-.0414	-.0588**	-.0684**
	(.0267)	(.0291)	(.0339)
Heterogeneity in age effect (n=1652)	-.0322	-.0508*	-.0574*
	(.0260)	(.0289)	(.0338)
Biological siblings only (n=1565)	-.0398	-.0639**	-.0609*
	(.025)	(.0290)	(.0344)
Productivity differences (n=1652)	-.0397	-.0571*	-.0640*
	(.0266)	(.0294)	(.0340)
11-17 year olds only (n=1063)	-.0538	-.0653*	-.0686*
	(.0346)	(.0361)	(.0403)
Work as dependent variable			
Correlation parsimonious model (n=1080)	.0444	.0665*	.0847**
	(.0323)	(.0344)	(.0423)
Work and productivity (n=1080)	.0430	.0632*	.0847**
	(.0328)	(.0406)	(.0426)
Excl. work outside the house (n=1016)	.0592*	.0635*	.0770*
	(.0356)	(.0362)	(.0442)
Excl. children working outside (n=765)	.0693*	.0706*	.0932*
	(.0398)	(.0403)	(.0492)

Notes: All models include country and time intercepts. Robust standard errors in parenthesis, clustered at child level; *, **, *** denote significance at 10%, 5% and 1% levels.

8 Figures

Figure 1: Unconditional Joint Distribution of $\ln x_{it}$ and $\ln l_{it}$



Notes: Y-axis shows relative expenditure using the inverse hyperbolic sine transformation; x-axis shows relative leisure using the inverse hyperbolic sine transformation. The figure contains circles and hexagons. Circles represent individual data points; in a light hexagon each line from the centre represents one observation; in a dark hexagon, each line from the centre represents four observations; overlaid are a linear regression and a local polynomial regression with 95% confidence intervals.

APPENDIX

A Additional Tables and Figures

Table 4: Relationship of Sibling to Panel Child

	Ethiopia	India	Peru	Vietnam
Brother/sister (both parents the same)	0.764	0.991	0.900	0.987
Half-sibling (same father)	0.005		0.004	0.005
Half-sibling (same mother)	0.085		0.059	0.002
Adoptive brother/sister	0.005			0.002
Uncle/aunt	0.035		0.015	
Cousin (including cousin-brother & cousin	0.070	0.007	0.015	0.005
Nephew/niece	0.010	0.002	0.007	
Brother/sister-in-law (spouse of sibling)	0.010			
Other relative	0.010			
Servant (farm-worker, maid, etc.)	0.005			

Notes: Relationship of sibling to panel child from household roster.

Table 5: Panel Child Characteristics

	2006				2009			
	mean	sd	min	max	age	sd	min	max
Ethiopia								
Age	11.49	0.50	11	12	14.50	0.50	14	15
Male	0.45	0.50	0	1	0.53	0.50	0	1
School	5.99	1.24	4	10	6.23	1.35	3	10
Study	1.89	0.93	0	5	2.25	1.23	0	7
Play	3.25	1.48	1	8	2.69	1.53	1	8
Child Care	0.11	0.40	0	2	0.38	0.75	0	4
Household Chores	2.44	1.59	0	8	2.58	1.47	0	6
Non Paid	0.80	1.46	0	5	0.98	1.68	0	8
Paid	0.11	0.59	0	4	0.21	0.89	0	6
Any Work†	3.45	1.91	0	8	4.15	1.76	1	9
Sleep	9.17	1.03	6	12	8.67	1.17	5	11
	n=95				n=104			
India								
Age	11.72	0.45	11	12	14.69	0.46	14	15
Male	0.51	0.50	0	1	0.52	0.50	0	1
School	6.89	1.06	4	10	8.26	1.29	1	13
Study	2.33	1.44	0	8	2.68	1.27	0	7
Play	3.86	1.81	1	9	3.58	1.45	1	8
Child Care	0.08	0.30	0	2	0.18	0.43	0	3
Household Chores	0.69	0.80	0	4	1.11	0.96	0	4
Non Paid	0.06	0.28	0	3	0.10	0.45	0	3
Paid	0.00	0.00	0	0	0.04	0.36	0	5
Any Work†	0.83	0.94	0	4	1.43	1.35	0	8
Sleep	8.92	0.89	6	11	8.05	0.92	5	10
	n=285				n=269			
Peru								
Age	11.88	0.44	11	13	14.41	0.57	13	17
Male	0.62	0.49	0	1	0.59	0.49	0	1
School	5.57	0.70	5	9	6.52	0.94	5	10
Study	2.14	0.94	0	6	2.42	0.94	0	6
Play	2.41	1.09	1	7	3.30	1.32	1	7
Child Care	0.34	0.67	0	4	0.49	1.05	0	6
Household Chores	0.95	0.61	0	3	1.32	0.84	0	4
Non Paid	0.24	0.71	0	4	0.32	0.81	0	4
Paid	0.06	0.43	0	3	0.05	0.24	0	2
Any Work†	1.6	1.29	0	7	2.18	1.7	0	8
Sleep	9.24	1.01	6	12	8.92	1.02	6	12
	n=141				n=130			
Vietnam								
Age	11.71	0.47	11	13	14.72	0.46	14	16
Male	0.53	0.50	0	1	0.46	0.50	0	1
School	4.59	0.63	2	8	5.48	0.86	4	10
Study	3.00	1.57	0	8	3.99	1.56	1	8
Play	5.92	1.83	1	10	4.03	1.47	1	8
Child Care	0.08	0.32	0	2	0.07	0.34	0	2
Household Chores	1.11	0.82	0	5	1.42	0.78	0	4
Non Paid	0.47	1.07	0	6	0.46	1.08	0	9
Paid	0.02	0.25	0	3	0.03	0.37	0	6
Any Work†	1.67	1.36	0	7	1.99	1.34	0	11
Sleep	8.81	0.79	7	11	8.54	1.04	5	12
	n=356				n=272			

Notes: Activities are measured in hours; †Any work is the sum of child care, household chores, non paid and paid work.

Table 6: Sibling Characteristics

	2006				2009			
	mean	sd	min	max	age	sd	min	max
Ethiopia								
Age	12.31	3.71	6	17	11.76	2.47	6	17
Male	0.55	0.50	0	1	0.63	0.49	0	1
School	6.07	1.44	4	11	6.16	1.26	4	10
Study	1.75	1.12	0	5	1.76	1.03	0	6
Play	3.34	1.76	1	8	3.40	1.61	1	8
Child Care	0.06	0.24	0	1	0.11	0.42	0	2
Household Chores	2.09	1.77	0	8	2.02	1.46	0	6
Non Paid	1.11	1.82	0	6	1.38	2.00	0	7
Paid	0.16	0.76	0	4	0.06	0.44	0	4
Any Work[†]	3.42	2.16	0	8	3.57	1.94	0	10
Sleep	9.11	1.12	7	12	9.11	1.34	6	12
	n=95				n=104			
India								
Age	11.58	3.03	6	17	13.18	2.48	6	17
Male	0.56	0.50	0	1	0.61	0.49	0	1
School	6.84	1.07	3	10	8.11	1.02	5	12
Study	2.34	1.51	0	9	2.16	1.06	0	5
Play	4.08	1.97	1	12	4.20	1.50	1	9
Child Care	0.05	0.24	0	2	0.12	0.38	0	2
Household Chores	0.53	0.74	0	3	0.74	0.82	0	4
Non Paid	0.04	0.23	0	2	0.05	0.25	0	2
Paid	0.01	0.12	0	2	0.01	0.12	0	2
Any Work[†]	0.62	0.9	0	5	0.91	1.01	0	5
Sleep	9.01	1.00	6	12	8.62	0.86	6	11
	n=285				n=269			
Peru								
Age	11.73	3.46	6	17	12.17	3.13	6	17
Male	0.55	0.50	0	1	0.51	0.50	0	1
School	5.52	0.78	4	10	6.28	0.97	4	10
Study	2.21	1.01	0	6	2.37	0.97	0	6
Play	2.44	1.20	1	6	3.52	1.21	1	7
Child Care	0.18	0.47	0	3	0.06	0.37	0	3
Household Chores	0.89	0.73	0	4	1.27	0.89	0	5
Non Paid	0.19	0.58	0	3	0.25	0.79	0	4
Paid	0.11	0.57	0	4	0.07	0.47	0	5
Any Work[†]	1.37	1.4	0	7	1.65	1.3	0	6
Sleep	9.26	1.10	7	12	9.16	1.11	6	13
	n=141				n=130			
Vietnam								
Age	12.12	3.60	6	17	11.97	3.54	6	17
Male	0.56	0.50	0	1	0.56	0.50	0	1
School	4.73	1.08	3	10	5.24	1.04	3	10
Study	2.96	1.77	0	8	3.47	1.63	0	9
Play	0.04	0.24	0	2	4.97	1.81	1	11
Child Care	0.04	0.24	0	2	0.02	0.18	0	2
Household Chores	0.93	0.92	0	4	0.92	0.86	0	5
Non Paid	0.39	0.97	0	6	0.31	0.90	0	6
Paid	0.01	0.16	0	3	0.03	0.38	0	6
Any Work[†]	1.38	1.38	0	6	1.27	1.46	0	10
Sleep	8.84	1.00	6	12	9.11	1.16	5	12
	n=356				n=272			

Notes: Activities are measured in hours; [†]Any work is the sum of child care, household chores, non paid and paid work.

Table 7: Clothes Expenditure per Child

Ethiopia	2006				2009			
	mean	sd	min	max	mean	sd	min	max
Ethiopia								
Index Child								
Clothes	75.9	52.5	7.5	337.5	164.9	166.3	4.25	1000
male	72.0	50.7	7.5	235	151.9	121.1	4.25	600
female	79.2	54.3	19	337.5	179.4	206.0	25	1000
Sibling								
Clothes	112.3	114.2	2.5	640	159.7	158.9	12.75	750
male	123.2	134.2	2.5	640	169.2	161.3	12.75	710
female	99.2	83.6	5	400	143.9	155.7	20	750
India								
Index Child								
Clothes	584.1	424.8	50	2500	1104.4	1133.6	100	13500
male	603.5	412.3	120	2500	1072.9	666.3	200	5000
female	564.3	437.7	50	2500	1138.6	1485.4	100	13500
Sibling								
Clothes	655.0	550.9	60	5000	1285.7	1287.4	50	15000
male	584.5	538.7	60	5000	1260.8	1027.2	50	8000
female	745.2	555.3	100	3000	1325.3	1621.8	100	15000
Peru								
Index Child								
Clothes	106.2	91.1	6	750	162.4	201.8	8	1300
male	104.3	73.2	6	300	157.8	218.6	8	1300
female	109.1	114.9	20	750	169.0	176.5	10	1000
Sibling								
Clothes	108.2	90.6	9	525	138.7	156.1	8	1000
male	107.7	95.6	15	525	161.4	244.0	15	1500
female	108.7	85.0	9	500	149.9	203.7	8	1500
Vietnam								
Index Child								
Clothes	198.4	189.9	15	2000	489.4	790.4	20	10000
male	180.6	151.9	45	1500	489.9	712.1	37.5	7000
female	218.6	224.2	15	2000	488.9	854.7	20	10000
Sibling								
Clothes	212.0	231.7	15	3000	408.7	767.7	12.5	10000
male	220.8	284.8	15	3000	383.6	613.4	12.5	7000
female	200.5	135.0	30	750	440.2	926.7	20	10000

Notes: Measured in local currencies.

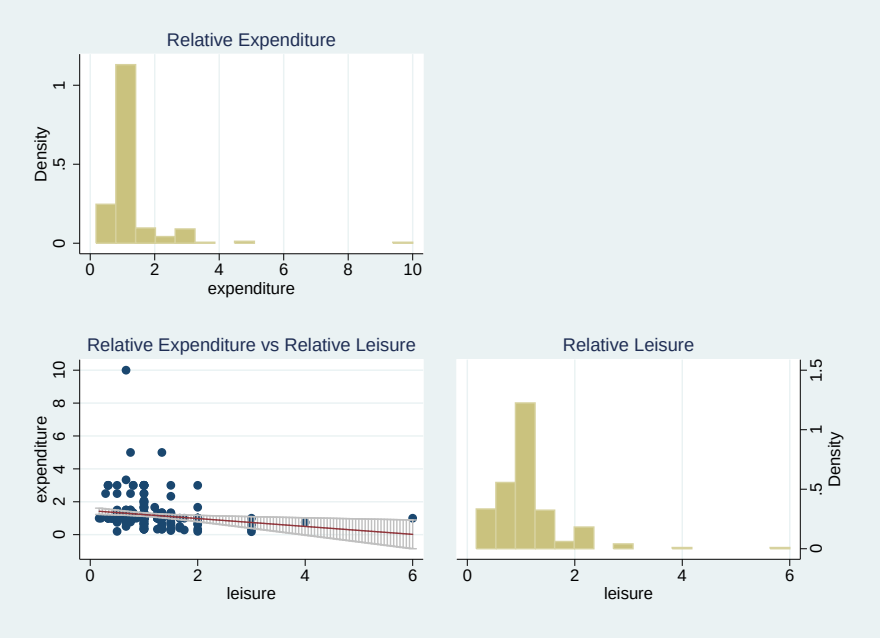
Figure 2: Relative Leisure and Consumption in Ethiopia

Notes: Linear regression of relative leisure on relative consumption with 95% confidence interval in the South-West panel.

Figure 3: Relative Leisure and Consumption in India

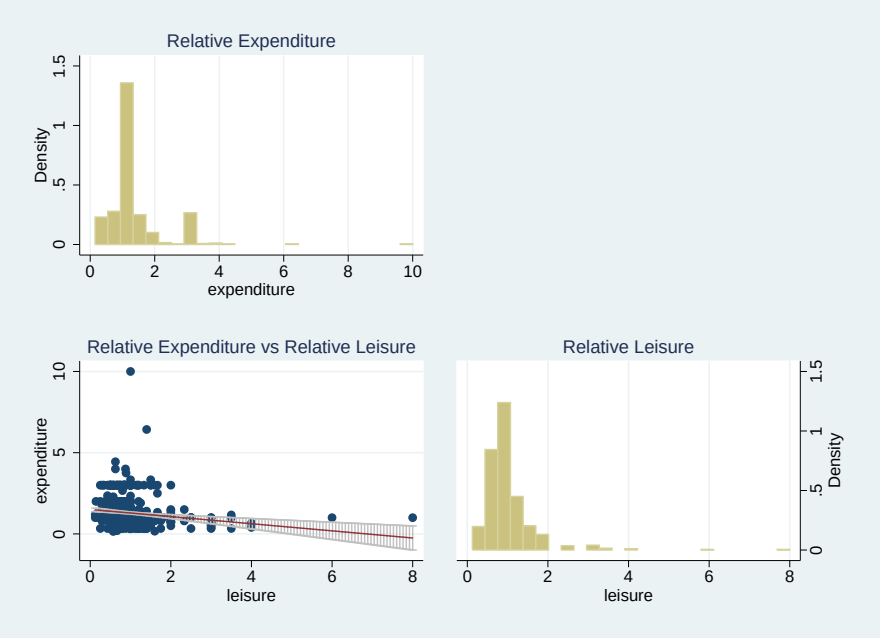
Notes: Linear regression of relative leisure on relative consumption with 95% confidence interval in the South-West panel.

Figure 4: Relative Leisure and Consumption in Peru



Notes: Linear regression of relative leisure on relative consumption with 95% confidence interval in the South-West panel.

Figure 5: Relative Leisure and Consumption in Vietnam



Notes: Linear regression of relative leisure on relative consumption with 95% confidence interval in the South-West panel.

Table 8: Base Model

	$\ln x_{it}$ continuous $\ln l_{it}$ continuous	x_{it} ordered $\ln l_{it}$ continuous	x_{it} ordered l_{it} ordered
	(1)	(2)	(3)
Relative Expenditure			
A's age	0.017	0.078	0.078
	(0.02)	(0.059)	(0.059)
B's age	-.036***	-.125***	-.125***
	(0.003)	(0.009)	(0.009)
A=male, B=male	-.012	0.006	0.006
	(0.029)	(0.068)	(0.068)
A=male, B=female	-.003	0.071	0.071
	(0.03)	(0.085)	(0.085)
A=female, B=male	0.044	0.304***	0.304***
	(0.028)	(0.08)	(0.08)
Urban	0.029	0.097	0.097
	(0.022)	(0.066)	(0.066)
Measurement Error	-.129***	-.377***	-.378***
	(0.032)	(0.1)	(0.099)
Obs.	1652	1652	1652
$R^{2\dagger}$	0.1507	0.0856	0.0856
Relative Leisure			
A's age	-.018	-.018	-.045
	(0.015)	(0.015)	(0.059)
B's age	0.035***	0.035***	0.154***
	(0.002)	(0.002)	(0.009)
A=male, B=male	0.001	0.001	0.09
	(0.02)	(0.02)	(0.085)
A=male, B=female	0.07***	0.07***	0.341***
	(0.022)	(0.022)	(0.087)
A=female, B=male	-.071***	-.071***	-.263***
	(0.021)	(0.021)	(0.082)
Urban	-.006	-.006	-.011
	(0.018)	(0.018)	(0.069)
Obs.	1652	1652	1652
$R^{2\dagger}$	0.1877	0.1877	0.1144
Correlation ρ	-.0302	-.0504*	-.0572*
	(.0258)	(.0289)	(.0337)

Notes: All models include country and time intercepts. †Pseudo R^2 for ordered probit. Robust standard errors in parenthesis, clustered at child level; *, **, *** denote significance at 10%, 5% and 1% levels.

B Extension: Collective Household Model

This section shows that the model is this paper is nested in a collective model with two parents who have different bargaining weights μ which can depend on prices and incomes. To see this, assume a household welfare function Ω'^P of the form

$$\Omega'^P = \mu\,(U^M + \kappa^M U^C) + (1-\mu)\,(U^F + \kappa^F U^C)$$

where U^M is the mother's utility, U^F is the father's utility, μ is the pareto weight, κ^M is the mother's weight for children, and κ^F is the father's weight for children. This can be rewritten as

$$\Omega'^P = \mu\, U^M + (1-\mu)\, U^F + (\mu\,\kappa^M + (1-\mu)\,\kappa^F)\, U^C.$$

Denoting $\phi = \mu\,\kappa^M + (1-\mu)\,\kappa^F$ and assuming $U^C = \delta\, U^A + (1-\delta)\, U^B$ in line with equation (1) we have

$$\Omega'^P = \mu\, U^M + (1-\mu)\, U^F + \phi\{\delta\, U^A + (1-\delta)\, U^B\}.$$

The maximization problem is

$$\max_{x_M,x_F,x_A,x_B,l_M,l_F,l_A,l_B} \mu\, U^M + (1-\mu)\, U^F + \phi\,\delta\, U^A + \phi\,(1-\delta)\, U^B \text{ subject to}$$

$$x_M + l_M\, w_M + x_F + l_F\, w_F + x_A + l_A\, w_A + x_B + l_B\, w_B = I + T(w_M + w_F + w_A + w_B)$$

and the first order conditions for x_A and x_B are

$$\mathscr{L}_{x_A} = \phi\,\delta\,\frac{\partial U^A}{\partial x_A} - \lambda = 0$$

$$\mathscr{L}_{x_B} = \phi\,(1-\delta)\,\frac{\partial U^B}{\partial x_B} - \lambda = 0.$$

Assuming that preferences of all household members are as given in (3) this collapses into equation (7) when taking ratios and equivalently for the relative leisure equation (8)

$$\frac{x_A}{x_B} = \frac{\phi}{\phi}\frac{\delta}{1-\delta}\frac{\theta^A}{\theta^B} = \frac{\delta}{1-\delta}\frac{\theta^A}{\theta^B}.$$

C Measurement Error

Measurement error in the expenditure data is due to the fact that we only know the allocation to child A with certainty, while we assign the remainder of children's expenditures to child B. In the presence of older siblings aged 18 and over who parents nevertheless regard as children, this will lead to an upward biased estimation of expenditures to child B, so that x_A/x_B is the lower bound. Below we discuss hypothetical cases for three children, A, B and C to illustrate when we can and can not identify expenditure shares.

Table 9: Identified Cases

	A	B	C	boy's x	girl's x	share A
Case 1						
Gender	male	male	female	100	50	0.5
Age	12	14	20			
Assignment	50	50	0			
Case 2						
Gender	male	female	male	100	50	0.5
Age	12	14	20			
Assignment	50	50	50			

Table 9 gives examples of cases when we can identify the share of expenditures with certainty. Case 1 is when the index child (A) is male, with a brother (B) and an older sister (C). Since we know the allocation to boy's clothes, and the share to the index child, we can assign the residual expenditures to child B. Clothes expenditures for the older sister would then be recorded either under adult expenditures of girl's expenditures, not affecting the allocations to child A and B. Case 2 is when the index child is male and child B is female, but there is an older brother in the family. We then know the allocation to child A from the questionnaire, and can assign girls expenditures to child B. The same cases hold for the opposite gender combinations.

Table 10 gives examples of cases when we are likely to measure the share of expenditures with measurement error if the parents consider males and females aged 18-25 as children when recording expenditures. Case 1 presents the scenario when the index child is male, with a brother aged 14 and an older brother aged 20. In this case, we assume that the residual expenditures (total expenditures minus the allocation share to the index child) is for child B, while alternative assignments for child B could be lower as illustrated if the parent record clothes expenditures for the 20 year old brother under boy's expenditures and not male adult expenditures. Case 2 presents the scenario when the index child is male, with a sister aged 14 and an older sister aged 20; again, the table shows that our assumed assignment is lower if the parents consider the 20 year old sister C as a child. The same logic applies to the opposite sex combinations.

We use these cases to model when measurement error is going to be more likely as illustrated in the examples. The cases particularly prone to measurement error are (i) when

Table 10: Under-identified Cases

	A	B	C	boy's x	girl's x	share A
Case 1						
Gender	male	male	male	100	0	0.5
Age	12	14	20			
Assumed assignment B	50	50	0			
Alternative assignment B (i)*	50	0	50			
Alternative assignment B (ii)*	50	25	25			
Case 2						
Gender	male	female	female	100	150	1
Age	12	14	20			
Assumed assignment B	100	150	0			
Alternative assignment B (i)*	100	0	150			
Alternative assignment B (ii)*	100	100	50			

Note: * illustrates hypothetical alternative assignments.

both children are of the same sex, and there are further siblings aged 18-25 of the same sex in the household who parents consider a child (denoted as case 1); (ii) when children are of the opposite sex, but there is a further member of the same sex as child B in the household aged 18-25 who the parents consider a child (denoted as case 2). We include a dummy variable that is equal to one if we observe either case (i) or case (ii) in the data which is case in 12% of the sample.