Family Networks and Orphan Caretaking in Tanzania*

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Abstract

This paper studies the effects of orphanhood on health and education outcomes of children in Tanzania. Using an original dataset on members of the extended family networks of orphaned children, I assess by how much the effects of orphanhood are reduced due to a systematic placement of the orphans within the family network. I find that orphanhood has significant negative impacts on female orphans' welfare in terms of health and education, not however for male orphans. I then provide evidence that the selection of caretakers reduces the negative impact of orphanhood on years of education by one year relative to caretaking by the average family within the family network.

Keywords: Orphans; Extended Family; Caregiving; Tanzania
JEL Classification: O15, D10, I3, J12

1 Introduction

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In African societies, households and individuals are faced with volatile incomes, disease and high mortality. In these high-risk environments, family networks are important risk-sharing institutions that pool risks such as crop failure, illnesses and burial costs. The death of parents is a severe risk facing children. According to UNAIDS nearly 8 million children under the age of 15 have lost both parents (UNAIDS et al., 2004). There is mounting evidence that these children are worse off in terms of access to education and health outcomes because of the loss of their parents (Beegle et al., 2006a; Case and Ardington, 2006; Evans and Miguel, 2007; Yamano and Jayne, 2005). The increase in the number of children who have lost their parents due to the HIV/AIDS pandemic has put orphans into the spotlight, and with them their caretakers.

This paper examines the role of family networks in mitigating negative impacts on orphans' health and education that are associated with parental mortality. If caretakers differ in their ability to provide adequate investments into the health and education of orphans, then choosing the caretaker becomes an important issue. I assess how the effects of orphanhood on health and education vary with the characteristics of the caretakers, in a context where most of the orphans are taken care of by close family members. Do richer caretakers provide better care than poorer caretakers? Or is the relationship between the orphan and the caretaker more important, such that grandparents might provide better care even if they are somewhat poorer? The answer to these questions is complicated by the fact that orphans are not randomly placed in the family network so that the characteristics of the caretakers are endogenous. Understanding the underlying mechanism of how the orphan is placed within the family network is thus crucial for understanding how the caretaker characteristics affect orphans' welfare.

I develop a model of orphan placement which shows that the systematic placement of the orphan leads to a bias when regressing orphans' outcomes on caretaker characteristics. The intuition behind this is that observable and unobservable characteristics will influence both the caretaking decision as well as orphans' outcomes: When a family member with very low levels of observable characteristics, such as wealth, takes care of an orphan, it is probably because she has some compensating unobserved characteristics, such as a high preference for the orphan. This leads to a negative correlation between the observed and the unobserved characteristics. Thus, in a regression of orphans' outcomes on the observed characteristics of the caretakers the estimated coefficients tend to be biased downward. The theoretical model of orphan placement also suggests a method for correcting for this placement bias. Using information on actual as well as potential caretakers, a correction term can be constructed via the two-step procedure developed by Lee (1983). This involves estimating the determinants of the placement of the orphan in the network and predicting the probability that a network member is chosen as caretaker.

In order to estimate the model of orphan placement I designed a survey and collected primary data in Tanzania that contains information on the extended family networks of double orphans. I sampled both network members who took care of orphans and those who did not, allowing me to estimate the determinants of the placement of the orphan. In order to provide evidence on how orphans' welfare is affected by caretaker characteristics, the data on the family networks of the orphans is linked back to a panel dataset. The sampling frame for my orphan survey is the Kagera Health and Development Survey (KHDS) which provides data on long-term health and education outcomes of respondents between 1991 and 2004. The orphan sample contains the children who lost both parents during this period, most of which have lost at least one parent due to HIV/AIDS. Thus, using the linked data I can analyze the long-term effects of orphanhood, while controlling for placement selection.

The empirical analysis proceeds in two steps. First, the determinants of the placement decision are analyzed, yielding information on how households systematically place orphans. This step can also be thought of as a first stage for the correction of the placement bias. The second step is then to estimate how orphans' welfare in terms of health and education is affected by caretaker characteristics while controlling for placement bias.

I estimate the determinants of the placement of the orphan using a conditional logit model which accounts for stratified sampling from the family network (McFadden, 1978; Bierlaire, Bolduc and McFadden, 2006). I find that economic variables are important. In particular, being a trader or owning business assets increase the probability of caretaking by twelve and six percentage points, respectively. These economic concerns are balanced with cultural norms: paternal relatives are much more likely to be caretakers than maternal relatives. Yet, the traditional caretakers, paternal uncles and aunts are much less likely to provide care than the grandparents or older siblings of the orphans.

The empirical analysis of how orphans' health and education is affected by caretaker characteristics reveals that the placement bias is important though the individual coefficients are imprecisely estimated. For orphans' years of education, not accounting for the placement of the orphan biases the estimated coefficients downwards (but again, this difference is not precisely measured). I then assess the magnitude of the effects of selection on orphans' education. Placing the orphan in the actual caretaking family increases the education of the orphan by one year compared with placing the orphan with a random household within the family network.

Concerning health, the empirical analysis reveals a puzzle. While selection is beneficial for the educational outcomes of orphans, the impacts on orphans' health are negative. These reverse patterns for health and education suggest that the systematic placement of the orphans within the family network might enable family networks to mitigate the impacts of orphanhood on orphans' education, but not so for health. Family networks in Tanzania are thus institutions in which the risks associated with parental mortality are only partially mitigated.

The remainder of the paper is organized as follows. The following section reviews the literature and provides some background on orphans in Tanzania. Section 3 develops a model of caretaking. Section 4 describes the data and presents some descriptive statistics. Section 5 present results for the estimation of the determinants of placement. Section 6 presents results for the estimation of the determinants of orphans health and education. Section 7 offers a summary and an outlook.

2 Orphans in the Tanzanian and African Context

Tanzania is one of the poorest countries in the world, with a purchasing power parity adjusted per capita income of around $670. The life expectancy is around 46 years, the under 5 mortality rate is 126 per 1000 and the adult illiteracy rate is over 30% (World Bank, 2004). The number of orphans is estimated to be 1.3 million, of which 800,000 have lost their father only (so-called paternal orphans) and 360,000 have lost their mother only and are called maternal orphans. There are also 165,000 double orphans who have lost both parents (Measure et al., 2001)[1]. While not all cases of orphanhood are due to HIV/AIDS, HIV/AIDS is seen as a major contributory factor since it affects mainly the reproductively active population (see section 2.2). The Kagera region in Northwestern Tanzania, was the first region within Tanzania to report a death from AIDS in 1983. Kagera borders on Uganda, Rwanda and Burundi and has traditionally been an area with frequent population movement. Orphan rates in Kagera are nonetheless comparable to the national average; 10.5% versus 10.8% respectively (TACAIDS et al., 2005). The rate of double orphans, however, at 1.7% in Kagera is substantially higher than at the national level, which amounts to 1%. In the KHDS sample, the stratified sampling scheme used led to a majority of the double orphans in the sample

[1] Up to recently, orphaned children were defined as children under the age of 15 who had lost at least one parent, and this is the definition that was used in the construction of my sample. The current definition supported by UNICEF includes all children under the age of 18 who have lost at least one parent.

having lost at least one parent to HIV/AIDS (see section 2.2). In the following section, I refer to previous research analyzing the effects of orphanhood on health and education outcomes. Then the causes of parental death are situated in the context of the HIV/AIDS epidemic in Kagera, before the traditional caretaking arrangements are contrasted with the observed arrangements in my sample of orphans.

2.1 The impact of orphanhood

Studies that have analyzed the impact of orphanhood are of 3 types: cross-sectional studies, caretaking household fixed effects studies, and panel data studies. These studies contribute to answering different questions about the welfare of orphans, typically measured by enrollment as a measure of investment in education or Body Mass Index (BMI) as an indicator of health status. Studies using cross-sectional data typically regress these orphans' outcomes in a cross-section on an orphan dummy and sometimes household controls (Ainsworth and Filmer, 2002; Case et al., 2004; Bicego et al., 2003). These studies provide information on how well orphans fare compared to the general child population and whether targeting orphans is an efficient strategy to reduce general poverty. The empirical findings from these studies have been mixed for Tanzania.

Household fixed effects studies use cross-sectional data and compare outcomes of orphans to those of non-orphans who reside in the same households (Case et al., 2004; Seck, 2005). They typically find evidence that orphans receive less investment in education than the biological children of the household head. These findings can provide some justification for conditional transfers to households taking care of orphans. Studies based on cross-sectional data are usually based on large nationally representative samples and can thus answer some policy relevant questions, such as whether a government should focus its efforts on particular regions. However, they do not identify the effects of orphanhood unless parents who die are a random sample of the population and the orphans are placed randomly within the family network. Both assumptions are unlikely to hold.

Much of the recent literature uses panel data in order to account for non-random parental death. These studies compare orphans' outcomes before and after the death of their parents and can thus correct for differences in parental background and often for individual fixed effects (Ainsworth et al., 2005; Ainsworth and Semali, 2000; Beegle et al., 2006a; Case and Ardington, 2006; Evans and Miguel, 2007; Yamano and Jayne, 2005). They conclude that there is evidence of negative effects of orphanhood on the health and education of orphans. The effects typically vary with which parent died and whether the other parent (if still alive) was still taking care of the orphan. In general, maternal death seems to have more severe impacts than paternal death.

Ainsworth et al. (2005) study the effects of orphanhood on schooling participation and hours spent in school using household panel data from Kagera (the baseline of the data used in Beegle et al. (2006a) and in this study). They find that maternal deaths delay schooling for younger children. Whilst children already in school do not drop out of school, the hours spent in school are significantly reduced. Ainsworth and Semali (2000) use the same data to analyze the effects of orphanhood on health. Individual fixed effects estimates do not show any impacts of maternal or paternal orphanhood on height-for-age Z-scores in their panel, possibly due to the small number of children, the short duration of the panel (two years) and the fact that households receive financial assistance following the adult death (Lundberg et al., 2000).

Case and Ardington (2006) find that maternal death negatively affects school participation using a 2-3 year panel survey from South Africa, whereas paternal deaths do not seem to have an effect. Since the mother's death does not seem to be associated with differences in socioeconomic conditions in the household before her death, Case et al. interpret their results as causal. Evans and Miguel (2007) analyze the impact of orphanhood on school participation using a sample of Kenyan school children in 1998 who were re-interviewed in 2002. Using child-specific fixed effects, they find evidence of effects of maternal death on school participation. However, this is true also for the period of 1-2 years immediately before the mother's death. Paternal death does not seem to have any effect. Beegle et al. (2006a) present evidence from Tanzania that orphanhood has negative long-run consequences on health and education for some orphans. Among other things, maternal orphans are 2cm shorter and receive about 1 year of schooling less than they would have had they not been orphaned. By including orphans' characteristics from the first wave of the study, they can control for parental background and individual endowments. They also note that the living arrangements of the orphan before the death of the parent mattered, though the inclusion of this endogenous variable makes the coefficients hard to interpret. An interesting feature of their survey data is that the survey attempted to interview all individual respondents of a previous household survey even when they had left the household or the village. Beegle et al. (2006a) find that the results change when they restrict the sample to those who remained in the village compared to the whole sample which underlines the importance of including orphans who moved out of the households and out of their villages. Households change their structure in response to shocks (Akresh, 2005; Taiwo, 2007); not accounting for this endogenous choice can bias the estimated coefficients (via sample attrition in the case of Beegle et al., and endogenous placement in the current study). Where the orphan is placed in the family network may affect the welfare of the child. Whether orphans move out of their households and to where they move depends on the options available to them and is also influenced by cultural norms.

In the following sections I first provide some background on HIV/AIDS in Kagera and in the Kagera Health and Development Survey before I then describe traditional caretaking norms in Kagera.

2.2 HIV/AIDS in Kagera and in the estimation sample

The first deaths due to AIDS in Tanzania were identified in Kagera in 1983. Based on a population-based survey, the prevalence rate of adults ages 15-54 in Kagera in 1987 was 6.7% in Kagera (Killewo et al., 1990). There were large regional differences: The prevalence rates in Bukoba Town (the capital) was 24.2%; in Bukoba Rural and Muleba districts (the peri-urban Eastern districts) 10.0%; in the northwestern district of Karagwe the prevalence was 4.5%; and in the southern districts of Ngara and Biharamulo prevalence was a mere 0.4%.[2]

Follow-up studies showed a marked decline in incidence and prevalence in Kagera. In the high-prevalence area of the capital town of Bukoba prevalence of HIV/AIDS decreased from 24.2% to 13.3% between 1987 and 1996; in the medium prevalence area of Bukoba Rural and of Muleba from 10% to 4.3% between 1987 and 1999; and in the low prevalence area of Karagwe from 4.5% in 1987 to 2.6% in 1999. Overall, a prevalence of 3 to 3.5% in the Kagera region at the end of the 1990s is plausible.[3] This corresponds well with the prevalence rates estimated by the Aids Indicator Surveys using a representative sample, where the estimates for 2003 for adults aged 15-49 are 3.9% for men and 3.5% for women (TACAIDS et al., 2005).[4][5] Kagera's HIV prevalence rates are thus quite low compared to the national

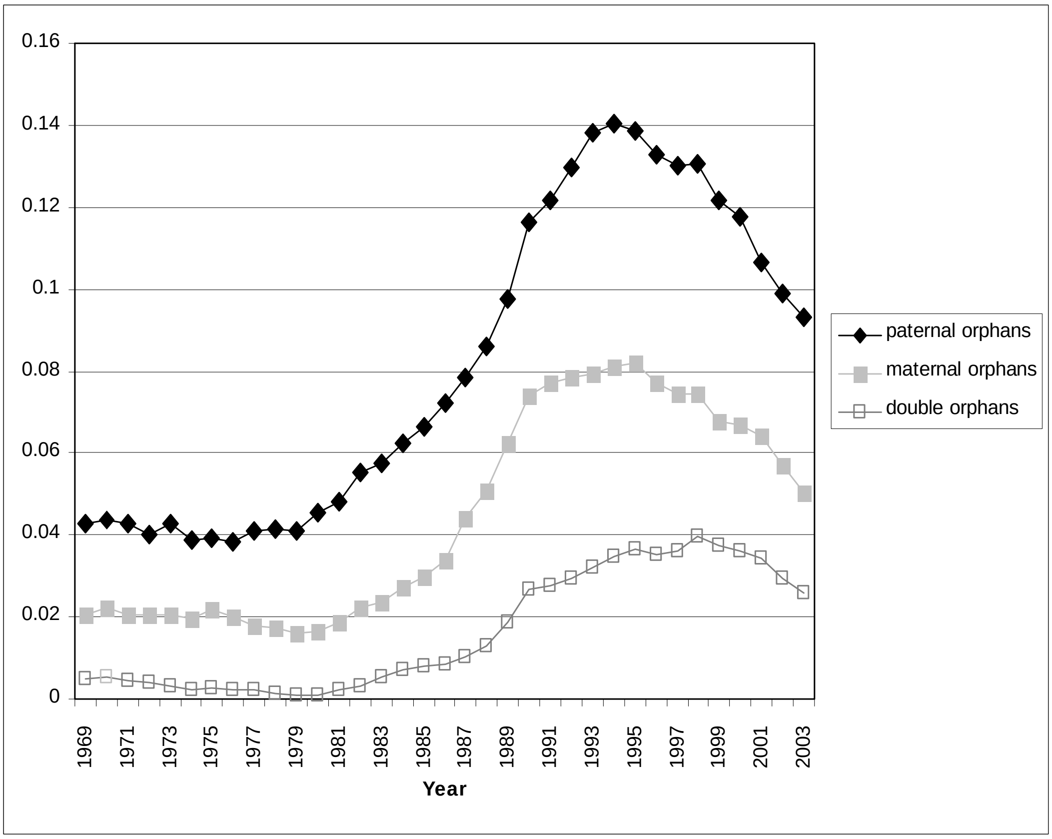
[2]While the paper reports a prevalence of 9.2% *in their sample,* the population weighted prevalence was 6.6%. According to 1988 census data, the population share of Bukoba urban was 3.5%, of the peri-urban zone 46.8; of Karagwe 21.6% and of the last two districts 28.1% (TZNBS, 2003). [Note: while the report reports the population share of Karagwe to be 22.6, this is a typo, it is in fact 21.6]

[3]Calculating an exact figure is impossible because the dates of the resurveys for the 3 zones are not the same and a fourth region (with a prevalence of 0.4%) was left out. Assuming that the prevalence rate from 1996 was still accurate for 1999 (which implies the implausible assumption that the strong downward trend in Bukoba Town did not continue) and that the low rate of 0.4% in Karagwe was still accurate in 1999, the estimated prevalence rate in Kagera (based on 1987 population shares) was 3.2 in the late 1990s.

[4]Among both sexes the percentage of respondents who refused testing refusals was equally low at 2.3%. In addition, 1.0% of women and 4.1% of men were sampled, but not interviewed.

[5]The Aids Indicator Surveys are conducted by ORC Macro, the same organization that also conducts the Demographic and

Figure 1: Evolution of Orphan Rates in Kagera (by type)



average of 6.3 and 7.7 respectively.

Figure 1 displays patterns of rates of orphanhood for respondents in the Kagera Health and Development Survey, while figure 4 in the appendix also includes confidence intervals. A clear break can be seen in 1980, from which point on rates of paternal orphanhood are rising. For rates of maternal orphanhood, the date is less clear, because of a slight downward trend in the rates of maternal orphans in the late 1970s. The downward trend is reversed between 1980 and 1982 and an upward trend in rates of maternal orphans emerges. For rates of double orphanhood, the date of the trend break is less clear, but is somewhere in the years between 1980 and 1985. While the average orphan rate in the 1970s is about 0.0028, i.e. 0.28% in the second half of the 80s it is significantly higher at 3%.

Unfortunately, I cannot say much about the evolution of rates of orphanhood after the beginning of the 1990s since at that point the regional trends mix with the stratified sampling employed by KHDS:

Health Surveys.

Households were heavily oversampled into the KHDS in 1991 if they had a sick household member-member or had experienced a recent adult death.[6] Thus, the increase in the 1990s could be due entirely to the sampling scheme. Unfortunately, this also makes it impossible to interpret the decrease starting in the late 1990s or early years of this millennium: It could be that fewer parents are dying in general, or that the households with sick parents in 1992 just do not have fewer parents in 2000 who can die. Given the substantial decrease in prevalence, at some point rates of orphanhood also will decrease. So I think that they evidence supports the hypothesis that rates of orphanhood declined in Kagera. However, using the KHDS, there is no way to quantify this decrease.

Table 1 displays the major causes of death for the parents of the orphans in my sample.[7] Respondents were asked whether the parent died of an illness (as opposed to an injury or other) and then whether a health practitioner had diagnosed the illness. If that was the case, the respondents were then asked about the diagnosis of the health practitioner. They were also always asked what the cause of death was in *their* opinion.

There are 139 cases where there is information available for the father. In 52 percent of these cases respondents indicated that they knew that a health practitioner gave a diagnosis and that the diagnosis was HIV/AIDS. Other causes of death are quite insubstantial, and some of them are infections that occur very frequently together with HIV/AIDS, such as tuberculosis. Since not all causes of death were diagnosed by a health practitioner and the respondents would not always know the diagnosis, it is also informative to gain additional information from the respondents. According to the opinion of the respondents, more than two thirds of the orphans had their father die of HIV/AIDS.

The case is similar for mothers. There is a report from a health practitioner that the mother of an orphan died of HIV/AIDS in 56% of the cases, and in the opinion of the respondents, almost three quarters of the mothers of orphans died of HIV/AIDS. Malaria is the second most important killer, with almost 3% and 10% of mothers' deaths according to health practitioners and respondents. All in all, for two thirds of the orphans, there is at least one report from a health practitioner that at least one parent died from HIV/AIDS. According to the opinion of respondents, the percentage of AIDS orphans is even

[6] Note that it is possible that a part of the strong increase in the late 80 that I see is due to the sampling as well: A household in which one member died of HIV/AIDS is more likely to experience a second death and therefore to have a higher probability of selection in KHDS-1.

[7] The table displays information for all orphans in the data with available data, regardless of whether they had missing on other regression covariates.

	Father		Mother	
	Reported Diagnosed by Health Practitioner	Opinion of Respondent	Reported Diagnosed by Health Practitioner	Opinion of Respondent
HIV/AIDS	52.4	68.4	56.0	74.6
Malaria	2.2	2.0	3.0	10.5
Typhoid	4.3	4.3		
Asthma		3.3		
Meningitis			2.2	
Tuberculosis	5.8	3.6	2.2	
Cancer	2.9	0.7	2.2	2.2
Diabetes		2.2		
Other	2.0	8.3	3.1	4.5
Don't Know	30.4	7.2	31.3	8.2
N	139		134	

Table displays the causes of death in a sample of double orphans in Kagera, Tanzania. Respondents were asked: "Did ..[NAME].. have a chronic illness when he/she died? (was sick for at least three months before he/she died)". If yes, "Was the illness from which ..[NAME].. was suffering ever diagnosed by a health professional?" If yes, "What did the health practitioner report that ..[NAME].. was suffering from?" Respondents were also asked: "What illness do you think ..[NAME].. was suffering from?"

The category "Don't Know" in the health practitioner column includes both cases in which there was no diagnosis of a health practitioner or the respondent was not aware of it, and cases in which there was a diagnosis by a health practitioner, but the respondent did not know its content.

Table 1: Causes of Death for the Parents of Double Orphans

higher, namely at more than three quarters.

In general in the literature the maintained assumption is that the stigma associated with AIDS will lead to underreporting of HIV/AIDS. On the other hand, my personal experience was that respondents in Kagera were very open about talking about HIV/AIDS. All in all, this high proportion of AIDS orphans among double orphans is plausible, in particular in the context of the stratified sampling scheme of KHDS-1 (see section 4). Households with sick household members were oversampled, and among these households there is going to be a higher proportion of households in which a member has an HIV, because of the extended period of dying and the fact that two parents are likely to be sick.

2.3 Caregiving Arrangements in Kagera

In Kagera, as in many parts of East Africa that are patrilineal, children belong to the paternal lineage. Traditionally, the caretaking duties thus lay with the paternal relatives, in particular paternal uncles and aunts (Foster, 2000). When husbands died, their wives' ability to remain on the land of their husband traditionally depended on whether they had children by the deceased and in general on their relations with their in-laws (Manji, 2000).[8]

When adult males die, members of the extended family and older men of the clan often come together and settle the inheritance and discuss the caretaking of the orphan children.[9] In many cases, dying parents have written a will concerning their inheritance and expressed a wish as to who should take care of the orphan. However, not all parents do and when they do, their will is not always respected.

The prevalence of paternal uncles and aunts in caretaking has gone down (Foster, 2000). More and more grandparents, maternal relatives and siblings have become caretakers, a fact that some observers

[8] Wives gained usufructuary rights over land through their husbands. In most parts of Kagera, only male children could inherit, with the major parts going to the eldest and the youngest male child. In some parts of Kagera, female children could inherit land, though their children, being from a different clan could not (Muchunguzi, 2002). Two things have changed more recently. First of all, more and more land is held not as clan land, and non-clan land can be bequeathed without restriction. In addition, recent legislative changes have invalidated obstacles to female inheritance in traditional laws. This invalidation is not perfect, however. Beyond issues of social acceptance, the process for a woman to claim land that she has inherited involves going to court and there invalidating the traditional laws that bar her from inheriting. Appleton (2000) mentions a law from colonial times that specified a wife's right to remain on her husband's land upon his death, but this colonial law was never mentioned by any person the author talked to and even if it exists, it might not be implementable.

[9] Information that I obtained from focus group interviews.

	Number	Percent
Brother or Sister	43	28.3
Paternal Grandparent	35	23
Paternal Uncle or Aunt	20	13.2
Maternal Grandparent	15	9.9
Maternal Uncle or Aunt	14	9.2
Other person or no one took care	25	16.5
Total	152	100.1

Notes: Table displays the degree of relatedness between the orphans and their caretakers in a sample of orphans in Kagera, Tanzania
Source: Author's survey

Table 2: Caregiving Arrangements of Double Orphans

attribute to a weakening of traditional safety nets.[10] However, despite these changes, the "predominant caring unit" remains the extended family (Foster, 2000).

Table 2 shows how many double orphans in my sample are taken care of by different categories of caregivers.[11] In my data collection effort and analysis, I defined the *family network* to be the aunts, uncles, grandparents and siblings of the orphan, as well as half-siblings of the orphan and half-siblings of his or her parents. Around 80% of double orphans are taken care of by members of the family network thus defined.[12]

[10]In fact, Urassa et al. (2003) find that on the Eastern shore of Lake Tanzania, in the Mwanza region, maternal relatives are more likely to be caretakers than paternal relatives. This is surprising since the Sukuma, who are the majority tribe, are a patrilineal tribe.

[11]Grandparents often reside with their eldest son, so that it is not clear whether a grandfather is listed as a caregiver because he is truly the primary caregiver or because he is considered the head of the household in which the orphan resides.

[12]This is in fact similar to what Deininger et al. (2003) report for a different area of Tanzania. They find that between 80 and 95 % of single parent and double orphans are taken care of by the extended family. The range is due to the fact that their definition of extended family includes cousins, whereas mine does not.

In the estimation sample, I have to drop a number of cases in which orphans were taken care of by caregivers to whom I could not administer questionnaires (see below). Thus, in the estimation sample, the percent taken care of by family members is lower.

3 Model

3.1 Framework

In this section, I present a simple model of caretaking that will be the basis of the subsequent empirical analysis. The model is used to give a structural interpretation to the estimates of the determinants of the orphan placement in section 6. For expository convenience, the model incorporates two people in the network and one orphan. The model is extended easily to more than two network members. The network members get together at the death of the deceased parent to decide on the caretaking arrangement for the orphan. They make their decision by maximizing a network welfare function: it incorporates the utility of consumption of the two network members, v_i, (where $i \epsilon \{1, 2\}$) and the orphan's utility from health and from education, respectively v_o^h and v_o^e. I assume that the orphan's utility from health is weighted by $\delta\delta^h$ and that his utility form education is weigted by $\delta\delta^e$. When deciding on the placement of the orphan, the network members cannot commit to specific levels of investment into the orphans' health and education. There are also no transfers between network members.[13] Thus, the consumption of the caretaker and the investment into orphan's health and education is determined by the caretaker: she maximizes an altruistic utility function where the orphan's utility from health and education is weighted by $\delta_j\delta_j^h$ and $\delta_j\delta_j^e$ respectively. I assume that network members have perfect knowledge about each other's resources and preferences. Therefore, they incorporate the optimal levels of consumption, health and education from the within household utility maximization into the decision of where to place the orphan. In the model the only relevant outcome for the network members is consumption, which can be thought of as some numeraire good. For the orphan, however, there are two outcomes, health and education.

In the model, i denotes the person and j the placement. The consumption of a network member i when person j is the caretaker is c_{ij}. In the household of the caretaker j, her consumption is denoted c_{jj} and the expenditures on the health and education of the orphan are h_{oj} and e_{oj} respectively.

The network maximizes the following network welfare function by choosing to place the orphan with

[13] Lundberg et al. (2000) point out that the transfers to the household that experienced an adult death petered out within a year. Moreover, respondents in focus groups that transfers between network members were not negociated at the meeting where the placement of the orphan was decided upon. However, it might be possible that network members include the expectation of future transfers into their decision making.

network member $j \epsilon \{1,2\}$

$$\begin{aligned} U_j &= v_1(c_{1j}) + \delta(\delta^e v_o^e(e_{oj}) + \delta^h v_o^h(h_{oj})) + v_2(c_{2j}) & (1) \\ c_{oj} &= p_j^e e_{oj} + p_j^h h_{oj} & (2) \end{aligned}$$

where

- $v_i,\ v_o,\ \ j\epsilon\{1,2\}$ are the utility of of the adult network member i and the orphan respectively, with v continuous and twice differentiable, $v' > 0, v'' < 0$. The orphan derives utility v_o^e from education and v_o^h from health

- c_{ij}, c_{oj} are the expenditures of adult network member i and of the orphan respectively, when the orphan is taken care of by j (it is possible that $i = j$) and person j determines the within-household allocation

- e_{oj}, h_{oj} denote the investment in education and health of the orphan; p_j^e, p_j^h their network member-specific price.[14] Note that the investment into orphans' health and education are priced at the prices that the caretaker faces

- δ is the utility weight of the orphan in the network's maximization problem and δ could be the sum of the weights attached to the orphan's utility by the network members, or any other number, such as 1. I assume that $\delta > \max(\delta_1, \delta_2)$

- δ^e, δ^h are the weight that the network attaches to the orphan's education and his health within the network utility function

Thus, $\delta^e v_o^e, \delta^h v_o^h$ are the utility the network derives from orphans' education and health respectively

I can rewrite the network maximization problem as

$$\max_{j\,\epsilon\,\{1,2\}} U = \begin{cases} v_1(c_{11}) + \delta\delta^e v_o^e(e_{o1}) + \delta\delta^h v_o^h(h_{o1}) + v_2(c_{21}) & if\ \ j = 1 \\ v_1(c_{12}) + \delta\delta^e v_o^e(e_{o2}) + \delta\delta^h v_o^h(h_{o2}) + v_2(c_{22}) & if\ \ j = 2 \end{cases} \quad (3)$$

where the constraints that the network faces are given by the within-household maximization problem of the network members.

[14] p_j^e, p_j^h can be interpreted as prices (e.g. farmers or people living near a health clinic might have lower prices for health inputs), or as coefficients of a linearized production function: more educated people might have lower costs to investing into orphans education and might be more knowledgeable about health issues as well.

Utility Maximization in the Households

In the household of the caretaker, the maximization of the altruistic utility function is done subject to the budget constraint

$$\begin{aligned} \max \quad & v_j(c_{jj}) + \delta_j(\delta_j^e v_o^e(e_{oj}) + \delta_j^h v_o^h(h_{oj})) \\ & s.t.\ p_j^e e_{oj} + p_j^h h_{oj} + c_{jj} = w_j + r_{oj} \\ \Leftrightarrow \quad & \max\ v_j(\, w_j + r_{oj} - p_j^e e_{oj} + p_j^h h_{oj}) + \delta_j(\delta_j^e v_o^e(e_{oj}) + \delta_j^h v_o^h(h_{oj})) \end{aligned}$$

where δ_j is the weight that the caretaker j attaches to the orphan's utility; δ_j^e, δ_j^h is the weight she attaches to the orphan's health and education, and r_{oj} is the contribution of the orphan to the household which could be composed of his inheritance and his labor. I assume that $\delta_j \delta_j^e < \delta\delta^e$ and $\delta_j \delta_j^h < \delta\delta^h$.

This leads to the following first order conditions

$$\begin{aligned} \frac{\partial v_j}{\partial c_{jj}} p_j^e &= \delta_j \delta_j^e \frac{\partial v_o^e(e_{oj})}{\partial e_{oj}} \\ \frac{\partial v_j}{\partial c_{jj}} p_j^h &= \delta_j \delta_j^h \frac{\partial v_o^h(h_{oj})}{\partial h_{oj}} \end{aligned} \tag{4}$$

Dividing the first first order condition by the second one leads to the following equation

$$\begin{aligned} \frac{p_j^e}{p_j^h} &= \frac{\delta_j^e}{\delta_j^h} \frac{\frac{\partial v_o^e(e_{oj})}{\partial e_{oj}}}{\frac{\partial v_o^h(h_{oj})}{\partial h_{oj}}} \\ \Leftrightarrow \frac{p_j^e}{p_j^h} &= \frac{\delta_j^e}{\delta_j^h} \frac{v_o^{e\prime}}{v_o^{h\prime}} \end{aligned} \tag{5}$$

Together with one of the first order conditions, this determines the consumption of the caretaker and the investment into the orphan's health and education. They can be written as a function of the exogenous parameters

$$\begin{aligned} c_{jj}^* &= c_{jj}(w_j, r_{oj}, \delta_j, \delta_j^e, \delta_j^h, p_j^e, p_j^h) \\ e_{oj}^* &= e_{oj}(w_j, r_{oj}, \delta_j, \delta_j^e, \delta_j^h, p_j^e, p_j^h) \\ h_{oj}^* &= h_{oj}(w_j, r_{oj}, \delta_j, \delta_j^e, \delta_j^h, p_j^e, p_j^h) \end{aligned}$$

The second household in the network is the household of the non-caretaker. The non-caretaker consumes her budget

$$c_{kj}^* = w_k$$

The maximization problem of the network can be rewritten subtracting the sum of utilities of each of the network members when the other network member is the caretaker. Define $V_o^j \equiv \delta\delta^e v_o^e(e_{o1}) + \delta\delta^h v_o^h(h_{o1})$[15]. Then,

$$\max_{j\,\epsilon\,\{1,2\}} U = \begin{cases} v_1(c_{11}) + V_o^1 + v_2(c_{21}) - \{v_1(c_{12}) + v_2(c_{21})\}\ ,\ j=1 \\ v_1(c_{12}) + V_o^2 + v_2(c_{22}) - \{v_1(c_{12}) + v_2(c_{21})\}\ ,\ j=2 \end{cases} \tag{6}$$

$$\Leftrightarrow \quad = \begin{cases} v_1(c_{11}) + V_o^1 - v_1(c_{12}) & if\ \ j=1 \\ v_2(c_{22}) + V_o^2 - v_2(c_{21}) & if\ \ j=2 \end{cases} \tag{7}$$

This simplification leads to a formulation in which the utility of the network from placing the orphan with network member i is only dependent on the characteristics of network member i and the contribution of the orphan to the budget of network member i.[16] Formally, the maximization problem of the network including the constraints can then be written as follows

$$\Leftrightarrow \quad \max_{j\,\epsilon\,\{1,2\}} U = \begin{cases} v_1(c_{11}^*) + \delta\delta^e v_o^e(e_{o1}^*) + \delta\delta^h v_{oh}(h_{o1}^*) - v_1(w_1) & if\ \ j=1 \\ v_o(c_{o2}^*) + \delta\delta^e v_o^e(e_{o2}^*) + \delta\delta^h v_o^h(h_{o2}^*) - v_2(w_2) & if\ \ j=2 \end{cases}$$
$$s.t.$$

$$c_{11}^*, e_{o1}^*, h_{o1}^* = \underset{c_{11},e_{o1},h_{o1}}{\arg\max}\ v_1(c_{11}) + \delta_1\delta_1^e v_o^e(e_{o1}^*) + \delta_1\delta_1^h v_o^h(h_{o1}^*)$$
$$s.t.\ \ c_{11} + p_1^e e_{o1} + p_1^h h_{o1} \leq w_1 + r_{o1}$$

$$c_{22}^*, e_{o2}^*, h_{o2}^* = \underset{c_{22},e_{o2},h_{o2}}{\arg\max}\ v_2(c_{22}) + \delta_2\delta_2^e v_o^e(e_{o2}^*) + \delta_2\delta_2^h v_o^h(h_{o2}^*)$$
$$s.t.\ \ c_{22} + p_2^e e_{o2} + p_2^h h_{o2} \leq w_2 + r_{o2}$$

Define the indirect utility from placing the orphan in household 1 as:

$$U_1(w_1, r_{o1}, \delta_1, \delta_1^e, \delta_1^h, p_1^e, p_1^h) = v_1(c_{11}^*) + \delta\delta^e v_o^e(e_{o1}^*) + \delta\delta^h v_o^h(h_{o1}^*) - v_1(w_1) \tag{8}$$

The network chooses to place the orphan with the network member whose caretaking yields highest network utility. That implies that network member 1 will be chosen as caretaker if

$$U_1(w_1, r_{o1}, \delta_1, \delta_1^e, \delta_1^h, p_1^e, p_1^h) \geq U_2(w_2, r_{o2}, \delta_2, \delta_2^e, \delta_2^h, p_2^e, p_2^h) \tag{9}$$

[15] As mentioned before, the level of consumption for the non-caretaker is determined by her own wealth, i.e. $c_{12} = w_1; c_{21} = w_2$.

[16] U_j can now be thought of as the change in network utility that occurs when network member j takes care of the orphan compared to a situation in which she does not take care of the orphan and consumes her own budget.

3.2 Unobservable Preferences and Selection Bias

Take the following linearized version of the network utility, where for simplicity I temporarily simplify the model to include only one outcome, education, and where I set $\delta = 1$ and $r_{oj} = 0$. Only wealth and preferences of the network members then affect the placement of the orphans.[17]

$$U_j = \beta w_j + \gamma_u \delta_j \tag{10}$$

The following inequality constraints must hold for allocation 1 to be chosen:

$$\beta w_1 + \gamma \delta_1 \geq \beta w_2 + \gamma \delta_2 \tag{11}$$

In the appendix, I derive the following results when assuming a uniform distribution for the observed and unobserved characteristics.[18] Denote the caretaker by j. Then

1. $E[\delta_j] > E[\delta]$

   In expectation, caretakers attach a higher weight to the utility of the orphans than non-caretakers

2. $E[w_j] > E[w]$

   In expectation, caretakers are richer than non-caretakers

3. $Cov[w_j, \delta_j] < 0$

   Among caretakers there will be a negative relationship between observable and unobservable characteristics, even when there is none in the general population. Intuitively, a person with low levels of the observable characteristic wealth w_j must compensate for this with high values of the unobservable utility weight δ_j to be chosen as caretaker. For a rich person, however, the value of δ_j can be quite low, and she might still be chosen as caretaker.

A problem arises with household data which only contains information on the caretaking households.

[17] These simplifications are not that restrictive, since the results for w_j extend to all observed characteristics and thos for δ_j extend to all unobserved characteristics.

[18] The results are corroborated for other distributions using simulations.

This would be the case with standard household data.[19] A regression of the following form

$$e_{oj} = \beta_e w_j + \varepsilon'_{ej} \tag{13}$$

$$h_{oj} = \beta_h w_j + \varepsilon'_{hj} \tag{14}$$

would therefore lead to biased results. In particular, the estimated coefficient on wealth will be biased *downward*

$$E[\widehat{\beta_c}|w_j] < \beta_c$$

because $Cov[w_j, \delta_j] < 0$ and δ_j is part of the unobserved characteristics in the caretaking household. I call this bias the *placement bias.*

3.3 Biases

In the appendix, I derive predictions for how $(w_j, r_{oj}, \delta_j, \delta_j^e, \delta_j^h, p_j^e, p_j^h)$ affect the network's utility from placing the orphan with a specific network member, and thus how they influence the placement of the orphan.

An increase in a network member's educational preferences increases the probability of placing the orphan with that network member, since it increases the investment into the orphan's education. It however reduces the investment into the orphan's health. The contribution of the orphan to a specific household r_{oj} always increases the utility of placing the orphan with that household. δ_j, δ_j^e and δ_j^h also increase the probablity that the orphan is placed in the household of network member j.

Wealth, preferences and caretaker-specific prices for investment in orphans' outcomes influence whether a network member takes care of the orphan. If some of these variables are unobserved, they will lead to biased estimates of the relationship between the caretaker characteristics and that outcome. The

[19] The effect of orphanhood on orphans is the difference between the level of education in the network member's household and the level of education the orphan would have received had his parents not died, where the latter is denoted by e_o^0. The previous equation then becomes

$$e_{oj} - e_o^0 = \beta_c w_j + \gamma_c \delta_j - e_o^0 \tag{12}$$

To control for e_o^0 (and the possibility that it might be correlated with w_j or δ_j), I need information on the orphan before his parents died, i.e. panel data. I then either include household information on the households before the orphans died or a fixed effect.

Table 3: Observability and Resulting Bias for Network Member Specific Variables

	caretaker characteristic is:	
characteristic	observ.	unobservable
wealth w_j	no bias	$\downarrow$biased coef. in both regressions
weight on orphans' welfare δ_j	no bias	$\downarrow$biased coef. in both regressions
weight for educ δ_j^e	no bias	$\downarrow$bias in education regression
price for education p_j^e	no bias	$\downarrow$bias in education regression
price for health p_j^h	no bias	$\downarrow$bias in health regression

following table summarizes how wealth, preferences and prices, if they are network-member specific, affect the estimated coefficients depending on whether the network member's characteristic is observable or not. "Biased coefficients" means that the coefficients on variables that positively influence caretaking are biased in the direction of the arrow in the outcome equation. Variables that negatively influence selection and negatively influence the outcome also lead to a downward bias.

In the case of caretaker-specific weights for education, the coefficient on the observable variable wealth will be biased downward. In a regression where a selection correction is included (and the caretaker-specific weight on education is the only source of bias) the selection correction term in the education regression will show positive selection.

Note that there are no effects of education prices on health effects (and vice versa) in this simple model because prices are uncorrelated and the utilities are separable. If utilities were non-separable, then there would be cross-price effects.

3.4 Selection Correction

The family networks in my data are of different sizes and many of the family networks in my data are quite large. Thus, the estimation of the placement of the orphans will be done with a conditional logit model. I then use the method of Lee (1983) and Trost and Lee (1984) is to correct for placement selection.[20] It involves estimating the probability of placement with a particular caretaker and then

[20]There is some debate on how good Lee's selection correction is. Bourguignon, Fournier and Gurgand (2004) show that in a standard multinomial setting with a sample size of 200 (or more) the Lee correction is outperformed by other corrections. They, however, also point out that in small sample sizes the Lee correction does not perform worse than these other corrections. In the

constructing a selection term for the selected caretaker[21]

$$\lambda_1 = \frac{\phi(\Phi^{-1}(P(1|w_1, w_2))}{P(1|w_1, w_2)} \tag{15}$$

where $P(1|w_1, w_2)$ is the predicted probability of placement 1 from a logit model when the characteristics of the network members are w_1, w_2 and ϕ (Φ) is the standard normal pdf (cdf). I estimate th probability of selection using a conditional logit model, following McFadden (1978). The choice probabilities are then defined by:

$$P_j = \frac{\exp(w_j)}{\sum_{l \in A} \exp(w_l)} \tag{16}$$

The estimation equation for the determinants of orphans' consumption is

$$e_{oj} = \beta_e w_j + \varphi_e \lambda_j + \varepsilon_{ej} \tag{17}$$

$$h_{oj} = \beta_h w_j + \varphi_h \lambda_j + \varepsilon_{hj} \tag{18}$$

which now yield consistent estimates for β_c.

As Lee (1983) notes, the coefficient on the selection correction term λ_j is the product of two terms, namely σ and ρ, where σ is the standard deviation of the error in the outcome equation. In this case e_{cj} is the error term and ρ is the correlation coefficient between the error in the outcome and the error in the selection equation. In the empirical results, I present the both $\widehat{\varphi}$ and $\widehat{\rho}$. The latter coefficient is typically more precisely estimated, since it is not affected by the estimation error that affects $\widehat{\sigma}$. Since I am bootstrapping the standard errors, the additional modification to estimate the standard errors for $\widehat{\rho}$ are minor.

It may be noted that there will be a placement bias, even when a proxy for the utility weight is available, such as the degree of relatedness between the orphan and the caretaker. Let $\widetilde{\delta}_j = \delta_j + \epsilon_j$,

case of the placement of orphan children in the network, there is not a choice of using another correction method, since the other correction methods require a universal choice set: This means that the individual choice set is a subset of a larger (universal) choice set. In my case, every orphan (excluding siblings) has a different non-overlapping network, so there is no universal choice set. Only the Lee correction method is flexible enough to incorporate this setup, at the cost of restrictive assumptions.

Bourguignon et al. also point out that all methods perform pretty well in correcting for the bias, so that it is always preferable to use a correction term rather than not.

[21] This can be thought of as an inverse Mill's ratio, where the logistic error terms of the placement model are transformed into normally distributed error terms via $\Phi^{-1}(P(1|w_1, w_2))$. The denominator of the Mill's ratio is $\Phi[\Phi^{-1}(P(1|w_1, w_2))] = P(1|w_1, w_2)$.

where δ_j and ϵ_j are the observed and unobserved components of the utility weight respectively. ϵ_j still influences both the placement as well as the outcome and will thus lead to a placement bias.

The standard errors for the selection equation are bootstrapped, using a stratified bootstrap.[22] Observations are sampled with replacement from the following 2 categories, orphans and non-orphans, such that the bootstrap sample has the same number of orphans and non-orphans as the original sample. Then for the chosen orphans, the family network is added for the first stage estimation.[23]

3.5 Benefits of Selection

Once the coefficients on the characteristics of the caretakers are estimated without bias, they can be used to predict outcomes for the orphan in all households within the family network. Define $\widehat{e_{oj}}$ to be the predicted outcome of the orphan in the caretaking household and $\overline{\widehat{e_{ok}}}$ to be the average predicted outcome of the orphan averaged over all network members in the network. To do that, I set $\lambda = 0$ and calculate $\widehat{e_{oj}} = \widehat{\beta_c} w_j$. Using the predicted values allows for a comparison between the actual outcomes of the orphan and certain counterfactual outcomes. Of particular interest is how much selection improves the outcomes of the orphan. To answer this question I assume that without selection, the orphan would be placed in a random household. Then the expected outcome of the orphan would be $\overline{\widehat{e_{ok}}}$. Since the actual outcome is e_{oj}, the difference $e_{oj} - \overline{\widehat{e_{ok}}}$ is therefore the value of selection for the orphan's outcome.

How strong is the selection on observable characteristics and how strong is the selection on unobservable characteristics? To answer this question, it is possible to decompose the effect of selection $e_{oj} - \overline{\widehat{e_{ok}}}$ into two components, the first of which is $\widehat{e_{oj}} - \overline{\widehat{e_{ok}}}$, i.e. the difference between the predicted outcome for the caretaker and the average predicted outcome for the network as a whole. This reflects the selection on observable characteristics of the households. The second component is $e_{oj} - \widehat{e_{oj}}$, the difference between the actual outcome and the predicted outcome in the household of the caretaking household. This represents how much better the chosen household is compared to a random network household with the same observable characteristics. This difference thus reflects selection on unobservable characteristics. To be more precise, it reflects selection on the characteristics of the households that are not controlled

[22]The estimation uses a STATA program to estimate a conditional multinomial logit model with a non-universal choice set. It's structure is based on the program "selmlog" by Fournier and Gurgand, used in Bourguignon, Fournier and Gurgand (2004). This program was modified to account for the non-universal choice set, sampling from the choice set as well as the fact that selection only occurs for the orphans.

[23]Thus, the estimation leaves the family network unchanged for a sampled orphan. The unit of bootstrapping is the orphan.

for in the regression[24].

The standard errors for $\widehat{e_{oj}}$ and $\widehat{\overline{e_{ok}}}$ are constructed through bootstrapping. Then a t-test of equivalence of means is conducted between e_{oj} and $\widehat{e_{oj}}$. The t-statistic is calculated as follows:

$$t = \frac{e_{oj} - \widehat{e_{oj}}}{\sqrt{\frac{1}{N-1}\left(var(e_{oj}) + var(\widehat{e_{oj}}) - 2cov(e_{oj}, \widehat{e_{oj}})\right)}}$$

where $var(\widehat{e_{oj}})$ has two components: the variance of $\widehat{e_{oj}}$ in the population and the variance of $\widehat{e_{oj}}$ over the bootstrap. The latter accounts for the fact that $\widehat{e_{oj}}$ is estimated.

4 Data and Empirical Setting

This paper uses a dataset on the family networks of orphan children that I designed and collected during field work in Northwestern Tanzania. The orphans were sampled from a panel dataset containing information on long-term education and health outcomes. In the following section, I first describe the Kagera Health and Development Survey before turning to the data that I collected on the family networks of orphan children, the Kagera Orphans, Networks and Inheritance Survey.

4.1 Kagera Health and Development Survey

The Kagera Health and Development Survey (KHDS) is a dataset that was specifically designed to analyze the impacts of adult mortality on the welfare of households experiencing these deaths. It was collected in two phases: the KHDS-1 comprised four rounds between 1991 and 1994 and was designed to estimate the shorter term impacts of adult mortality. The KHDS-2 or KHDS 2004 was a resurvey in 2004 that was designed to understand the long run impacts of adult mortality.

During KHDS-1, in 1991, 816 households were sampled and interviewed up to four times, with 6 to 7 month intervals each between the four rounds.[25] The sampling frame of KHDS-1 oversampled households which had a high probability of experiencing an adult death. It involved stratified sampling at two levels: the first involved the agro-economic zones of Kagera (urban, tree crop zone, riverine zone, annual crop zone). Within the zones, the clusters were chosen from the Primary Sampling Units (PSU) from the 1998 Tanzania Census with probability of selection proportional to the adult mortality in that

[24] To be even more exact the component of these characteristics that are orthogonal to the included characteristics.

[25] In addition, some households were added to deal with sample attrition, so that the total number of households was 915.

cluster. The second level of stratification was at the level of the selected clusters: households were split into two groups according to the probability of experiencing an adult death. The high risk group comprised all households in which there was a sick adult member or in which an adult death had occurred very recently, the low risk group all other households. 14 respondents were chosen from this group and 2 respondents were chosen from the low risk group. The sampling scheme was successful in increasing adult mortality by a factor of 2 in the sample during the period covered by KHDS-1, compared with the expected population mortality. Moreover, as noted in section 2.2, it also succeeded in selecting a high proportion of deaths due to HIV/AIDS.[26]

The KHDS-2 survey attempted to resurvey all individuals who had been interviewed during any of the four rounds of KHDS-1,[27] thus turning what was a household level panel dataset into an individual level panel dataset. The new households of these respondents were then interviewed so that, starting from the 915 original households, the KHDS-2 sample consisted of 2700 households. The recontact rate of households was 93% and of individuals 82%.[28] Beegle et al. (2007) note that this compares very favorably with surveys in both developed and developing countries, in particular for a panel covering 13 years. In fact, the long-term panel dimension of the KHDS is an extraordinary feature of a dataset in a developing country context. Moreover, the KHDS-2 also attempted to interview respondents even when they had moved outside the village and outside the region (and there are even some households that were interviewed in the neighboring country of Uganda). This feature not only explains part of the recontact success and is a very unique feature in the African context, but it is important in a context of in which households use changes in the household structure to deal with shocks and take advantage of opportunities (see also Akresh, 2005).

The mortality of household members was documented in a mortality questionnaire administered to all original households. During the 13 years spanned by the KHDS, around 18 percent of household members died. The questionnaire of the KHDS-2 is similar to that of the KHDS-1 thus ensuring the comparability of the datasets across time. For a more detailed description of the data, see Beegle, De

[26]However, the drawbacks are that the sample is not a representative sample and that the sampling weights in this case range from below 2 to 10,000 higher. Resampling with such diverging weights is problematic. Most papers using the KHDS thus include original household effects or individual fixed effects in the analysis.

[27]This includes households added due to attrition.

[28]Of the 895 households interviewed in KHDS-1 in which at least one household member was still alive in 2004, the resurvey contacted at least one member of 832 households, leading to the recontact success of 93%.

Weerdt and Dercon (2006b) and World Bank (2004a).

4.2 Kagera Orphans, Networks and Inheritance Survey

I designed and collected a survey to study the placement of orphans within their family network and its effects on their health and education outcomes. Starting from a sample of orphans found in the KHDS, I interviewed members from the family network of the orphan, defined as their uncles and aunts, grandparents, surviving parents and stepparents as well as older siblings.

I sampled from KHDS-1 members who died between 1991 and 2004 and who had children under 15 at the time of their death. The mortality questionnaire of the KHDS-2 contained information on the year of death of deceased KHDS-1 members. Information on whether the adults had children came from three sources: first, whether the parents had lived with their children in the interviewed households in 1991-1994. The KHDS-1 had a section that listed children of household members who were living elsewhere. The last source of information on children was whether respondents in 2004 mentioned the deceased as their parent.[29]

The sample of deceased parents was then constructed as follows: I considered all parents with at least one child below the age of 15 when the parent died. I kept all parents who left behind double orphans (i.e. both parents died), all households in which there were two separate adult deaths and all cases in which at least one child of the parents died after their death. Of the 215 parents who died during the period from 1991 to 2004, I sampled 141 households. Of these, information could be found on 138 cases.[30] In the end, my sample comprised 67 cases in which both parents had died before the youngest child was 15 years of age, 40 cases in which there were orphans who lost their father but not their mother and 32

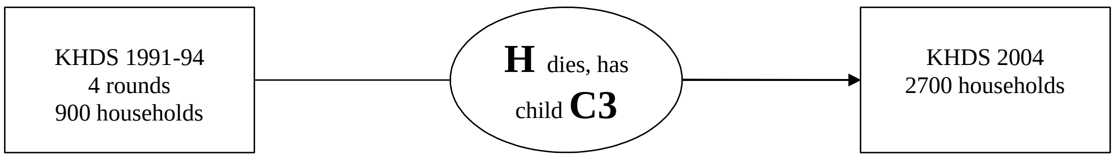
[29]My survey is thus not comprehensive: First and foremost, I do not capture cases in which KHDS respondents did not have children by 1994, then had children between 1994 and 2004, died between 1994 and 2004, and their children were not living with any other household member from KHDS-1 in 2004. Unfortunately, I cannot estimate how frequent that is. Second, the information on children living elsewhere in KHDS-1 was not always very good, as I found out in our survey, especially for polygamous men, some of whose spouses were not known to (or not mentioned by) KHDS-1 respondents. Nonwithstanding the shortcomings of my sample, the advantage of the present strategy was the integration within a 13-year panel. However, the multiple layers of sampling as well as the above limitation of the survey make it difficult to view this sample as truly "representative" of the orphan population in Kagera.

[30]Two cases turned out to be incorrect because of discrepancies in parental information in KHDS-1. The 138 cases come from 122 KHDS-1 households, since some households had multiple KHDS-1 deaths.

cases in which there were orphans who lost their mother but not their father.

Figure 2 illustrates a case in which a father, called "H" for husband, died between 1991 and 2004 with a child below the age of 15. The child is called "C3" indicating that there are two older siblings who might be over the age of 18.

Figure 2: Integration of the KHDS and KONIS Surveys



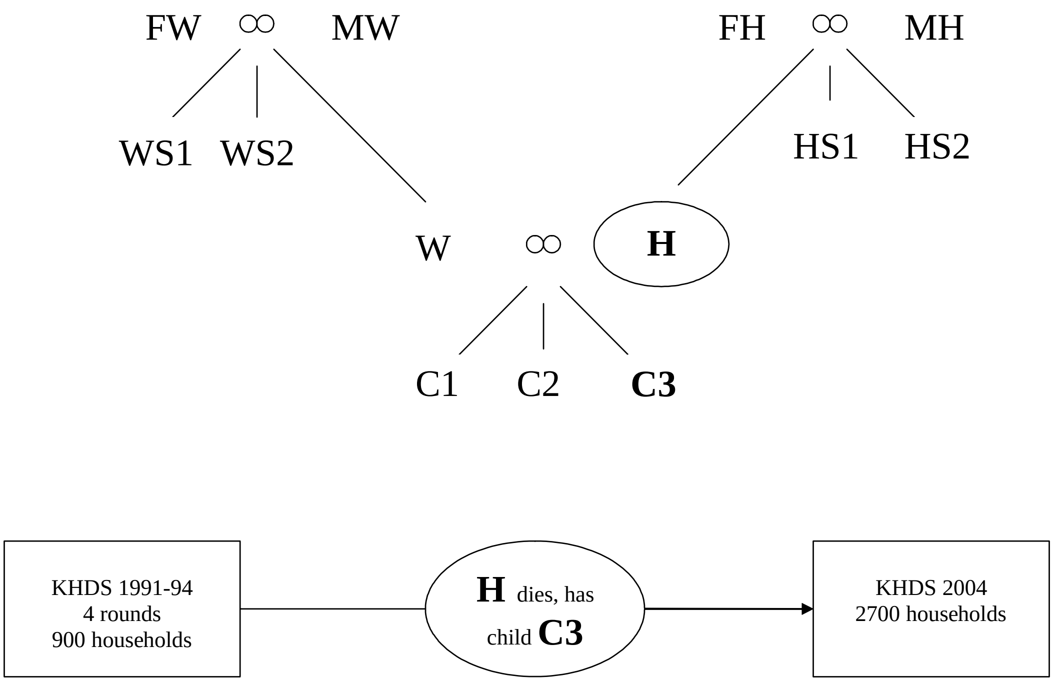
The fieldwork took part during October 2004 through March 2005.[31] During a first visit to the communities in which the KHDS households lived, the field teams constructed a family tree for every sampled case. The family tree consists of the following people: the deceased member and his or her "spouse(s)" who were defined as all persons with whom the deceased had children and all persons to whom the deceased was considered to be "married";[32] the children of the deceased and of his or her spouse; the biological parents of the deceased; the biological parents of the spouse(s) as well as siblings and half-siblings of the deceased and his or her spouse(s). Viewed from the perspective of the orphaned children, the family tree lists their parents, step-parents, aunts, uncles and grandparents and various step-relatives. The members listed on this family tree form the family network or extended family of the orphan. Figure 3 illustrates this process of starting from the same case of an adult death in KHDS (who had a child) and then constructing the family tree. "W" denotes the wife of the deceased and mother of the orphan, "HS" denote siblings of the husband, "WS" siblings of the wife. "FW" and "MW" are the father and mother of the wife respectively and "FH" and "MH" the paternal grandparents.

In the case in which one of the parents of the orphan had multiple partners (either sequentially or concurrently), the children from these relationships are also included in the sample and with them their

[31] A few households were interviewed in June 2005.

[32] The concept of being married is very loosely defined in Tanzania, in particular because living together without at least claiming to be married is frowned upon. A relationship can be made official through three channels: a traditional marriage involving a bride price paid to the bride's relatives, a church or mosque wedding or a state marriage in front of the court. The last one is very uncommon.

Figure 3: Constructing the Family Network of the Orphan



uncles, aunts and grandparents.[33]

The data collected on members of the family network also included the location of the family network members, which the interviewers used to find members of the family network who moved outside of the original KHDS-1 cluster; their relationship to the deceased; age and sex; as well as time of death if deceased. For individuals living away from the village, an individual tracking form was filled out which contained more specific information on how to find this person. Not all information was available during the first contact, so that the family tree was continually updated.[34]

Since some of these networks were very large, respondents were then sampled from the network according to the following rules: the grandparents of the orphans and surviving spouses were sampled, as were all children under 18. In monogamous relationships, up to four siblings of the father and up to four siblings of the mother were sampled. Other children of the parents were also included with the

[33] In the empirical investigation, I drop step-relatives from the family network, since for cultural reasons none of them took care of the orphans. Half-siblings, however, were kept.

[34] In particular, it was not uncommon that branches of the family tree were added as more spouses and children of the deceased became known.

exception of very large networks. In polygamous relationships, spouses whose children were not orphans (because they were 15 years or older at the time of death of the deceased) were not sampled. Among households that were to be included in the sample but that were living outside of the Kagera, I dropped those living outside the two largest towns of Tanzania, Dar es Salaam and Mwanza. This was (partially) justified by the fact that of households who moved outside of Kagera two thirds moved to these major towns. Compared to households interviewed in Kagera, the rate of completed interviews in these urban areas was much lower.

The families that were sampled from the family network were administered a household questionnaire. The household questionnaire elicited individual information on family background of all household members, health status (morbidity and anthropometric measurements), education (highest class attended and current schooling information) and employment. At the household level, the collected information covered information on land, living quarters, assets, business and livestock as well as assistance received in the last 10 years. These parts were modeled on the questionnaire of the KHDS-2. In addition, a section asked about interaction with (living) members of the family network to determine the quality of the family network. A last section asked about relations with the deceased, such as frequency of communication, of frequent loans and gifts, contributions to the wedding, helping with illness and how they would characterize their relations with the deceased. These are indicators to determine the relations with the deceased which also include mutual obligations in times of crisis. Differences between the KONIS and KHDS survey instruments are listed in the appendix.

A number of additional questionnaires were administered only to select members of the family network: the mortality questionnaire asked about the period of sickness and cause of death of the deceased spouse(s) and the child mortality questionnaire did the same for the children of deceased parents who died. The orphan living arrangements questionnaire asked about caretaking for orphans after the death of the first parent and where applicable the second parent. This part yields information on who took care of the orphans for how long and what happened to the orphans after that. The inheritance questionnaire lists the assets of the deceased and identifies who inherited these assets.

In addition, there was some information on inheritance customs in the communities. Thus for the KHDS communities, I administered a community questionnaire. In addition, to assess how inheritances would normally be distributed when the father died, I constructed vignettes, where the respondent was asked to assume the role of a clan member of the clan of the deceased (since male clan members settle the inheritance). Confronted with fictitous cases in which a certain number of assets and a certain number of children with varying characteristics, of children the respondent was asked to distribute the inheritance.

In addition, I constructed an NGO questionnaire, which was administered to major NGOs in Kagera who supported orphans. The questionnaire comprised questions on geographical coverage of orphan support over the past 15 years as well as type and intensity of support offered.

In total, the field teams collected slightly over 1100 questionnaires for 139 cases of adult deaths. Since some of the networks overlap (due to the fact that in some KHDS-1 households multiple parents died), this means that on average 9 households were interviewed for each of the 122 networks sampled.

A last issue to note is that the composition of the actual sample differs somewhat from the composition indicated in the description the sampling procedure: In the context in which respondents are (or were) involved in concurrent polygamous relationships or sequential monogamous relationships, respondents frequently had children from more than one spouse. Thus, although the sampling procedure led me to sample 67 cases in which there were double orphans according to KHDS-2 information, in my actual sample there were 79 cases, since the father (or mother) of a single parent orphan from KHDS had a child with another spouse who also died. In addition to these 79 networks, there were 21 networks in which there were only maternal orphans and 37 in which there were only paternal orphans.

4.3 Double Orphan Sample

The following table (table 4) describes for what reasons the sample of orphans is reduced from 152 children of parents in the KHDS-1 to 74 orphans for this analysis. For 37 cases, the caretakers were not interviewed or died. An additional 20 children could not be recontacted in 2004, one of the reasons being the death of the children. For two children there was no education information. Lastly, 19 were not taken care of by members of the extended family network.

The summary statistics for the variables used to construct the selection correction term are presented in table 5. Paternal grandparents are much more likely caretakers than uncles and aunts. Caretakers are somewhat richer, although there are significant differences only for landholdings not for owning business assets.

The definition of these variables can be found in the appendix.

Table 4: Sample of Double Orphans (Estimation of Determinants of Orphans' Education)

	Number	Percent
Children of KHDS-1 parents who died	152	100
Caretaker not interviewed (or died)	37	24.3
Children not interviewed in 2004 or died	20	13.2
No education information	2	1.3
Noone took care	19	12.5
Orphans in the analysis	74	48.7

Notes: Table shows how the original sample size of 152 orphans reduced to an estimation sample of 74, due to different reasons.
Source: Author's survey

Table 5: Descriptive Statistics for Variables used in the Construction of the Selection Correction Term

Mean levels of variable	Non-caretakers	Caretakers	SE of Diff	
Paternal Grandfather is caregiver	0.02	0.16	0.02	***
Paternal Grandmother is caregiver	0.02	0.12	0.02	***
Paternal Uncle or Aunt is caregiver	0.29	0.20	0.06	
Maternal Grandfather is caregiver	0.05	0.03	0.03	
Maternal Grandmother is caregiver	0.03	0.07	0.02	
Maternal Uncle or Aunt is caregiver	0.34	0.12	0.06	***
Sibling is caregiver	0.18	0.28	0.05	**
Members HH owns Business Assets	0.25	0.32	0.05	
Landholdings of Member	13.57	14.18	0.18	***
Member does not own land or no information on land available	0.17	0.16	0.05	
Number of Observations (b)	469	74		

Notes: Table displays summary statistics for non-caretakers (Column 1) and network members who took care of orphans (Column 2). Column 3 reports the standard error of the difference. * significant at 10%; ** significant at 5%; *** significant at 1%
a in 100000 Tanzanian Shilling, approximately 100 USD
b Summary statistics for network members with non-missing information

5 Determinants of Orphan Placement

5.1 Regression Results

An indicator variable for whether a network member was chosen as a caretaker is regressed on the characteristics of the network member as well as interactions of the network member with the orphan. Using the assumptions on the error term of a conditional logit model, I estimate the following equation;

$$y_{jn} = RD_{jn}\beta_1 + DM_{jn}\beta_2 + W_{jn}\beta_3 + OCC_{jn}\beta_4 + \\ + 1 * csp + \alpha_n + \varepsilon_{jn} \tag{19}$$

where

- $y_{jn} \epsilon \{0, 1\}$: Dummy whether network member j in network n is chosen
- RD : Dummies to capture the biological relationship to the orphan
- DM : Demographic characteristics of the network member
- W : Wealth variables
- OCC : Occupation of the network member
- csp : probability of observing this choice set, if this were the chosen caretaker
- α_n : Network specific fixed effect
- ε_{jn} : Logit error

The estimated coefficients for the first stage are presented in table 6 There are 617 observations, each representing a network member and therefore a potential placement for the orphan. There are 74 orphans.[35] I find that paternal grandparents and the maternal grandmothers have a significantly higher probability of caretaking than paternal uncles and aunts. Maternal uncles and aunts, on the other hand,

[35]The first stage displayed here is for the sample used to estimate the determinants of the years of completed education. The first stage will be slightly different for different outcomes, since the number of observations is different.

are significantly less likely to be caretakers.[36] Households who own business assets are more likely to become caretakers of the orphans, as are households who own more land.

6 Estimating the Impact of Caretaker Characteristics on Orphan Welfare

As previously pointed out, the main difficulty in estimating the impact of orphanhood on orphans in cross-sectional data is that the parents of orphans who die might be different along observable and unobservable dimensions. In this section I present two estimation strategies to deal with this issue. A first estimation strategy relies on controlling for observable characteristics of the households the parent(s) were living in before they died.[37] Controlling for these characteristics X_{i0} and age yields a profile of how education and health would have evolved for children had the parents not died.[38] Including an orphan dummy then identifies the average effect of orphanhood on double orphan's health and education (assuming the families were not different before the parents died)[39][40].

$$y_{i1} = \alpha + \delta_1 X_{i0} + orphan * \alpha_o + age_{i0}\delta_2 + age_{i0}^2\delta_3 + \varepsilon_{i0}$$

The second estimation strategy includes an orphan specific fixed effect, instead of pre-orphanhood

[36]The omitted category is paternal uncles and aunts, the caretakers according to traditional norms; the member's sex is female; she does not own business assets and does not own land, her occupation is being a farmer.

[37]There is a way of testing whether this assumption is reasonable, that follows Case and Ardington (2006). They show that families with orphans and without orphans are not different along observable dimensions *before* the parents died. By making the additional assumption (which seems reasonable given the lack of difference for observable characteristics) that the two groups do not differ according to unobservable dimensions.

In our case it would be possible to regress the 1991/1994 outcome of interest on the observable characteristics of the 1991/1994 households and include an orphan dummy for whether the child subsequently became an orphan. If that variable is not significant, then this strategy is reasonable.

[38]Note that this profile includes short term fostering which exists in East Africa, though is not as prevalent as in West Africa. For the effect of fostering on children, see Akresh (2006).

[39]For the results for single parent orphans, see Beegle et al. (2006a)

[40]Ideally we would add two elements: The time at which the parent died and the duration since the parent died. There could be effects that become larger with longer lasting orphanhood, and the effects might be different according to when the child became an orphan. A third element that would be very interesting to include would be the duration of illness of the parent (that is hard to observe accurately, although the questionnaire does ask about it). These parameters would all be identified, since the duration of time during which parents were still living (between KHDS-1 and their death) is different for different orphans.

Table 6: Results for the Construction of the Selection Term

Dependent Variable: Network member is caretaker		
Paternal Grandfather	3.94	***
	(0.78)	
Paternal Grandmother	4.53	***
	(0.87)	
Maternal Grandfather	0.52	
	(1.35)	
Maternal Grandmother	2.58	***
	(0.86)	
Maternal Uncle or Aunt	-1.33	
	(0.79)	
Sibling	0.56	
	(1.06)	
Members HH owns Business Assets	2.56	***
	(0.73)	
Logarithm of Land owned by Member	0.56	**
	(0.15)	
Member does not own Land	3.78	**
	(2.29)	
Probability of Observing the Choice Set	-	
	-	
Pseudo R2	0.51	
N	617	
N (Orphans)	74	

a Estimates from a conditional logit model estimating the determinants of whether a network member was chosen as caretaker, correcting for sampling from the network of the orphan
b Clustered Standard errors in parenthesis, *** significant at 1% level,;** at 5% and * at 10%.
c Excluded category for relationship variables is paternal aunts and uncles

household characteristics. This strategy controls for both observable as well as unobservable characteristics.

Outcome in t=0 (1991):

$$y_{i0} = \alpha_i + age_{i0}\delta_2 + age_{i1}^2\delta_3 + \varepsilon_{i0}$$

Education in t=1 (2004); $orphan_{i1} = 1$

$$y_{i1} = \alpha_i + orphan * \alpha_o + age_{i1}\delta_2 + age_{i1}^2\delta_3 + \varepsilon_{i1}$$

First-difference:

$$\Delta y_{i1} = orphan * \alpha_o + \alpha' + age_{i1}\delta' + \varepsilon_{i1}$$

Note that the first difference of a quadratic term in age is a linear term in age (plus an intercept). The intercept here thus captures the trend in education of this group. In the actual estimation, I include a quadratic in age (equivalent to a cubic in the OLS regression). I also include a male dummy, since the trend might well be different for male and female orphans. The variable "time between KHDS-1 &2 interviews" now captures the fact that if the period between the two interviews is longer, we expect a larger difference. In the OLS regression, the term was included to account among other things for price changes in expenditures between the different rounds of KHDS-1. The controls X_{i0} include the sex, age and education of the head of the 1991/1994 household; log consumption; and whether there is a good floor; and whether the father and the mother of the orphan are present in the 1991/1994 household. For education, I also include an orphan dummy, an orphan dummy sex interaction, the sex of the child, a polynomial in age and the time elapsed between the 1991/1994 and 2004 interviews. For health, I find that the Z score tables match girls and boys differently well for different age groups in Tanzania, so I include the same variables as in the education regression plus interactions with sex.

In the case of education, however, since not all children in Tanzania start school at the same and can catch up to regular levels of schooling, both strategies are less than ideal. This is also true for height-for-age where the adolescent growth spurt might be postponed or drawn out due to malnutrition, without the final height being affected as much. Using final height-for-age at age 25 would be an option if the panel had a longer duration, but my sample size of over-25 year old orphans is too small. Nevertheless, the delayed schooling might be less effective in providing the child with less human capital and the delayed growth spurt still an indicator of poorer subsequent health, though this is an area of future research. I use these two measures for availability and also consider log expenditures on education and BMI-for-age Z-scores.[41]

6.1 Disaggregating the Effects of Orphanhood: Importance of Caretaker Characteristics

With these caveats in mind, I now turn to disaggregating the effects of orphanhood by the characteristics of the caretaker. For the estimation strategy that conditions on 1991/1994 household characteristics, the first equation correlates education in 1991/1994 with observable 1991/1994 household characteristics, denoted by X_{i0}, for non-orphans. The second equation correlates education outcomes in 2004 with observable 1991/1994 household characteristics.

Outcome in t=0 (1991)

$$y_{i0} = \alpha + \delta_1 X_{i0} + age_{i0}\delta_2 + age_{i0}^2\delta_3 + \varepsilon_{i0}$$

Outcome in t=1 (2004); $orphan_{i1} = 0$

$$y_{i1k} = \alpha + \delta_1 X_{i0} + age_{i1}\delta_2 + age_{i1}^2\delta_3 + \varepsilon_{i1k}$$

The following equation just adds an orphan dummy to capture the average effect on orphans given the assumption that conditioning on observable characteristics is sufficient. Equation 6.1 then interacts the orphan dummy with characteristics of the caretaking household (and an intercept)[42][43]. However it

[41] Both of these indicators of orphan welfare have their own problems. Log expenditures on education is the *current year's* expenditure on education, not orphan's total expenditure over the life cycle. So in addition to considering only one year, children who have completed schooling are not taken into account, which is problematic with delayed schooling and catchup.

BMI-for-age is a more short-term measure of nutritional intake. On the one hand, it is a comprehensive measure of welfare, since it also includes the effects of reduced educational attainment and health effects on nutritional intake via their effect on the income of the orphan. On the other hand, because the height is in the denominator when calculating BMI, the effect on BMI will be an underestimate of the true effects.

[42] Ideally, I would have comprehensive information on the network members at the time at which the parents of the orphans died. However, my household survey includes only information on the current household characteristics. Thus, I include variables that are less likely to be endogenous to the orphan's presence. For landholdings I subtract the orphans' contribution to the household land and land that the household did not own at the time of death of the parent. This lack of information on the original situation of the household is definitely one of the reasons of selection on "unobservables".

[43] I can include the characteristics of the caretaking households for the non-orphans as well. In this case the intercept would

does not account for the fact that the orphan is not found in a random household but was placed in that household. This is taken into account by equation 6.1, where λ_{i1j} denotes the selection correction term as defined before.

Outcome in t=1 (2004); $orphan_{i1} = 1$; average effect

$$y_{i1} = \alpha + \delta_1 X_{i0} + \alpha_k orphan + age_{i1}\delta_2 + age_{i1}^2\delta_3 + \varepsilon_{i1j}$$

Outcome in t=1 (2004); $orphan_{i1} = 1$; interactions with caretaker characteristics, no selection correction

$$y_{i1} = \alpha + \delta_1 X_{i0} + orphan * (\alpha'_k + X_{i1j}\beta) + age_{i1}\delta_2 + age_{i1}^2\delta_3 + \varepsilon_{i1j}$$

Outcome in t=1 (2004); $orphan_{i1} = 1$; interactions with caretaker characteristics, and selection correction

$$y_{i1} = \alpha + \delta_1 X_{i0} + orphan * (\alpha''_k + X_{i1j}\beta + \gamma\lambda_{i1j}) + age_{i1}\delta_2 + age_{i1}^2\delta_3 + \varepsilon_{i1j}$$

For the first difference specification, the equivalent equations follow[44]

Outcome in t=0 (1991):

$$\Delta y_{i0} = \alpha + age_{i0}\delta_2 + \varepsilon_{i0}$$

capture the effect on orphans that is not linked to the observable characteristics, the interactions would capture the effect on orphans of having moved to a household with different household characteristics and the selection term the amount of moderation of the effect on orphans due to the selection of the caretaker from his family network

This is future work. One caveat has to be noted here which is that the characteristics of the caretaking household for the non-orphan could be endogenous as well when there is temporary fostering. In addition, while I have information on the caretakers for orphans, I do not have this information for non-orphans who moved out of their parents'/caretakers' homes.

[44] I use a first difference specification, though this is equal to the fixed-effects specification with two observation in time, see Greene.

Outcome in t=1 (2004); $orphan_{i1} = 0$

$$\Delta y_{i1k} = \alpha + age_{i1}\delta_2 + \varepsilon_{i1k}$$

Outcome in t=1 (2004); $orphan_{i1} = 1$; average effect

$$\Delta y_{i1} = \alpha + \alpha_k orphan + age_{i1}\delta_2 + \varepsilon_{i1j}$$

Outcome in t=1 (2004); $orphan_{i1} = 1$; interactions with caretaker characteristics, no selection correction

$$\Delta y_{i1} = \alpha + orphan * (\alpha'_k + X_{i1j}\beta) + age_{i1}\delta_2 + \varepsilon_{i1j}$$

Outcome in t=1 (2004); $orphan_{i1} = 1$; interactions with caretaker characteristics, and selection correction

$$\Delta y_{i1} = \alpha + orphan * (\alpha''_k + X_{i1j}\beta + \gamma\lambda_{i1j}) + age_{i1}\delta_2 + \varepsilon_{i1j}$$

6.2 Empirical Results

The empirical results for the analysis are displayed in Tables 7 through 15. The discussion begins with the impact of orphanhood and of selection within the family network on children's years of completed education. Then I turn to effects on the logarithm of expenditures on the children's schooling, on Body-Mass-Index Z-scores and Height-for-Age Z-scores in the following Tables. Readers interested only in a summary should turn to section 6.3 as well as tables 8 and 15 which summarize the effects of orphanhood and of selection on these four outcomes. The empirical analysis is done first controlling for observable characteristics of the households the orphans were living in during the first KHDS survey. Then results are presented where I regress the changes in the outcome variable between the first KHDS survey and the KHDS-2/KONIS surveys on explanatory variables. In the Tables 6.3 and 15, the top panel presents results for the four outcomes from the OLS regression, whereas the second panel reports results from the regression of changes on covariates.

In Table 7, the first column shows the effect of orphanhood for male and female orphans on years of completed education in KHDS-2/KONIS surveys, controlling for household characteristics during 1991/1994 and sex and an age polynomial of the children. (The KHDS-1 household controls include the age, sex and education of the household head, whether the household had a good floor and log per capita household consumption.) The effect on female orphans of about 0.7 years of education less is significant at the 10% level. For male children there is no effect on education. Thus only female children seem to be negatively affected in their schooling attainment.

The second column then interacts the orphan dummy with characteristics of the caretakers.[45] These are the coefficients that do not account for the selection of the orphan into that family. The coefficients are individually and jointly insignificant. Moreover the R-squared for the regression does not seem to change, but this is because among the 2000 observations in the regression, there are only 74 orphans.

The third column then adds the Lee correction term, and displays the results for the coefficient on the Lee correction term and the correlation coefficient ρ. The coefficient on the Lee correction term is a test for whether the difference in coefficients on the other variables is significant. This is not the case, and none of the individual coefficients is significant. The patterns are interesting, though: whereas before, the impact of paternal grandparents on education seemed to be negative (yet very imprecisely measured) the impact now seems positive (yet again imprecisely measured). Unfortunately, the small dataset prevents us from reaching any further conclusions on how individual characteristics of caretakers affect outcomes.

The significance of the coefficient on the correction term, however, is evidence that family networks select caretaking families from the family network in order to provide the orphan with higher levels of education. In particular, family networks also include unobserved characteristics in their decision.[46]

To understand how strong selection on observable and “unobservable” characteristics is, I predict the expected outcome for orphans in the non-caretaking families (See table 6.3). I assume that if there were no selection, the orphan would go to a random family within the family network.[47] Averaging the predicted values for orphans’ education over all family members yields the average education of the orphans had they been randomly allocated. On average, orphans would receive 3.6 years of education if they were assigned to a random member within the family network (see the overview Table 6.3). Since in reality, orphans receive 4.6 years of education, the value of selection is thus 1.0 years. This is a significant

[45] I do not interact these variables separately for male and female children, since I do not have enough observations.

[46] To be more precise, they include characteristics that I did not include into the regression equation either because they are unobserved or because of sample size issues. Yet, the correlation coefficient only shows whether there is selection on "unobservable" characteristics.

[47] An alternative that I will also consider in future versions is to allocate the orphan to the traditional caretaker and try to understand by how much the traditional allocation would have been better or worse.

Table 7: Impact of Orphanhood on Years of Education

Dependent Variable: Years of Completed Education in 2004/2005	I	II	III
Orphan Dummy	-0.72 *	-4.32	-6.72
	(0.42)	(2.83)	(4.68)
Orphan Dummy *Male	0.95 *	0.91 *	0.95
	(0.57)	(0.49)	(0.61)
Male	0.21 **	0.21 **	0.21 **
	(0.11)	(0.11)	(0.10)
Time between KHDS-1 & 2 interviews (1000 days)	0.00 ***	0.00 **	0.00 ***
	(0.00)	(0.00)	(0.00)
Born after KHDS-1	4.37 ***	4.58 ***	4.49 ***
	(1.64)	(1.69)	(1.66)
Age of Child in resurvey (2004)	1.01 ***	1.00 ***	1.00 ***
	(0.11)	(0.12)	(0.11)
Age of Child squared	-0.02 ***	-0.02 ***	-0.02 ***
	(0.00)	(0.00)	(0.00)
Child had lost one parent in KHDS-1	-0.25	-0.26	-0.25 *
	(0.18)	(0.18)	(0.14)
Age of KHDS1-hh-head	0.02 ***	0.02 ***	0.02 ***
	(0.01)	(0.01)	(0.00)
Sex of KHDS1-hh-head	-0.70 ***	-0.72 ***	-0.72 ***
	(0.20)	(0.20)	(0.15)
Years of Educ of KHDS1-hh-head	0.24 ***	0.24 ***	0.24 ***
	(0.03)	(0.03)	(0.02)
Log consumption in KHDS1	0.56 ***	0.55 ***	0.55 ***
	(0.13)	(0.13)	(0.09)
Dwelling in KHDS1 has good floor	0.48 **	0.49 **	0.48 ***
	(0.22)	(0.22)	(0.16)
Double Orphan x			
Paternal Grandfather is caregiver		0.52	1.07
		(0.75)	(1.15)
Paternal Grandmother is caregiver		-0.57	0.30
		(0.74)	(1.52)
Maternal Grandfather is caregiver		0.60	0.35
		(1.04)	(1.30)
Maternal Grandmother is caregiver		2.46	3.02
		(1.88)	(2.72)
Maternal Uncle or Aunt is caregiver		0.88	0.71
		(0.98)	(1.30)
Sibling is caregiver		0.27	0.39
		(0.88)	(1.13)
Members HH owns Business Assets		1.21 *	1.33
		(0.73)	(1.00)
Landholdings of Member		0.20	0.30
		(0.18)	(0.29)
Member does not own land		2.82	3.52
		(2.92)	(4.10)
Lee selection correction term			0.53
			(0.54)
Rho - Correlation betw. errors in selection and outcome eq.			0.19 *
			(0.10)
Constant	-18.03 ***	-17.76 ***	-17.78 ***
	(1.99)	(2.02)	(1.69)
Observations	2132	2132	2132
Number Orphans	74	74	74
R-squared	0.31	0.31	

Notes: Clustered Standard Errors in parenthesis, clustered at the original KHDS-1 household level for columns I and II. Bootstrapped Standard Errors in Column 3 (Description in Text). * denotes significance at the 10% level, ** at the 5% level, *** at the 1% level. Columns I and II reports coefficients from an OLS regression of childrens' years of completed education in KHDS-2 on individual characteristics of the orphan, KHDS-1 household controls (Columns I & II) and Interactions of the orphan dummy with caretaker characteristics (Column II). Column III also includes a selection correction term that controls for the placement of the orphan. Note that in Columns II and III, the coefficient on orphanhood is for the left out categorie: a paternal uncle and aunt, who does not own business assets .

Table 8: Overview of the Effects of Selection on Orphans Health and Education

Panel I: OLS Regression (Controlling for 1991/1994 Household Characteristics)	Years of Education	Log Schooling Expenditures	BMI-for-age Z-scores	Height-for-age Z-scores
A: Actual Outcomes	4.6	2.5	-1.1	-1.7
B: Predicted, Caretakers	3.9	1.0	-1.2	-1.3
C: Predicted Mean, Any Netw. Mem.	3.6	0.4	-1.2	-1.1
D: (Actual Outcomes, Non-Orphans)	5.1	2.5	-0.7	-1.3
Difference A,B	0.7 **	1.4 ***	0.1	-0.3 **
Difference B,C	0.3 *	0.6 *	0.0	-0.2 **
Difference A,C	**1.0 *** **	**2.0 *** **	**0.1**	**-0.6 *** **

Panel II: First Difference Regression (Change between KHDS-1 and KHDS-2/KONIS surveys)	Years of Education	BMI-for-age Z-scores	Height-for-age Z-scores
A: Actual Outcomes	4.4	-0.8	-0.2
B: Predicted, Caretakers	3.7	-0.5	0.4
C: Predicted Mean, Any Netw. Mem.	3.5	-0.5	0.6
D: (Actual Outcomes, Non-Orphans)	4.0	0.2	0.4
Difference A,B	0.7 **	-0.3 *	-0.6 **
Difference B,C	0.2	-0.0	-0.2
Difference A,C	**0.9 ** **	**-0.3 * **	**-0.8 *** **

Notes: Standard Errors account for the fact that the predicted values for Caretakers and Non-Caretakers are based on estimated coefficients (250 bootstrap replications)
Estimates in Panel I control for 1991/1994 Household Characteristics. Panel II estimates are individual fixed effects specifications.
* denotes significance at the 10% level, ** at the 5% level, *** at the 1% level.

difference compared to a random family. To put this into perspective, Beegle et al. (2006a) estimate that the effect of children of losing their mother is about 0.9 years of education (in the group of respondents aged 19-28 in the resurvey). In my sample of double orphans, only female children are affected and their education is reduced by 0.7 years, whereas there is no effect on male children. This would imply that the placement in the family reduced the effect of orphanhood by between 50% (taking the results of Beegle et al. (2006a)) and 100% (for male children) compared with random placement.

I can further split this effect of selection into a component that is due to variables that I am including in the regression and "unobserved" (or not included) variables. The predicted years of education for caretakers is 3.9 years, so that the difference between the actual outcomes (namely 4.6 years) and the predicted years, which is 0.7 years, is due to selection on unobserved characteristics. The remainder, namely 0.3 years is due to selection on observable characteristics.

Family networks are thus very important and apparently quite successful at placing orphans within the family network, at least with regards to educational attainment. Moreover, they include both variables that are observed and variables that are unobserved to the econometrician in their decision.

Table 9 displays the results for the effect of orphanhood on years of education regressing the change in years of education on individual controls, then also caretaker characteristics; and finally these variables and a selection term. The direct effect of orphanhood is approximately the same as for the previous regression, though not precisely measured. Again the effect on male orphans, were it precisely measured would be extremely small. Otherwise, the results are very similar to the OLS regressions. The joint differences between the second and third columns 2 and 3 is again insignificant, and, as before, the individual coefficients are insignificant preventing us from providing any interpretation of the individual coefficients. The estimates of the value of selection are in line with the previous estimates. Selection increases orphans' years of completed education by 0.9 years.

The results in Table 10 are for the expenditures on children's education in 2004/2005. In this case there is no second table containing results of changes, since changes are often linked to a child starting school or stopping school. I show these results as supportive evidence for the results on years of education.

There is no direct effect of orphanhood on the logarithm of schooling expenditures, neither for female nor male orphans. The selection correction term is marginally insignificant, however, the correlation coefficient ρ is significant, and, when calculating the impact of selection, selection has a strong impact on the logarithm of schooling expenditures. Selection increases the logarithm of schooling expenditures by 2. This means that selection increases the value of schooling expenditures by a factor of 7.5 (e.g. from 2000 TSH to 15000 TSH)[48]. Since the actual expenditures on orphans and non-orphans seem to be the same, the placement of the orphan seems to place orphans into families in which as not much less is spent on their education than on non-orphans.

Tables 11 through 14 present results for health outcomes. There are significant negative impacts of orphanhood on female orphans' BMI-for-age Z-scores, but not on male orphans' outcomes. Table 11 shows that orphanhood reduces female orphans' BMI-for-age Z-scores by 0.56 standard deviations.[49]

I then turn to the impact of selection on health outcomes. When analyzing BMI-for-age Z-scores in Table 11, none of the caretaker characteristics is significant and there seems to be no benefit or detrimental impact of selection. Table 12 regresses the changes in BMI-for-age Z-scores on the same sets

[48]If the logarithm of a variable increases by 2, then the variable increases by about 7.38 which is equal to $exp(2)$.

[49]Note that the impact of being a boy is not 4.74 standard deviations: the age profile is allowed to differ from that of the WHO reference population separately for boys and for girls. The male dummy is thus an intercept that cannot be interpreted.

Table 9: Impact of Orphanhood on Years of Education (First Difference)

Dependent Variable: Change in Years of Education between KHDS-1 and 2004/2005	I	II	III
Orphan Dummy	-0.46	-1.60	-3.91
	(0.47)	(3.37)	(5.32)
Orphan Dummy *Male	0.78	0.85 *	0.90
	(0.63)	(0.49)	(0.63)
Male	0.32	0.32 ***	0.32 ***
	(0.11)	(0.11)	(0.11)
Time between KHDS-1 & 2 interviews (1000 days)	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Born after KHDS-1	2.09	2.19	2.11
	(1.68)	(1.72)	(1.72)
Age of Child in resurvey (2004)	1.75 ***	1.75 ***	1.75 ***
	(0.13)	(0.13)	(0.12)
Age of Child squared	-0.05 ***	-0.05 ***	-0.05 ***
	(0.00)	(0.00)	(0.00)
Child had lost one parent in KHDS-1	0.10	0.10	0.11
	(0.18)	(0.18)	(0.14)
Double Orphan x			
Paternal Grandfather is caregiver		0.72	1.25
		(0.94)	(1.37)
Paternal Grandmother is caregiver		-1.76 **	-0.94
		(0.89)	(1.71)
Maternal Grandfather is caregiver		0.46	0.23
		(0.99)	(1.25)
Maternal Grandmother is caregiver		2.74	3.28
		(1.67)	(2.61)
Maternal Uncle or Aunt is caregiver		0.91	0.75
		(1.03)	(1.34)
Sibling is caregiver		-0.38	-0.27
		(0.93)	(1.20)
Members HH owns Business Assets		1.70 **	1.82 *
		(0.77)	(1.03)
Landholdings of Member		0.03	0.13
		(0.21)	(0.32)
Member does not own land		0.20	0.88
		(3.48)	(4.49)
Lee selection correction term			0.50
			(0.58)
Rho - Correlation betw. errors in selection and outcome eq.			0.19 *
			(0.10)
Constant	-13.33 ***	-13.21 ***	-13.21 ***
	(1.46)	(1.46)	(1.32)
Observations	2132	2132	2132
Number of Orphans	74	74	74
R-squared	0.20	0.20	

Notes: Clustered Standard Errors in parenthesis, clustered at the original KHDS-1 household level for columns I and II. Bootstrapped Standard Errors in Column 3 (Description in Text). * denotes significance at the 10% level, ** at the 5% level, *** at the 1% level. Columns I and II reports coefficients from a regression of the change in childrens' years of completed education from KHDS-1 to KHDS-2 on individual characteristics (Columns I & II) and interactions of the orphan dummy with caretaker characteristics (Column II). Column III also includes a selection correction term that controls for the placement of the orphan.
Note that in Columns II and III, the coefficient on orphanhood is for the left out categorie: a paternal uncle and aunt, who does not own business assets .

Table 10: Impact of Orphanhood on Log Expenditures on Schooling

Dependent Variable: Log Schooling Expenditures in 2004/2005	I	II	III
Orphan Dummy	-0.20	0.93	-4.26
	(0.19)	(1.76)	(4.49)
Orphan Dummy *Male	0.50 *	0.70 **	0.65
	(0.27)	(0.28)	(0.44)
Male	0.05	0.05	0.05
	(0.08)	(0.08)	(0.08)
Time between KHDS-1 & 2 interviews	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Born after KHDS-1	-0.12	-0.21	-0.14
	(1.06)	(1.06)	(1.15)
Age of Child in resurvey (2004)	-0.19	-0.17	-0.17
	(0.15)	(0.15)	(0.15)
Age of Child squared	0.01 **	0.01 **	0.01 **
	(0.00)	(0.00)	(0.00)
Child had lost one parent in KHDS-1	-0.15	-0.17	-0.16
	(0.15)	(0.15)	(0.13)
Age of KHDS1-hh-head	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Sex of KHDS1-hh-head	-0.17	-0.17	-0.19
	(0.14)	(0.14)	(0.12)
Years of Educ of KHDS1-hh-head	0.09 ***	0.08 ***	0.08 ***
	(0.02)	(0.02)	(0.01)
Log consumption in KHDS1	0.42 ***	0.42 ***	0.42 ***
	(0.09)	(0.09)	(0.07)
Dwelling in KHDS1 has good floor	0.28	0.27	0.27 **
	(0.19)	(0.19)	(0.12)
Double Orphan x			
Paternal Grandfather is caregiver		0.67	1.80
		(0.59)	(1.20)
Paternal Grandmother is caregiver		-0.66	1.00
		(0.53)	(1.27)
Maternal Grandfather is caregiver		0.57	0.99
		(0.73)	(1.17)
Maternal Grandmother is caregiver		0.59	2.01
		(0.79)	(1.34)
Maternal Uncle or Aunt is caregiver		-0.03	-0.32
		(0.75)	(1.11)
Sibling is caregiver		-0.41	0.13
		(0.61)	(0.98)
Members HH owns Business Assets		0.39	0.42
		(0.28)	(0.70)
Landholdings of Member		-0.10	0.14
		(0.11)	(0.26)
Member does not own land		-1.20	0.70
		(1.55)	(3.29)
Lee selection correction term			0.97
			(0.66)
Rho - Correlation betw. errors in selection and outcome eq.			0.38 ***
			(0.11)
Constant	-3.46 **	-3.46 **	-3.46 **
	(1.50)	(1.52)	(1.38)
Observations	754	754	754
Number of Orphans	38	38	38
R-squared	0.36	0.36	

Notes: Clustered Standard Errors in parenthesis, clustered at the original KHDS-1 household level for columns I and II. Bootstrapped Standard Errors in Column 3 (Description in Text). * denotes significance at the 10% level, ** at the 5% level, *** at the 1% level. Columns I and II report coefficients from an OLS regression of log schooling expenditures (for children with non-zero values) in KHDS-2 on KHDS-1 household controls (Columns I & II) and interactions of the orphan dummy with caretaker characteristics (Column II). Column III also includes a selection correction term that controls for the placement of the orphan.
Note that in Columns II and III, the coefficient on orphanhood is for the left out categorie: a paternal uncle and aunt, who does not own business assets .

Table 11: Impact of Orphanhood on BMI-for-age Z-scores

Dependent Variable: BMI-for-age Z-score in 2004/2005	I	II	III
Orphan Dummy	-0.56 ***	-1.42	-1.92
	(0.19)	(1.54)	(2.40)
Orphan Dummy *Male	0.42	0.30	0.33
	(0.27)	(0.24)	(0.27)
Male	3.40 ***	3.42 ***	3.42 ***
	(0.62)	(0.62)	(0.59)
Time between KHDS-1 & 2 interviews	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Born after KHDS-1	0.98	0.96	0.95
	(0.61)	(0.59)	(0.61)
Age of Child in resurvey (2004)	0.35 ***	0.35 ***	0.35 ***
	(0.05)	(0.05)	(0.05)
Age of Child squared	-0.01 ***	-0.01 ***	-0.01 ***
	(0.00)	(0.00)	(0.00)
Age of Child in resurvey (2004) *Male	-0.41 ***	-0.41 ***	-0.41 ***
	(0.07)	(0.07)	(0.06)
Age of Child squared *Male	0.01 ***	0.01 ***	0.01 ***
	(0.00)	(0.00)	(0.00)
Child had lost one parent in KHDS-1	0.02	0.02	0.02
	(0.06)	(0.06)	(0.05)
Age of KHDS1-hh-head	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Sex of KHDS1-hh-head	0.00	-0.01	-0.01
	(0.06)	(0.06)	(0.06)
Years of Educ of KHDS1-hh-head	0.02 *	0.02 **	0.02 ***
	(0.01)	(0.01)	(0.01)
Log consumption in KHDS1	0.07	0.06	0.06 *
	(0.05)	(0.05)	(0.04)
Dwelling in KHDS1 has good floor	0.08	0.08	0.08
	(0.09)	(0.09)	(0.07)
Double Orphan x			
Paternal Grandfather is caregiver		0.16	0.28
		(0.40)	(0.54)
Paternal Grandmother is caregiver		-0.41	-0.20
		(0.45)	(0.77)
Maternal Grandfather is caregiver		-0.58 *	-0.53
		(0.35)	(0.51)
Maternal Grandmother is caregiver		0.53	0.65
		(0.49)	(0.69)
Maternal Uncle or Aunt is caregiver		0.77 **	0.75
		(0.36)	(0.58)
Sibling is caregiver		-0.24	-0.21
		(0.46)	(0.53)
Members HH owns Business Assets		0.82 ***	0.86 **
		(0.29)	(0.43)
Landholdings of Member		0.04	0.06
		(0.11)	(0.15)
Member does not own land		0.86	0.97
		(1.50)	(1.97)
Lee selection correction term			0.11
			(0.25)
Rho - Correlation betw. errors in selection and outcome eq.			0.12
			(0.10)
Constant	-5.64 ***	-5.51 ***	-5.51 ***
	(0.89)	(0.89)	(0.74)
Observations	2129	2129	2129
Number of Orphans	70	70	70
R-squared	0.20	0.20	

Notes: Clustered Standard Errors in parenthesis, clustered at the original KHDS-1 household level for columns I and II. Bootstrapped Standard Errors in Column 3 (Description in Text). * denotes significance at the 10% level, ** at the 5% level, *** at the 1% level.
Columns I and II report coefficients from an OLS regression of childrens' BMI-for-age Zscores in KHDS-2 on individual characteristics of the orphan, KHDS-1 household controls (Columns I & II) and Interactions of the orphan dummy with caretaker characteristics (Column II). Column III also includes a selection correction term that controls for the placement of the orphan.
In Columns II and III, the coefficient on orphanhood is for the left out categorie: a paternal uncle and aunt, who does not own business assets.

Table 12: Impact of Orphanhood on BMI-for-age Z-scores (First Difference)

Dependent Variable: Change in BMI-for-age Z-score between KHDS-1 and 2004/2005	I	II	III
Orphan Dummy	-0.59 **	-0.13	0.79
	(0.25)	(2.44)	(3.50)
Orphan Dummy *Male	0.43	0.58 *	0.53
	(0.36)	(0.34)	(0.40)
Male	4.74 ***	4.68 ***	4.69 ***
	(0.82)	(0.81)	(0.85)
Time between KHDS-1 & 2 interviews	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)
Born after KHDS-1	0.04	0.12	0.13
	(0.84)	(0.83)	(0.70)
Age of Child in resurvey (2004)	0.49 ***	0.50 ***	0.50 ***
	(0.07)	(0.07)	(0.07)
Age of Child squared	-0.01 ***	-0.01 ***	-0.01 ***
	(0.00)	(0.00)	(0.00)
Age of Child in resurvey (2004) *Male	-0.56 ***	-0.55 ***	-0.55 ***
	(0.09)	(0.09)	(0.09)
Age of Child squared *Male	0.01 ***	0.01 ***	0.01 ***
	(0.00)	(0.00)	(0.00)
Child had lost one parent in KHDS-1	0.09	0.09	0.08
	(0.07)	(0.07)	(0.06)
Double Orphan x			
Paternal Grandfather is caregiver		1.11 ***	0.87
		(0.37)	(0.66)
Paternal Grandmother is caregiver		0.76	0.38
		(0.61)	(1.12)
Maternal Grandfather is caregiver		1.06	0.97
		(0.66)	(1.00)
Maternal Grandmother is caregiver		0.77	0.55
		(0.47)	(0.79)
Maternal Uncle or Aunt is caregiver		0.87***	0.91
		(0.26)	(0.58)
Sibling is caregiver		0.17	0.12
		(0.42)	(0.57)
Members HH owns Business Assets		0.66*	0.58
		(0.38)	(0.58)
Landholdings of Member		-0.09	-0.13
		(0.17)	(0.22)
Member does not own land		-1.50	-1.71
		(2.40)	(2.95)
Lee selection correction term			0.21
			(0.36)
Rho - Correlation betw. errors in selection and outcome eq.			0.16
			(0.1)
Constant	-5.55 ***	-5.60 ***	-5.60 ***
	(0.87)	(0.87)	(0.76)
Observations	2115	2115	2115
Number of Orphans	70	70	70
R-squared	0.29	0.29	

Notes: Clustered Standard Errors in parenthesis, clustered at the original KHDS-1 household level for columns I and II. Bootstrapped Standard Errors in Column 3 (Description in Text). * denotes significance at the 10% level, ** at the 5% level, *** at the 1% level.

Columns I and II report coefficients from a regression of the change in childrens' BMI-for-age Zscores between KHDS-1 and KHDS-2 on individual characteristics of the orphan, KHDS-1 household controls (Columns I & II) and Interactions of the orphan dummy with caretaker characteristics (Column II). Column III also includes a selection correction term that controls for the placement of the orphan.

Note that in Columns II and III, the coefficient on orphanhood is for the left out categorie: a paternal uncle and aunt, who does not own business assets.

Table 13: Impact of Orphanhood on Height-for-Age Z-scores

Dependent Variable: Height-for-Age Z-score in 2004/2005	I	II	III
Orphan Dummy	-0.49 **	-1.44	-0.42
	(0.23)	(1.60)	(2.45)
Orphan Dummy *Male	0.52 *	0.40	0.34
	(0.29)	(0.32)	(0.38)
Male	0.65	0.62	0.64
	(0.71)	(0.71)	(0.76)
Time between KHDS-1 & 2 interviews	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Born after KHDS-1	0.27	0.20	0.21
	(0.69)	(0.69)	(0.70)
Age of Child in resurvey (2004)	0.09	0.09	0.09
	(0.06)	(0.06)	(0.06)
Age of Child squared	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)
Age of Child in resurvey (2004) *Male	-0.14 *	-0.14 *	-0.14 *
	(0.08)	(0.08)	(0.08)
Age of Child squared *Male	0.00 *	0.00 *	0.00 *
	(0.00)	(0.00)	(0.00)
Child had lost one parent in KHDS-1	0.06	0.06	0.05
	(0.07)	(0.07)	(0.06)
Age of KHDS1-hh-head	0.00 *	0.00 *	0.00 **
	(0.00)	(0.00)	(0.00)
Sex of KHDS1-hh-head	-0.10	-0.10	-0.10 *
	(0.07)	(0.07)	(0.06)
Years of Educ of KHDS1-hh-head	0.02	0.02	0.02 **
	(0.01)	(0.01)	(0.01)
Log consumption in KHDS1	0.02	0.01	0.01
	(0.05)	(0.05)	(0.04)
Dwelling in KHDS1 has good floor	0.26 ***	0.25 ***	0.26 ***
	(0.09)	(0.09)	(0.07)
Double Orphan x			
Paternal Grandfather is caregiver		-0.07	-0.32
		(0.48)	(0.73)
Paternal Grandmother is caregiver		-0.85 *	-1.27
		(0.49)	(0.86)
Maternal Grandfather is caregiver		-0.37	-0.46
		(0.59)	(0.81)
Maternal Grandmother is caregiver		0.26	0.01
		(0.70)	(0.99)
Maternal Uncle or Aunt is caregiver		0.31	0.35
		(0.33)	(0.56)
Sibling is caregiver		-0.09	-0.14
		(0.38)	(0.46)
Members HH owns Business Assets		0.40	0.32
		(0.27)	(0.42)
Landholdings of Member		0.07	0.03
		(0.12)	(0.18)
Member does not own land		1.21	0.98
		(1.72)	(2.47)
Lee selection correction term			-0.23
			(0.25)
Rho - Correlation betw. errors in selection and outcome eq.			-0.20 **
			(0.1)
Constant	-2.90 ***	-2.77 ***	-2.77 ***
	(0.91)	(0.92)	(0.86)
Observations	2109	2109	2109
Number of Orphans	70	70	70
R-squared	0.16	0.16	

Notes: Clustered Standard Errors in parenthesis, clustered at the original KHDS-1 household level for columns I and II. Bootstrapped Standard Errors in Column 3 (Description in Text). * denotes significance at the 10% level, ** at the 5% level, *** at the 1% level.
Columns I and II report coefficients from an OLS regression of childrens' Height-for-Age Zscores in KHDS-2 on individual characteristics of the orphan, KHDS-1 household controls (Columns I & II) and Interactions of the orphan dummy with caretaker characteristics (Column II). Column III also includes a selection correction term that controls for the placement of the orphan.
Note that in Columns II and III, the coefficient on orphanhood is for the left out categorie: a paternal uncle and aunt, who does not own business assets.

Table 14: Impact of Orphanhood on Height-for-Age Z-scores (First Difference)

Dependent Variable: Change in Height-for-Age Z-score between KHDS-1 and 2004/2005	I	II	III
Orphan Dummy	0.07	-1.85	-0.09
	(0.25)	(1.68)	(2.57)
Orphan Dummy *Male	-0.08	-0.33	-0.43
	(0.35)	(0.35)	(0.39)
Male	2.36 ***	2.41 ***	2.44 ***
	(0.88)	(0.88)	(0.88)
Time between KHDS-1 & 2 interviews	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Born after KHDS-1	-1.53 **	-1.49 *	-1.47 *
	(0.77)	(0.79)	(0.83)
Age of Child in resurvey (2004)	0.29 ***	0.29 ***	0.29 ***
	(0.07)	(0.07)	(0.06)
Age of Child squared	-0.01 ***	-0.01 ***	-0.01 ***
	(0.00)	(0.00)	(0.00)
Age of Child in resurvey (2004) *Male	-0.32 ***	-0.33 ***	-0.33 ***
	(0.09)	(0.09)	(0.09)
Age of Child squared *Male	0.01 ***	0.01 ***	0.01 ***
	(0.00)	(0.00)	(0.00)
Child had lost one parent in KHDS-1	0.05	0.05	0.05
	(0.07)	(0.07)	(0.07)
Double Orphan x			
Paternal Grandfather is caregiver		-1.25 ***	-1.69 ***
		(0.40)	(0.60)
Paternal Grandmother is caregiver		-0.02	-0.75
		(0.59)	(1.20)
Maternal Grandfather is caregiver		0.19	0.03
		(0.63)	(0.93)
Maternal Grandmother is caregiver		0.44	0.02
		(0.36)	(0.62)
Maternal Uncle or Aunt is caregiver		0.07	0.15
		(0.31)	(0.70)
Sibling is caregiver		0.38	0.29
		(0.38)	(0.49)
Members HH owns Business Assets		-0.04	-0.18
		(0.31)	(0.56)
Landholdings of Member		0.14	0.07
		(0.11)	(0.16)
Member does not own land		2.07	1.67
		(1.72)	(2.14)
Lee selection correction term			-0.40
			(0.29)
Rho - Correlation betw. errors in selection and outcome eq.			-0.25 **
			(0.09)
Constant	-2.79 ***	-2.79 ***	-2.80 ***
	(0.83)	(0.83)	(0.82)
Observations	2109	2109	2109
Number of Orphans	70	70	70
R-squared	0.12	0.12	

Notes: Clustered Standard Errors in parenthesis, clustered at the original KHDS-1 household level for columns I and II. Bootstrapped Standard Errors in Column 3 (Description in Text). * denotes significance at the 10% level, ** at the 5% level, *** at the 1% level. Columns I and II report coefficients from a regression of the change in childrens' Height-for-Age Zscores between KHDS-1 and KHDS-2 on individual characteristics of the orphan, KHDS-1 household controls (Columns I & II) and Interactions of the orphan dummy with caretaker characteristics (Column II). Column III also includes a selection correction term that controls for the placement of the orphan.

Note that in Columns II and III, the coefficient on orphanhood is for the left out categorie: a paternal uncle and aunt, who does not own business assets.

of covariates as before. In this case, I find that while the coefficient on the selection correction term is insignificant, the correlation coefficient is significant. Corresponding to this estimate, column 3 in the second panel of Table 15 then shows that there is a large and significant and negative impact of selection on BMI-for-age Z-scores. Orphans' BMI-for-age Z-scores are reduced by 0.3 standard deviations due to selection.

The impacts on orphans' Height-for-age Z-scores in Table 13 are similar to the latter results for BMI-for-age Z-scores. Orphanhood reduces female orphans' Height-for-age Z-scores by 0.49 standard deviations, but has no effects on male orphans. Again none of the individual coefficients is significant, and while the correction term is insignificant, the correlation coefficient is not. Table 15 shows that selection reduces Height-for-age Z-scores by 0.6 standard deviations. These same patterns are found in Table 14, which looks at changes in Height-for-age Z-scores over time.

6.3 Overview of the Determinants of Orphans' Outcomes

The two panels of Table 8 show the estimation of the benefit (or detrimental effect) of selection. The actual outcomes for the orphans (in the caretaking families) in the first line of each panel are compared with the predicted outcome in the household of the caretaker, and the predicted outcome in the network as a whole. To put this into perspective the simple sample mean of the non-orphans is listed in line four. Line five shows the selection on unobserved characteristics, line six selection on observed characteristics and line seven the total effect of selection.

The top panel comes from an OLS regression controlling for individual, household and caretaker characteristics in the outcome equation, while the bottom panel regresses the changes in the outcome variable on individual and caretaker characteristics. The strong positive impact of selection on education is noteworthy as is the large negative impact on Height-for-age Z-scores and BMI-for-age Z-scores. In particular, orphans receive approximately one year of education more in the caretaking households than if they had been placed with a random household. However their Height-for-age Z-scores are half a standard deviation lower because of selection.

Table 15 then puts these results into perspective, by comparing them with the direct impact of orphanhood on male and female children. The top lines contain the impact of orphanhood on female and male orphans for the four outcomes: years of education, logarithm of schooling expenditures, BMI-for-age Z-scores and Height-for-age Z-scores. The third line shows the calculation of the effect of selection on

Table 15: Overview of the Effects of Orphanhood on Orphan's Health and Education

Panel I: OLS Regression (Controlling for 1991/1994 Household Characteristics)

	Years of Education	Log Schooling Expenditures	BMI-for-age Z-scores	Height-for-age Z-scores
Orphan	-0.72 *	-0.20	-0.56 **	-0.49 **
Orphan * Male	0.95	0.50 *	0.42	0.52 *
Effect of Selection	1.0 ***	2.0 **	0.1	-0.6 ***

Panel II: First Difference Regression (Change between KHDS-1 and KHDS-2/KONIS surveys)

	Years of Education	BMI-for-age Z-scores	Height-for-age Z-scores
Orphan	-0.46	-0.59 *	0.07
Orphan * Male	0.78	0.43	-0.08
Effect of Selection	0.9 ***	-0.3 *	-0.8 ***

Notes: Coefficients for Orphan and Orphan*Male are based on clustered standard errors.
Coefficients for Effect on Selection is based on bootstrapped standard errors.
* denotes significance at the 10% level, ** at the 5% level, *** at the 1% level.

these outcomes. There is a direct impact of orphanhood on years of education and the health related outcomes, though only for female orphans. Selection greatly increases the years of education and schooling expenditures but seems to degrade health related outcomes.

In summary, I find substantial evidence for the strategic placement of the orphans in the family network, which has positive consequences with regards to education. For education, the coefficients in the outcome regression and the coefficients in the placement regression are typically of the same sign. This implies that orphans are allocated within the network in a way that provides them with better education outcomes than a random allocation. This strategic placement contributes to mitigating the impacts of orphanhood on orphan's education, but seems to have negative impacts on their health related outcomes. This is quite a surprising result, since, a priori, we would expect schooling and health related outcomes to be positively correlated. One possible explanation for this could be that the cost of providing schooling and health related costs are negatively correlated. There only very weak evidence, however, that prices of some food items and the cost of schooling might be negatively correlated. Future research should try to understand more in depth what the reasons are for this negative correlation, and whether within a network this negative correlation holds.

7 Conclusion

In this paper, I analyze the welfare effects from the selection of caretakers from among the network members on orphans' health and education outcomes. Using a dataset I collected on the family networks of orphan children in Kagera, Tanzania, I provide evidence that caretakers are selected from among the extended family network with respect to their characteristics. Economic factors such as household landholdings and whether the household owns business assets are positively correlated with caretaking. Moreover, the biological relationship between the network member and the orphan is important.

This systematic placement has substantial welfare effects, which can be assessed only using data on the extended family network of orphaned children. I combine such data with data from a longitudinal survey on outcomes of these same orphans to deal with (some) selection issues associated with parental death. The data on members of the extended family network allow me to construct counterfactual outcomes for the orphans, had a different member taken care of them. An additional complication arises from the fact that, among the determinants of orphans' welfare, are the characteristics of the caretakers. I show analytically that the systematic placement of the orphan can lead to a placement bias when regressing orphans' outcomes on the characteristics of the caretakers. The theoretical framework developed here motivates a method for dealing with this bias. This method involves using the predicted probabilities of caretaking from the estimation of where the orphan is placed in the family network. In the empirical analysis I find that the selection on unobservable characteristics is substantial, though the bias is imprecisely measured. In particular, the selection on unobservable characteristics of the caretakers reduces the impact on orphans' years of completed education outcomes by 0.7 years. The selection on the observable characteristics of the caretakers further reduces the impact by 0.3 years. Family networks in Kagera are thus fairly successful at mitigating impacts on orphans. In fact, a negative effect of orphanhood can be found only for female orphans but not male orphans. The impact of selection on health outcomes, however, represents somewhat of a puzzle, since it seems as if selection has detrimental impacts on orphans' health, and is a subject of future research.

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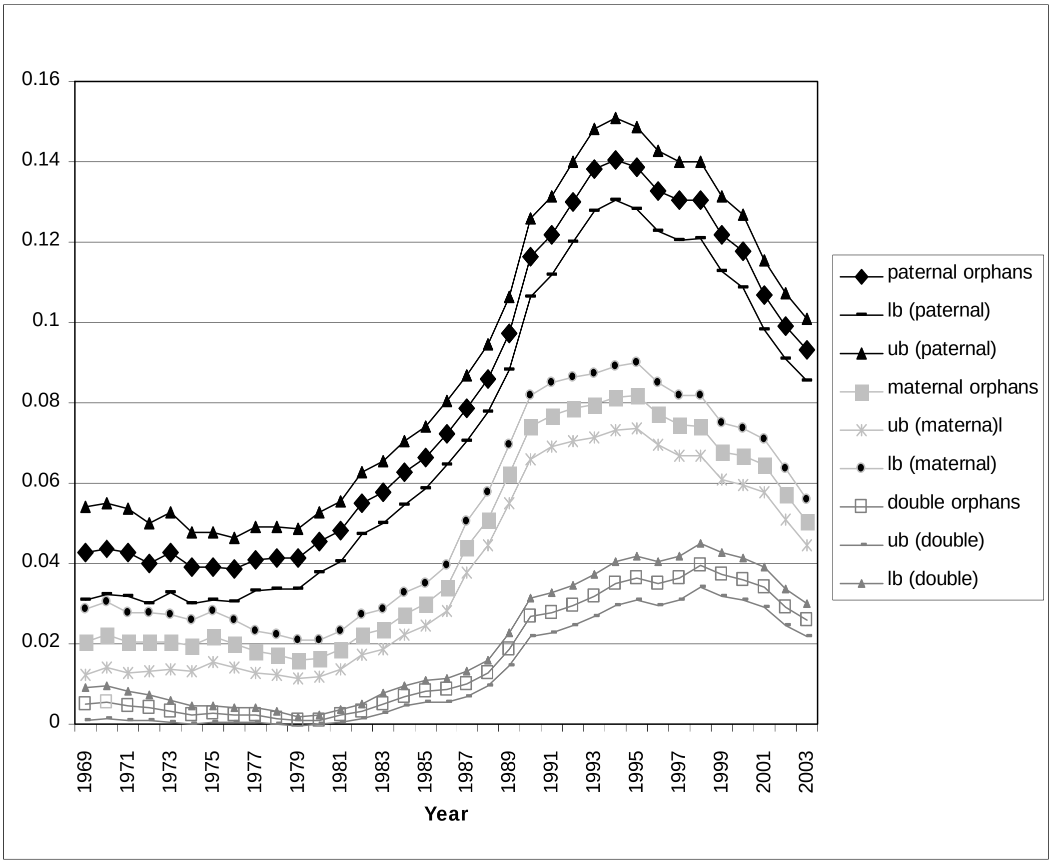
8 Appendix

Figure 4: Rates of Orphanhood with Confidence Intervals



8.1 Predictions of the Model

To derive predictions for the influence of particular characteristics on the placement, I analyze critical values around which a formerly non-chosen placement is chosen (or a formerly chosen alternative is replaced). This is important since for some ranges of parameters, even large changes in one parameter will not affect the placement. Take for example a very poor and a very rich household. The rich household is taking care of the orphan and is providing the orphan with more consumption than the total wealth of the poor household. It is possible that the orphan will be taken care of by the rich network member, regardless of the orphan's weight in the utility of the poor caretaker. The analysis below therefore assumes constellations of parameters where the placement can be affected by a change in the network members characteristics and/or the orphans contribution to that household. Conditional on this restriction, it is sufficient to analyze the change in the network utility from placing the orphan with a particular member in the neighborhood of the critical value for the parameter of interest. In this appendix, I document the predictions for three variables, w, r_o, δ in a model with only one outcome.

The effect of w_1 on U_1 is ambiguous, depending on the other characteristics of network member $1:$ r_{o1} and δ_1. The ambiguity is documented first. Then it is shown that there exists a level of $w_1^+(r_{o1}, \delta_1)$ s.t.$\forall\, w_1 > w_1^+$, $\partial U_1(w_1, r_{o1}, \delta_1)/\partial w_1 > 0$.

$$\partial U_1(w_1, r_{o1}, \delta_1)/\partial w_1 = \partial v_1(c_{11}^*)/\partial w_1 + \partial v_o(c_{o1}^*)/\partial w_1 - \partial v_1(c_{12})/\partial w_1$$

where $(c_{11}^*, c_{o1}^*) = \arg\max \quad v_1(c_{11}) + \delta_1 v_o(c_{o1}) \quad \text{s.t.} \;\; c_{11} + c_{o1} < w_1 + r_{o1}$

With $r_{oj} = 0$, it follows that $\partial U_1(.)/\partial w_1 > 0$ as

$$\frac{\partial v_1(c_{11})}{\partial c_{11}}\frac{\partial c_{11}}{\partial w_1} + \frac{\partial v_o(w_1 - c_{11})}{\partial c_{o1}}\frac{\partial c_{o1}}{\partial w_1} > \frac{\partial v_1(c_{12})}{\partial c_{12}}\frac{\partial c_{12}}{\partial w_1}.$$

Then I can use the intra-household utility maximization which leads to an equalization of the marginal utilities of the network member and (weighted) of the orphan: $\frac{\partial v_1(c_{11})}{\partial c_{11}} = \delta_1 \frac{\partial v_o(w_1 - c_{11})}{\partial c_{o1}}$. This leads to

$$\frac{\partial v_1(c_{11})}{\partial c_{11}}\frac{\partial c_{11}}{\partial w_1} + \frac{\partial v_1(c_{11})}{\partial c_{11}}\frac{\partial c_{o1}}{\partial w_1} * \frac{1}{\delta_1} > \frac{\partial v_1(c_{12})}{\partial c_{12}}.$$

Since $\delta_1 < 1$ this leads to

$$\frac{\partial v_1(c_{11})}{\partial c_{11}}\frac{\partial c_{11}}{\partial w_1} + \frac{\partial v_1(c_{11})}{\partial c_{11}}\frac{\partial c_{o1}}{\partial w_1} > \frac{\partial v_1(c_{12})}{\partial c_{12}}.$$

Now, $\frac{\partial c_{o1}}{\partial w_1} = 1 - \frac{\partial c_{11}}{\partial w_1}$ since the household consumes its budget.

$$\begin{aligned} \frac{\partial v_1(c_{11})}{\partial c_{11}}\frac{\partial c_{11}}{\partial w_1} + \frac{\partial v_1(c_{11})}{\partial c_{11}}(1 - \frac{\partial c_{11}}{\partial w_1}) &> \frac{\partial v_1(c_{12})}{\partial c_{12}} \\ \frac{\partial v_1(c_{11})}{\partial c_{11}} &> \frac{\partial v_1(c_{12})}{\partial c_{12}} \end{aligned}$$

The last inequality is true because $c_{12} = w_1$ and $c_{11} = w_1 - c_{o1}$ and v_1 concave. *QED.*

The intuition is actually very simple, namely that the marginal utility from consumption is higher at lower levels of consumption, and that is always true when a network member shares her wealth between herself and the orphan.

In the case of $r_{oj} > 0$, the result is ambiguous. It depends on

$$\partial v_1(w_1 + r_{o1} - c_{o1})/\partial w_1 <> \partial v_1(w_1)/\partial w_1$$

which depends on whether the orphan's consumption is greater or less than his contribution, $c_{o1} <> r_{o1}$. When the orphan contributes more to the household than his share of consumption, the marginal utility of consumption in that household is lower than if the network member were alone. This can translate into the orphan being placed by the network with a network member to boost the consumption of that network member. For $c_{o1}(w_1, r_{o1}, \delta_1) > r_{o1} : \partial U_1(.)/\partial w_1 > 0$

Define $w_1^+(r_{o1}, \delta_1)$ as the level of c_{o1}, s.t. $c_{o1}(w_1, r_{o1}, \delta_1) = r_{o1}$ then for $w_1 > w_1^+ \geq 0$: $\partial U_1(.)/\partial w_1 > 0$.

The network utility of placing the orphan with network member 2 is $U_2 = U_2(w_2, r_{o2}, \delta_2) = \overline{U_2}$, which is unaffected by characteristics of network member 1, (w_1, r_{o1}, δ_1).

It is possible that $U_1(w_1', r_{o1}, \delta_1) > \overline{U_2} \;\; \forall \;\; w_1' \geq 0$. This might be the case if r_{o1} is very large compared to r_{o2} and w_2 together. Otherwise, there exists a critical value of w_1, called $w_1^* \geq w_1^+$ where $U_1(w_1^*, r_{o1}, \delta_1) = \overline{U_2}$ and $\partial U_1(w_1^*, r_{o1}, \delta_1)/\partial w_1 > 0$. This results from the $\partial U_1(.)/\partial w_1 > 0$ (for $w_1^* \geq w_1^+$) and that U is unbounded,

8.1.1 Derivations with Respect to r_{o1} and δ_1

For r_{oj} and δ_1 the predictions are unambiguous, since they affect the network utility only when the orphan is placed with network member 1.

$$\begin{aligned}
\frac{\partial U_1(w_1, r_{o1}, \delta_1)}{\partial r_{o1}} &= \frac{\partial v_1(c_{11})}{\partial c_{11}}\frac{\partial c_{11}}{\partial r_{o1}} + \frac{\partial v_o(w_1 - c_{11})}{\partial c_{o1}}\frac{\partial c_{o1}}{\partial r_{o1}} - \frac{\partial v_1(c_{12})}{\partial c_{12}}\frac{\partial c_{12}}{\partial r_{o1}} \\
&= \frac{\partial v_1(c_{11})}{\partial c_{11}}\frac{\partial c_{11}}{\partial r_{o1}} + \frac{\partial v_o(w_1 - c_{11})}{\partial c_{o1}}\frac{\partial c_{o1}}{\partial r_{o1}} - 0 \\
&> 0
\end{aligned}$$

$$\begin{aligned}
\frac{\partial U_1(w_1, r_{o1}, \delta_1)}{\partial \delta_1} &= \frac{\partial v_1(c_{11})}{\partial c_{11}}\frac{\partial c_{11}}{\partial \delta_1} + \frac{\partial v_o(w_1 - c_{11})}{\partial c_{o1}}\frac{\partial c_{o1}}{\partial \delta_1} - \frac{\partial v_1(c_{12})}{\partial c_{12}}\frac{\partial c_{12}}{\partial \delta_1} \\
&= \frac{\partial v_1(c_{11})}{\partial c_{11}}\frac{\partial c_{11}}{\partial \delta_1} + \frac{\partial v_o(w_1 - c_{11})}{\partial c_{o1}}\frac{\partial c_{o1}}{\partial \delta_1} - 0 \\
&> 0
\end{aligned}$$

There is however a difference between how r_{o1} and δ_1 affect placement. It can easily be shown that there exists a critical value of r_{o1}, called $r_{o1}^* \geq 0$, such that $\forall \; r_{o1}' \geq r_{o1}^* \; U_1(w_1, r_{o1}', \widetilde{\delta_1}) > \overline{U_2}$.

This is not the case for δ_1. Take the case of a network member who puts a lot of weight on the orphan, and therefore gives a large share of the household resources to the orphan. If the wealth of that network member is small, then giving the orphan an ever larger share of it will not necessarily make the orphan's consumption larger than in the other household.[50]

8.2 Signing the Bias

This section shows that the observable and unobservable characteristics of the network members will be correlated, conditional on caretaking, even if the variables are unconditionally uncorrelated.

Assume there are two network members, 1 and 2, both of whom have observable characteristics, w, as well as unobservable characteristics, δ. Assume further that these variables enter the utility linearly and separately, and are all independently uniformly distributed, $(w_1, \delta_1, w_2, \delta_2) \sim iid\ U[0,1]$. The uniform distribution is chosen because the conditional distributions and covariances can be calculated. Then

$E[w_j] = E[\delta_j] = \frac{1}{2}$

$cov(w_j, \delta_j) = 0$

Define $x_j = w_j + \delta_j$ and $a_j = w_k + \delta_k - \delta_j$

The first allocation is chosen, i.e. $j = 1$, if any of the following four equivalent formulations holds

$$w_1 + \delta_1 > w_2 + \delta_2 \;\Leftrightarrow\; x_1 > x_2$$
$$\Leftrightarrow\; w_1 > w_2 + \delta_2 - \delta_1 \;\Leftrightarrow\; w_1 > a_1$$

The conditional expectation of wealth, conditional on allocation 1 being chosen, is

$$E[w_1 | w_1 > w_2 + \delta_2 - \delta_1] \equiv E[w_1 | j = 1] = \int w_1 f(w_1 | j = 1)\, dw_j$$

and the conditional density of wealth is

$$f(w_1 | j = 1) = \frac{f(w_1, w_1 > a)}{\Pr(j = 1)} = \frac{f(w_1) F_a(w_1)}{\Pr(j = 1)}$$

$F_a(A)$, the cdf of $a_1 = w_2 + \delta_2 - \delta_1$ is defined over $A \epsilon [-1, 2]$; however since w_1 is only defined on $[0, 1]$, this is the relevant range for $F_a(A)$. When $A \epsilon [-1, 0]$ the cdf $F_a(A)$ is

$$F_a(A) = \int_{\delta_1 = -A}^{1} \int_{w_2 = 0}^{A + \delta_1} \int_{\delta_2 = 0}^{A + \delta_1 - w_2} d\delta_2 dw_2 d\delta_1 \;=\; \frac{1}{6}(1 + A)^3$$

where I use the fact that $f(\delta_1) = f(\delta_2) = f(w_2) = 1$. Thus $F_a(0) = \frac{1}{6}$.

[50] Here the assumption that $\delta_1 < \delta$ matters, because otherwise it could be that the network utility falls when δ_1 rises.

When $A\epsilon[0,1]$,

$$\begin{aligned}
F_a(A) &= \int_{\delta_1=0}^{1-A}\int_{w_2=0}^{\delta_1}\int_{\delta_2=\delta_1-w_2}^{A+\delta_1-w_2} d\delta_2 dw_2 d\delta_1 \\
&\quad + \int_{\delta_1=0}^{1-A}\int_{w_2=\delta_1}^{A+\delta_1}\int_{\delta_2=0}^{A+\delta_1-w_2} d\delta_2 dw_2 d\delta_1 \\
&\quad + \int_{\delta_1=1-A}^{1}\int_{w_2=0}^{A+\delta_1-1}\int_{\delta_2=\delta_1-w_2}^{1} d\delta_2 dw_2 d\delta_1 \\
&\quad + \int_{\delta_1=1-A}^{1}\int_{w_2=A+\delta_1-1}^{\delta_1}\int_{\delta_2=\delta_1-w_2}^{A+\delta_1-w_2} d\delta_2 dw_2 d\delta_1 \\
&\quad + \int_{\delta_1=0}^{1-A}\int_{w_2=\delta_1}^{1}\int_{\delta_2=0}^{A+\delta_1-w_2} d\delta_2 dw_2 d\delta_1 \\
&\quad + F_a(0) \\
&= \frac{1}{2}(1-A)^2 A + \frac{1}{2}(1-A)A^2 + \frac{1}{3}A^3 + (A^2 - A^3) + \frac{1}{3}A^3 + F_a(0) \\
&= \frac{1}{2}A + \frac{1}{2}A^2 - \frac{1}{3}A^3 \quad + \frac{1}{6}
\end{aligned}$$

The ex-ante probability that a particular allocation j will be chosen, $\Pr(j=1)$, is $1/2$ because all four variables are independent random variables from the same distribution, so that the probability that the sum of two is larger than the sum of the other two is $1/2$. This can easily be shown, as $\Pr(j=1) = \int_0^1 f(w_1)F_a(w_1)\,dw_1$.

Then, the conditional density of wealth is

$$f(w_1|j=1) = \frac{f(w_1)F_a(w_1)}{1/2} = w_1 + w_1^2 - \frac{2}{3}w_1^3 + \frac{1}{3}$$

The conditional expectation of wealth

$$\begin{aligned}
E[w_1|w_1 &> w_2 + \delta_2 - \delta_1] \\
&= \int_0^1 w_1 f(w_1|j=1) dw_j \\
&= \int_0^1 w_1(w_1 + w_1^2 - \frac{2}{3}w_1^3 + \frac{1}{3}) dw_j \\
&= \frac{37}{60} > \frac{1}{2} = E[w_1]
\end{aligned}$$

is larger than the unconditional expectation, proving that on average caretakers have better observable characteristics than non-caretaking network members. The proof for δ_1 follows the same equations, replacing w_1 with δ_1 and redefining a_1 appropriately.

The covariance between δ_1 and w_1, conditional on caretaker 1 being chosen, is:

$$\begin{aligned} Cov(\delta_1, w_1|j &= 1) = \frac{1}{2}\left[Var\left(w_1+\delta_1|j=1\right) - Var\left(w_1|j=1\right) - Var\left(\delta_1|j=1\right)\right] \\ &= \frac{1}{2}\left[Var\left(w_1+\delta_1|j=1\right) - 2Var\left(w_1|j=1\right)\right] \end{aligned}$$

The second step follows from the fact that w_1 and δ_1 are drawn from the same distribution.

$$\begin{aligned} Var\left(w_1+\delta_1|j=1\right) &= Var\left(x_1|j=1\right) = \int \left(x_1 - E\left(x_1|j=1\right)\right) f\left(x_1|j=1\right) dx_1 \\ Var\left(w_1|j=1\right) &= Var\left(\delta_1|j=1\right) = \int \left(w_1 - E\left(w_1|j=1\right)\right) f\left(w_1|j=1\right) dw_1 \end{aligned}$$

The conditional expectation and distribution function of w_1 were derived above. The conditional expectation of x_1 is the sum of the conditional expectations of w_1 and δ_1.

$$E\left(x_1|j=1\right) = E\left(\delta_1|j=1\right) + E\left(w_1|j=1\right) = 2 * \frac{37}{60} = \frac{37}{30}$$

The density of $x_1 = w_1 + \delta_1$, conditional on being the caretaker, is

$$f\left(x_1|j=1\right) = \frac{f(x_1, x_1 > x_2)}{\Pr(x_1 > x_2)} = \begin{cases} x_1^3 & x_1 \epsilon [0,1] \\ 10x_1 - 6x_1^2 + x_1^3 - 4 & x_1 \epsilon [1,2] \end{cases}$$

since

$$\begin{aligned} f\left(x_1, x_1 > x_2\right) &= \int_0^{x_1} f(x_1, x_2)\ dx_2 \\ &= \begin{cases} \int_0^{x_1} x_1 x_2\ dx_2 & x_1 \epsilon [0,1] \\ \int_0^1 (2-x_1) x_2\ dx_2 + \int_1^{x_1} (2-x_1)(2-x_2)\ dx_2 & x_1 \epsilon [1,2] \end{cases} \\ &= \begin{cases} \frac{1}{2} x_1^3 & x_1 \epsilon [0,1] \\ 5x_1 - 3x_1^2 + \frac{1}{2} x_1^3 - 2 & x_1 \epsilon [1,2] \end{cases} \end{aligned}$$

and

$$\Pr(x_1 > x_2) = \frac{1}{2}$$

The conditional variance of x_1 is

$$\begin{aligned} Var\left(x_1|j=1\right) &= \int_0^1 \left(x_1 - \frac{37}{30}\right)^2 x_1^3\, dx_1 + \int_1^2 \left(x_1 - \frac{37}{30}\right)^2 \left(10x_1 - 6x_1^2 + x_1^3 - 4\right)\ dx_1 \\ &= \frac{101}{900} \end{aligned}$$

and the conditional variance of w_1 is

$$Var\left(w_1|j=1\right) = \int_0^1 \left(w_1 - \frac{37}{60}\right)^2 \left(w_1 + w_1^2 - \frac{2}{3} w_1^3 + \frac{1}{3}\right) = \frac{251}{3600}$$

The covariance between the observable and unobservable characteristics is

$$\begin{aligned} Cov(\delta_1, w_1|j &= 1) = \frac{1}{2}\left[Var\left(w_1+\delta_1|j=1\right) - 2Var\left(w_1|j=1\right)\right] \\ &= \frac{1}{2}\left[\frac{101}{900} - 2*\frac{251}{3600}\right] \\ &= -\frac{49}{3600} \end{aligned}$$

which is smaller than zero. This negative conditional correlation between w_1 and δ_1 leads to a downward bias on the coefficient on w_1 when regressing orphans' outcomes on caretaker characteristics.

8.3 Definition of Variables

8.4 Effect of p^e, p^h,δ^e,δ^h on the Utility of Placement

The budget constraint is $c_{jj} + p_j^h h_{oj} + p_j^e e_{oj} \leq w_j + r_{oj}$, where the price of the network members consumption is set as a numeraire and assumed equal across network members. Then the caretaker will invest the following values into the orphan's education and health

$$\begin{aligned} e_{oj} &= \frac{\delta_j \delta_j^e}{1+\delta_j\delta_j^e+\delta_j\delta_j^h}\frac{w_j+r_{oj}}{p_j^e} \\ h_{oj} &= \frac{\delta_j \delta_j^h}{1+\delta_j\delta_j^e+\delta_j\delta_j^h}\frac{w_j+r_{oj}}{p_j^h} \end{aligned}$$

The derivative of the network utility with respect to the price for educational investments is

$$\partial U_j(w_j, r_{oj}, \delta_j)/\partial p_j^e = \frac{\partial v_j(e_{oj})}{\partial e_{oj}}\frac{\partial e_{oj}}{\partial p_{oj}^e} < 0$$

A rise in the price for investments into the orphan's education only decrease his education. It would not have any effects on the investements in health, since utilities are separable.

The effects of δ_j^e and δ_j^h on the network utility from placing the orphan with network member j follow those of δ.[51] An increase in a network member's educational preference reduces the investment in health: the share of household resources devoted to health is $\frac{\delta_j\delta_j^h}{1+\delta_j\delta_j^e+\delta_j\delta_j^h}$, which decreases when δ_j^e increases.

[51] This result depends on our assumption on the following assumption $\delta\delta^e > \max_j[\delta_j\delta_j^e]$, that the network as a whole places a higher utility on the education of the orphan than any single network member. The same must also be true for health.

Table 16: Description of Variables used in the Empirical Analysis

Variable	Description
Orphan specific characteristics	
Orphan Dummy	Whether the Child had lost both parents by the KHDS-2/KONIS surveys
Time between KHDS-1 & 2 interviews	Some children were first interviewed in the first round of KHDS-1, some were interviewed in the last round of KHDS-1. This variable is defined as the number of days between the interview used from KHDS-1 and the interview used from KHDS-2/KONIS surveys. This can account for a secular trend in goods prices over KHDS-1
Born after KHDS-1	Some children in the sample are born after KHDS-1. This dummy is included to account for that. Since for these children the previous variable is set to zero, this variable accounts for the fact that they did not have a first interview.
Age of Child in KHDS-2/KONIS surveys	Age during the resurvey, either in the KHDS-2 survey or the KONIS survey.
Child had lost one parent in KHDS-1	Dummy whether the child had lost one parent in KHDS-1. This accounts for the possible non-random placement of the child in KHDS-1 households.
KHDS-1 household characteristics	
Age of KHDS1-hh-head	Age of the household head in the household that the parent of the orphan was living in during the KHDS-1 survey
Sex of KHDS1-hh-head	Sex of this household head
Years of Educ of KHDS1-hh-head	Years of education of the household head
Log consumption in KHDS1	Logarithm of per (adult-equivalent) capita consumption in KHDS-1
Dwelling in KHDS1 has good floor	Whether the dwelling of the household had a concrete or brick floor
Characteristics of the Caretaker and other network members	
Relationship Variables	Members of the family network were asked who had been the main caretaker of the orphan. Using the family tree of the orphan provided information on the relationship of the orphan to the caretaker. The left out categorie contains the paternal aunts and uncles who at the time of death of the second parent had a separate household.
Logarithm of the Value of HH land	Value of land of the household the network was living in 2004 minus the value of land owned by any sibling of the orphan who at the time of death was below the age of 21 (to avoid biases through joint movements to other households with somewhat older sibling) and who was not the head of the household or his or her spouse. In 100000 Tanzania Shilling which corresponds to approximately 100 USD.
HH owns Business Assets	Dummy indicating whether the household owns any business assets, after subtracting the inheritance in business assets that the orphan(s) brought with them. This information is from the inheritance questionnnaire which attempted to list all assets the deceased owned at their death.