Do Parents Favor their Biological Offspring over Adopted Orphans? Theory and Evidence from Tanzania

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Abstract

This paper looks at the consequences children face when they lose a parent(s). After modeling the representative household's bargaining process between their biological and orphaned children, the empirical section of this paper looks at the types of activities that children engage in, and the differences in educational outlays of host households between those children who have lost their parents and those who have not. The results indicate that orphanhood is of critical importance to human capital formation as the probability of engaging in child labor and being idle increases relative to school attendance, following the loss of both parents. This has the same distortionary effect as a tax on children as a result of orphanhood. Even though these children do not have markedly lower abilities to read, write or perform written calculation before the death of their parents, they are outperformed in all three categories once they join the new household following the loss of both parents. It concludes that for policymakers, in-kind subsidies provided at the school level will have a bigger impact than those provided at the household level.

JEL codes: C23, C25, D13, D19, I20, I30, J12, O15.

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Theory and Evidence

I- Introduction

The process of human capital accumulation is complex and starts at a young age. Among its determinants, education stands out as the most important, as well as good health and other conditions. Economists have been studying these determinants for decades, and some important strides have been made in understanding the process (Haveman and Wolfe 1995, Bergstrom 1995). The various theories of the family pioneered by Gary Becker's seminal 1964 work have used different aspects of economics to explain the intricate functioning of the family unit. Bergstrom (1995) writes:

> "To a labor economist or industrial organization economist, a family looks like "a little factory." To a bargaining theorist, a husband and wife are "two agents in a relation of bilateral monopoly." To an urban or a public choice theorist, a family looks like "a little city", or perhaps "a little club". To a welfare economist, a family is an association of benevolently interrelated individuals. Each of these analogies suggests useful ways in which the standard tools of neoclassical economics can aid in understanding the workings of a family."

The core of these theories has been devoted to explaining the household educational production function. In this growing body of research, drawing from both economic theory and other social sciences, a consistent and stylized fact is that parental characteristics enter strongly into the production function with strong causal effects on children's outcomes. For example, it has been posited that children growing up in single parent households are more likely to drop out of school before graduation than their peers living with both parents (Astone and McLanahan 1991). Examples like these and the effects of other parental inputs like school supervision, living with a stepparent, and parental school aspiration for the child span the social science literature (Datcher 1982). For a more extensive discussion, see the thorough summary of studies on the determinants of children's attainments by Haveman and Wolfe (1995). Lately, there has been an increased focus on the effects of losing a parent or both on educational and health outcomes. Certainly, in developed countries, one can safely posit that the problem has not drawn much attention because of low death rates, low birth rates, and the corresponding high life expectancy at birth. Consequently, people generally live to see their grandchildren. Evidently this is not the case in most developing countries where life expectancy at birth is still very low. The effects of losing a parent is exacerbated by the advent of the HIV/AIDS epidemic, which is spreading quickly across the developing world, especially in sub-Saharan Africa where HIV infection rates are in double digit figures for a number of countries. Therefore, it is of pressing importance for governments to understand the effects of losing a parent(s) on the well being of children to avert a bigger calamity. This paper is consequently an extension of a body of literature that is still in relative infancy.

The early literature on this topic has looked at the effects of losing a parent from the standpoint of the lost parental input that occurs after the death of a parent. For instance, Ainsworth et al. (2002) compare and contrast the effects of losing a father to a mother or of losing both. They show that maternal orphans are more at risk relative to paternal orphans. The lost maternal input outweighs that of the father. In contrast, Gertler et al. (2004) show that while the gender of the deceased parent does not matter, orphaned children's schooling outcomes are significantly worse than those of non-orphaned, but otherwise identical children. To further substantiate these findings, Case et al. (2004), using several demographic and Health Survey (DHS) datasets from Africa, find that children living in blended families are less likely to be enrolled in school than those living in non-blended families (a blended household is defined as one that has one or more orphans). Similarly, in a recent paper, Evans and Miguel (2004) use an unusual five year panel survey conducted in rural Kenya between 1998 and 2002 to find that schooling decreases leading to the parent's death, and then substantially more following such an event. Their study also corroborates one of the claims of this paper: studies using cross sectional surveys to estimate the impact of orphanhood are likely to yield biased estimates.

While all these studies clearly indicate that children are adversely affected by the death of a parent, the process that induces this outcome is still not well understood. For policy purposes, it is important to understand the reason(s) why orphans drop out of school following the loss of their parent(s). An attempt to identify this mechanism is undertaken by Case et al. (2004), but their use of pooled cross-sectional surveys is likely to suffer from an omitted variable bias as well as endogeneity issues. Also, while Gertler et al. (2004) and Evans and Miguel (2004), circumvent the endogeineity problem by respectively using semi-parametric techniques and linear child fixed effects regression methods, neither study is able to identify the specific pathways through which children are affected. Instead, they only identify the negative cumulative effect of parental death on the schooling status of children. This paper adds several dimensions to understanding the impact of orphanhood on children. In essence, it argues that while the potential input of the deceased parent can be a deciding factor as to whether the child goes to school, or engages in a different type of activity, another channel that is equally important is host household resource allocation decisions once children lose both parents. Throughout the paper, I look at household resource allocation decisions by comparing the outcomes for children with one or more living parent with those of children who have lost both parents. The reason for this focus stems not only from the fact that those children have lost the valuable inputs of their parents into their future, but also because they are most likely left in the care of immediate relatives who then have to decide on the proportion of household resources that will be devoted to them. Additionally, an area in which literature has been mute is establishing the activities of orphans that are not attending school. Virtually, all of the studies referenced above define children's activities as binary, taking a value of one if children are currently attending school, and zero if otherwise. However, children who drop out of school can be either working or idle, and within those children reporting school attendance, some may actually be working as well. This suggests that to capture the full extent of children's activities, the researcher should take into account the multinomial nature of the dependent variable. For this reason, I estimate a multinomial logit model of children's activities, before and after they lose their parents, with standard errors corrected for clustering at the household level[1]. The results indicate that children are less likely to be in school, more likely to be idle and at work, following the loss of their parents than non-orphans. The results also indicate that orphans are equally likely to

[1] [1] An issue that arises with this estimation strategy is that the fixed effects multinomial logit model is hard to estimate and the random effects version raises some substantial technical issue without effectively addressing the omitted variable bias problem. See section V for a more extensive discussion.

undertake the aforementioned activities than non-orphans before the death of their last surviving parent[2].

In addition, this paper goes further than just a mere estimation of the impact of parental death on children. I explicitly model the decision process of the representative household of sending children to school, or to work. The model results indicate that however benevolent the representative agent is, she will always have an incentive to invest more in the schooling of her own child. These theoretical results are partly substantiated by looking at the host household's schooling outlay decisions between orphaned children and their non-bereaved peers, once the former lose their parents and join the new household (the new household doesn't necessarily have to be physically different). I estimate a set of linear household fixed effects and random effects tobit regressions of various school expenditure decisions and find that there is a negative and significant bias against double orphans in virtually all expenditure categories (on books, universal primary education (UPE) contributions, uniforms, other miscellaneous school expenditures, and total school expenditures).

Yet the simple observation that there is a bias in school investment against orphans is not necessarily a cause for concern; if orphans as a group have lower abilities than other non-orphaned children, then this bias in educating them is justified, at least on the basis of efficiency. To investigate this issue, I estimate linear household fixed effects regressions of children's reading, writing and mathematical abilities, before and after they become orphaned. The results indicate that while no systematic difference exists

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[2] This finding contrasts with that of Evans and Miguel (2004).

before they become orphaned, double orphans lose out to other children once they lose their parents and are placed with the new households.

All of these results imply that there exists a wedge between the schooling outcomes of children that is detrimental to orphans. This is likely to be magnified if the returns to education increase in the amount of education received while young.

The remainder of this paper is organized as follows: Section II reviews the literature. Section III formally models the determinants of children's education and child labor outcomes. Sections IV and V respectively explain the data and the estimation strategies, and section VI discusses the results. The last section discusses the policy implications and concludes.

II- Literature overview

The transmission of human capital to subsequent generations is well studied in the economic literature (Becker, 1964, 1972, 1981; Becker and Tomes, 1979, 1986; Behrman et al., 1982). Investments in children's future are sometimes motivated by a sense of duty or altruism towards children, but also in some cases by purely selfish motives. These selfish motives range from parental preferences for a "qualitative progeny" to a form of old age insurance and pension. This fact may be more important where capital markets are imperfect and formal insurance seldom exists. In their 1979 paper on income distribution and intergenerational mobility, Becker and Tomes show that, under certain underlying conditions, if families are able to borrow against their children's future income, they will invest in each child until the marginal returns to education equate the marginal costs associated with it. In this sense, families will smooth out consumption over the life cycle of the family dynasty. These results have strong implications for shocks to the family's lifetime income. One of the most important perennial shocks to family income is certainly the death of a breadwinner. Consequently, if family members are able to circumvent the immediate shock to income by using capital markets in their period of transition, the effect on children's lifetime chances may not be felt, at least if the income effect is the primary mechanism through which children are affected. However, this is not necessarily the case all the time. Capital markets may be imperfect, which is generally the case in developing countries. In addition, there are also other channels like the possible change in the household's preference for the quality of children, the opportunity cost of their time in school and also parental involvement in the children's education, especially if education enters their utility function as a consumption good. All these channels are documented in detail by Gertler et al. (2004). Additionally, in certain cases, afflicted children are left in the care of relatives who will not necessarily have the same incentives to invest in their future as their biological parents. This is often the case when the child loses both parents.

Ainsworth et al. (2002), using a panel survey conducted in the Kagera region of Tanzania –the Kagera Health and Development Survey (KDHS), show that the death of a parent only delays children's enrollment, but otherwise does not affect the probability that children attend school. They estimate a probit model clustered at the household level, where the outcome variable is defined as a dichotomous 0-1 variable of whether the child attends school or not. The main variables of interest in this study are orphans by type (maternal, paternal and double orphan), where the effect on double orphans is constructed to be the cumulative sum of the effect on maternal, paternal and double orphans. They also find that, controlling for the household's standard of living, the gender of the deceased parent matters, as maternal orphans have a significantly higher probability of dropping out of school, whereas paternal and double orphans are not generally affected. Even though they control for the usual parental characteristics such as education, age and a set of specific household, community and school level characteristics[3], the presence of one or more unobservable characteristics that is correlated with the decision to send the child to school would bias the final results.

In another study, Case et al. (2004) use several Demographic and Health surveys (DHS) of the Africa region to study the impact of being orphaned on schooling. DHS surveys are particularly useful for this kind of study because they include a broad range of questions about household members' health and nutrition status as well as the livelihood of their parents. They find that orphans are less likely to be in school than non-orphaned children with whom they live, and that closeness of biological ties to the host family is a deciding factor into their schooling outcome. They explain their results with the fact that orphans tend to be left in the care of more distant relatives, and tend to live in more impoverished households.

Similarly, Gertler et al. (2004) use a large sample of children in Indonesia to look at afflicted versus non-afflicted children that they use as a control group. Analyzing data from the Indonesian National Socioeconomic Survey (SUSENAS) from 1994 to 1996 (roughly a sample of 600,000 households) and using parametric and semi-parametric regression techniques, they are able to match bereaved, and non-afflicted but identical children living in the same neighborhood. Even though the authors are limited by the

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[3] These include household asset ownership, the distance to school, the number of available secondary schools, the number of blackboards and teachers per classroom and whether the household is located in an urban or rural area.

non-longitudinal nature of their survey, they are in a sense able to control for neighborhood fixed effects by comparing children who live in roughly the same block. Their results indicate that the recent loss of a parent significantly affects enrollment, with little difference found for boys and girls, or the gender of the deceased parent. However, the specific pathways through which this outcome is observed are not identified. The authors provide evidence, although indirect, that children do not drop out of school while their parents are sick. This latter finding however contradicts a recent study by Evans and Miguel (2004) that uses a panel data survey constructed from five different surveys that attempted to track 75 primary schools in rural Kenya. The authors estimated the effect of parental death on school participation using child fixed effects Ordinary Least Squares (OLS) regressions. They find that parental death adversely affects schooling. Additionally, they found that there is a small but increasing gap in the attendance between would be orphaned and non-orphaned children two years prior to the death of their parents[4], with the marginal effects greater for children who have lost their mothers. They also present the results of OLS specifications that do not account for fixed effects. They concluded that cross-sectional surveys tend to underestimate the effect of parental death on schooling outcome. Furthermore, the authors see no evidence of a widely held belief that the increasing prevalence of orphanhood threatens the viability of the safety networks, with the local orphan rate having no effect in enrollment rates in those communities.

Using the Integrated and Uganda National Household Surveys of 1992 and 2000, which produced a panel of 1300 households, and looking at foster children in Uganda,

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[4] It should be mentioned that the regression results for pre-parental death are not statistically significant in none of their specifications.

Deminger et al. (2003) estimated household fixed effect OLS regressions. They found that while foster children were at a disadvantage before the introduction of Universal Primary Education (UPE) (which eliminated school fees for up to four children in the same household in Uganda) they were able to "catch up" to children who lived with their biological parents. They found, however, that foster children were less likely to be vaccinated, and that households with two children of their own that received a foster child between 1992 and 2000, had a smaller propensity to invest in productive assets than similar households with two children who had a third of their own. The authors hypothesize that the unforeseen receipt of a foster child is similar to a shock, and the necessity to accommodate the new member could mean a reduction in savings, whereas if households know that they are having a new child, they are able to adjust their consumption needs.

All of these studies somewhat confirm the fact that orphans are at a significant disadvantage when compared to non-orphans. However, due to data limitations in most cases, the specific pathways that induce this outcome are not identified. This identification of the cumulative effect of parental death (via all pathways) provides little guidance to policy makers. Indeed, if children stop attending school because of the trauma associated with the loss of a parent, the provision of school subsidies would have less impact than expected. Also, as this paper argues, if an important factor in the schooling of children, after the death of both parents, has to do with host household resource allocation decisions. Financial subsidies made at the household level would do little to alleviate the problem as they would merely represent an increase in income. Even though measuring the overall impact of parental death is important, identifying the specific ways through which it affects children is also of crucial importance -something that this paper attempts to do.

Another likely consequence of parental death that has received scant attention in the literature is child labor. Children who are not in school can either be idle or working. Lately, the phenomenon of child labor has received a lot of attention, both from a theoretical and an empirical perspective (Basu and Van 1998; Basu 1999; Baland and Robinson 2000, 2002; Rosati and Tzannatos 2003; Edmonds 2004). Most of the early literature on child labor considered work as the only alternative to being in school. In recent studies, there has been an increased recognition, both theoretically as well as empirically, that children not attending school can be idle as well (Balacod and Ranjan 2004; Deb and Rosati 2002).

Looking at the reason why children attend school, work or stay idle, Balacod and Ranjan (2004) develop a formal model where children's time endowment is split between the three activities. Using a dataset from the Philippines, they find that household wealth and child ability are the primary determinants of the decision by households to keep children idle or at work, relative to being in school. On the opposite side of the spectrum, looking at the role of household unobservable characteristics, Deb and Rosati (2002) use a semi-parametric latent class random effect multinomial logistic model. They find that household unobserved heterogeneity is more of a deciding factor than income and wealth heterogeneity in determining which activity children undertake.

The decision to send children to work, or to keep them idle, also hinges crucially on the household's socioeconomic status. Indeed, if households need the extra income that children can provide, they can decide to send them to work rather than keep them idle, especially if these children can be net providers as opposed to being net consumers. Using the KDHS dataset, Beegle et al. (2003) look at the effects of transitory shocks on household income and the use of child labor as a way to mitigate them. The authors find that in general households use child labor to smooth transitory shocks, with the effect magnified for households that are credit constrained. Similarly, Edmonds (2004) finds in South Africa that households where one or more elderly becomes eligible for a large pension significantly reduce the use of child labor. This is associated with an increase in schooling.

These results carry some very important consequences for orphanhood. An obvious reason would be the need to resort to child labor to cope with the shock induced death of a parent. Another possible channel through which children may be affected is through host household resource allocation between their own children and the bereaved ones, once orphaned children are left under the care of surviving relatives. Indeed, if parents expect a higher payoff from investing in the education of their own children than they expect if they invest in educating children who are left under their care, as the next section argues, they will decide to send their own children to school and keep the orphans under their care idle, or send them to work. Consequently, there will be a wedge between the enrollment of orphans and biological children and their future income, even if malevolence is not a factor. The incentive structure induces this outcome, however undesirable it may be.

III- The Model

1- Same Cost of Education for all Children

This paper follows the modeling framework of Rammohan (2000). From the outset, I assume imperfect capital markets and some parents cannot borrow against children's future incomes. Since I do not address credit market failures in this paper, there is a departure from a first best efficient allocation framework. The question being asked is the following: conditional on access to resources, are those resources being allocated efficiently between biological and orphaned children?

Both parents and children live for two periods. In the first period, parents work and invest in children. In the second period they retire and live off the transfers from their children, which in turn are a function of the amount of human capital received in the first period. Children have one unit of time in the first period that they allocate between school and work. Biological children supply an amount L_1 and dedicate $e_1 = 1 - L_1$ to their schooling. Similarly, orphans supply an amount L_2 and dedicate $e_2 = 1 - L_2$ to their schooling (e_i can be thought of as the level of education and L_i represents a combination of labor and leisure/idle time for children). The cost of educating a child is assumed to be constant and the same for both types of children. It is denoted by ψ per unit of schooling. This ψ condition will be relaxed later to allow the cost of education to differ between children. Children earn a wage w per unit of time worked, and this wage accrues to their parents. For non-working children $w=0$. Parents earn an income I which is assumed to be exogenous, derived from the labor that they supply inelastically. Assuming no savings, household consumption in the first period will be given by:

$$C_1 = I + w(2 - e_1 - e_2) - \psi(e_1 + e_2) \qquad (1)$$

Since parents can only observe the fraction of their income that children will transfer to them *a posteriori*, they assume subjectively that due to the biological ties, their own children will transfer a fraction δ_1 of their income, while orphans with whom they have weaker ties will transfer a fraction $\delta_2 < \delta_1$. This situation arises because orphaned children cannot credibly pledge to repay their educational advance. Second period consumption will be given by:

$$C_2 = \delta_1 f(e_1) + \delta_2 f(e_2) \tag{2}$$

with $f(e_i)$ being children's income when they enter the job market. It should be mentioned that ability is an argument of $f(.)$. In order not to complicate the model further, I do not consider it explicitly. This, as well as an explicit consideration of credit markets, could be undertaken in a follow-up paper.

In the first period, parents will maximize the following utility function:

$$V = U(C_1) + \beta U(C_2) \tag{3}$$

with respect to e_1 and e_2 subject to the consumption constraints. β is a discount factor expressed as a function of n which represents the number of years to retirement. I now substitute (1) and (2) into (3), and maximize the utility function with respect to e_1 and e_2. The first order conditions yield:

$$\frac{\partial V}{\partial e_1} = -U'(C_1)(w+\psi) + \beta U'(C_2)\delta_1 f'(e_1) = 0 \tag{4}$$

$$\frac{\partial V}{\partial e_2} = -U'(C_1)(w+\psi) + \beta U'(C_2)\delta_2 f'(e_2) = 0 \tag{5}$$

Dividing equation (4) by equation (5), we get:

$$f'(e_1) = \frac{\delta_2}{\delta_1} f'(e_2) \tag{6}$$

If we assume $f(e_i)$ to be a convex function of e_i, these results indicate that biological children will always get more education than orphaned children if parents perceive δ_1 to be more than δ_2. For illustration, if we chose $f(e_i) = \sqrt{e_i}$, we have $e_1 = \left(\frac{\delta_1}{\delta_2}\right)^2 e_2$ meaning that e_1 will be greater than e_2.

I now allow altruism into the model and parents care about children's future consumption. They give a weight of λ to the future consumption of their own children and a weight of 1 – λ to the consumption of orphaned children. The utility function becomes:

$$V = U(C_1) + \beta U(C_2) + \alpha(\lambda f(e_1) + (1-\lambda) f(e_2))$$

with $\alpha \in [0,1]$ being the degree to which parents are altruistic. We can note that the first case where parents are completely selfish and only care about themselves, corresponds to the case where α = 0. From the first order conditions, we have:

$$\frac{\partial V}{\partial e_1} = -U'(C_1)(w+\psi) + \beta U'(C_2)\delta_1 f'(e_1) + \alpha\lambda f'(e_1) = 0 \tag{7}$$

$$\frac{\partial V}{\partial e_2} = -U'(C_1)(w+\psi) + \beta U'(C_2)\delta_2 f'(e_2) + \alpha(1-\lambda) f'(e_2) = 0 \tag{8}$$

Both equations (7) and (8) confirm something long known in economics: parents will invest in each child until the marginal utility forgone in the first period (in the form of lower consumption) equates the marginal gain in utility in the second period due to transfers from children, and the utility provided by seeing children succeed.

If we define two functions *H* and G as the maximand of $V(.)$ with respect to e_1 and e_2, we get the educational production function of child i, which depends on certain common characteristics and, more importantly, on the education of child j. Using these two functions, we can derive the comparative statics. The interested reader will be referred to the appendix of this paper for a complete derivation and simulation of the results.

$$H(e_1, e_2, w, \psi, \alpha, \beta, \lambda, \delta_1, \delta_2)$$
$$G(e_1, e_2, w, \psi, \alpha, \beta, \lambda, \delta_1, \delta_2)$$

If we divide equation (7) by equation (8), we get a result similar to equation (6). Expressing $f'(e_1)$ as a function of $f'(e_2)$ yields:

$$f'(e_1) = \frac{\delta_2 \beta U'(C_2) + \alpha(1-\lambda)}{\delta_1 \beta U'(C_2) + \alpha\lambda} f'(e_2) \tag{9}$$

For illustration purposes, let us consider again the case where $f = \sqrt[k]{e_i}$. Equation (9) becomes: $e_1 = \left[\frac{\delta_1 \beta U'(C_2) + \alpha\lambda}{\delta_2 \beta U'(C_2) + \alpha(1-\lambda)} \right]^k e_2$ (10)

We can see that since $\delta_1 > \delta_2$, for any given λ such that ½ ≤ λ ≤ 1, e_1 will be greater than e_2. The amplitude will be determined by the shape of the function *f*; as k increases, the wedge between e_1 and e_2 increases. If parents believe that the function *f* has a small magnitude, meaning that the marginal return to education is small, the wedge will be greater. Indeed if parents are concerned that the marginal return to educating children is low, they will chose to invest more in their own children since they are presumed to transfer a higher proportion of their income. This result has broader consequences and suggests that everything else held constant, richer countries need not worry about the orphan problem due to high marginal returns to education.

It is important to note that none of the arguments in the first period utility function enter as determinants of the wedge in the children's education. This means that on the margin, both exogenous income, wages that children receive and the cost of schooling affect both types of children equally. More importantly, none of these parameters are observable household characteristics. Studies attempting to quantify the effect of being orphaned on schooling should therefore pay close attention to this fact. Using single or pooled cross sectional surveys and controlling for "the usual suspects" to measure the impact could yield misleading and biased estimates. Deb and Rosati (2002) as well as Evans and Miguel (2004) cited above provide corroborating empirical evidence for this.

2- Relaxing the ψ condition and Possible Policy Prescriptions

The modeling framework in this section follows the same logic, but this time I relax the assumption that the cost of schooling is the same for both types of children. Household consumption in the first period becomes:

$$C_1 = I + w(2 - e_1 - e_2) - \psi e_1 - \sigma e_2 \tag{11}$$

where ψ and σ respectively represent the costs of educating own and orphaned children. Maximization of the utility function and solving for e_1 as a function of e_2 yield:

$$f'(e_1) = \frac{\left[\delta_2 \beta U'(C_2) + \alpha(1-\lambda)\right]\left[U'(C_1)(w+\psi)\right]}{\left[\delta_1 \beta U'(C_2) + \alpha\lambda\right]\left[U'(C_1)(w+\sigma)\right]} f'(e_2) \tag{12}$$

Proceeding as earlier, I take $f(e_i) = \sqrt{e_i}$, equation 12 becomes:

$$e_1 = \left[\frac{\left(\delta_1 \beta U'(C_2) + \alpha\lambda\right)\left(w+\sigma\right)}{\left(\delta_2 \beta U'(C_2) + \alpha(1-\lambda)\right)\left(w+\psi\right)}\right]^2 e_2 \tag{13}$$

In this case policy makers can chose a value of σ such that $e_1 = e_2$. This should not be mistaken with a blanket financial subsidy to households that are caring for orphaned children. It would only represent an increase in household non-labor income. Even though an increase in income is beneficial to both types of children, the wedge in their education would still remain for relatively poor households. This suggests that targeting orphaned children would be more effective when it is done at the school level rather than at the household level.

IV: The Data

In this paper, I use the Kagera Health and Development Survey (KDHS)[5]. The survey was conducted in the Kagera region of the Federal Republic of Tanzania between 1991 and 1994. Its stated purpose was to measure the economic impact of fatal adult illness due to AIDS and other causes on surviving household members. The survey consists of a stratified sample of 816 households that were followed over the course of three years at six to seven month intervals. In addition to interviewing households, a community questionnaire, as well as a survey of health facilities and traditional healers in the area was included[6]. Out of the original sample, a total of 759 households completed all four survey rounds. The resulting sample consists of 20829 observations of which 4696 are children between the ages of 7 and 14 (inclusive). The summary statistics are displayed in table I. As the table indicates, the sex ratio is close to 1, with 51% of children being male. About 11.2% of all children are maternal orphans, 18.4% of them are paternal orphans and about 8% of them have lost both parents. The school attendance

[5] I am extremely grateful to Kathleen Beegle at the World Bank for making this dataset available.

[6] Traditional Healers were surveyed once.

rate is very low; only 56% of all children currently attend school, 8.5% of them are reported as working and attending school. In addition, 2.9% of them report having worked since the last time they were surveyed. This means that about 11.5% of the children in the sample report being economically active. One would expect to find a difference in the academic performance of those children who work and attend school and those who simply report being in school. Akabayashi and Psacharopoulos (1999) find that there is a trade-off between child labor and reading and mathematical skills in Tanzania; in other words, increased levels of child labor displace human capital accumulation. A sizable portion of these children (32.6%) is reported as being idle; if children were not reported to be active in either one of the previously mentioned categories, I have labeled them as idle. An overwhelming 85.8% of children report doing household chores at an average of 10.3 hours per week. Therefore, some of these children may not be totally idle. For the purposes of this paper, they were still labeled as such (77% of the children labeled as idle report doing house chores).

Tables II and III show the distribution of double orphans stratified by the number of double orphans living in the household. These figures represent the averages across all four waves. We can see that 90.7% of all households do not foster orphans while 6.7% of them foster one and 3.23% foster two or more double orphans. The mean income of these households is not substantially different. It is higher for households fostering one double orphan and lower for households fostering two or more double orphans. Male headed households are least likely to have orphaned children, with non-fostering households headed by a male 74% of the time. These households also have a higher probability of being headed by a younger person, relative to households fostering orphans. The average

age of the head in those households is 49, close to the mean of 49.7. As table III reveals, 74% of the school aged children in non-fostering households are the children of the head while the comparative figures are respectively 21% and 8% for households with one and two or more double orphans.

Table III also shows the relative proportion of double orphans and own children attending school and working by stratified households. Households with zero orphans are least likely to send their children to school, with only 56% of the children living in these households reporting school attendance, compared to 67% and 75% for households with respectively one and two or more orphans. The comparable figures for orphans are 52% and 53%, substantially lower than those of biological children. The child labor figures display a pattern that is exactly opposite, declining sharply from 11.3% to 2.5% as the households add one double orphan and reaching 0% for households that foster two or more orphans. For double orphans, we can observe that 12.8% of them work in households with one orphan, and this figure rises slightly to 13.3% for households that have two or more orphans. Across all stratified categories, we can see that orphans are much less likely to be in school than biological children, and more likely to be at work. Moreover, the schooling of the latter rises as the household adds one or more orphans. It could well be because their work burden declines substantially. This is a preliminary indication that there is a preferential treatment for own children.

Table IV shows the fraction of children receiving a subsidy. Subsidies were classified in three categories: financial subsidies received from household members, external subsidies that were received from people outside the household and in-kind subsidies. A fraction of 1.98% of all children (59 out of 4696) received a financial subsidy during the survey period. Orphans fare relatively better, as 9% of all orphans receive financial support, 10% of them have an external benefactor and approximately 25% of them receive some sort of in-kind support, compared respectively to 1.36%, 7% and 18.34% for non orphans. The majority of children, both orphans and non-orphans, do not receive any kind of support. Although this situation may not be problematic for those children living with their parents, the same cannot be said of children with no living parents for the reasons outlined earlier.

V. Methods and Identification Strategy

V.1. Methods

To test the predictions of the model developed in section III, one can either attempt to estimate the structural equation (equation 10), or else estimate reduced form equations that would control for the unobservable household characteristics. The equations to be estimated are:

$$Activity_{ijkt} = \Lambda(CHILD_{ijt}\beta_{1k} + D.ORPHAN_{ijt}\beta_{2k} + HHOLD_{ijt}\beta_{3k} + \varepsilon_{jt}) \quad (1)$$

$$Expenditure_{ijt} = \mathrm{E}(CHILD_{ijt}\gamma_1 + D.ORPHAN_{ijt}\gamma_2 + HHOLD_{ijt}\gamma_3 + \varepsilon_{jt}) \quad (2)$$

and $Ability_{ijt} = \mathrm{H}(CHILD_{ijt}\tau_1 + D.ORPHAN_{ijt}\tau_2 + HHOLD_{ijt}\tau_3 + \varepsilon_{jt})$ (3)

Equation (1) considers the full range of activities that children can undertake, with school attendance as the comparison category. The dependent variable is a categorical choice variable that takes the value of 1 if child *i=1,2,3…..N* in household *j=1,2,3…..J* at time *t=1,2,3,4* undertakes activity *k=1,2,3,4* and 0 otherwise. The values of k respectively stand for school attendance, work, work and school and idle. These activities were constructed to be mutually exclusive. *CHILD*[7] is a vector of child characteristics and *HHOLD* is a vector of household characteristics. The main variable of interest *D.ORPHAN* is a binary variable taking a value of 1 if the child has lost both parents and 0 otherwise. In order to clearly identify the effect on double orphans, all of the orphan categories were constructed to be mutually exclusive. For instance, a child is a paternal orphan if only her mother is alive and vice versa. In all previous specifications, neither paternal nor maternal orphans were found to be significantly different from children whose parents were living (results not shown), which in part strengthens the main claim of this paper. They were subsequently aggregated with the control group.

The error term has two components: a time varying factor u_j that captures household specific characteristics and a time invariant factor η_j that measures fixed household characteristics that are constant over time.

An issue that arises in the estimation of equations (1) through (3) is that they have to account for the time invariant component of the error term. Not accounting for this will bias the standard errors in the linear case, and both the parameter estimates and standard errors in the non-linear case. In the linear case however, these unobserved characteristics can be differenced out. The resulting coefficients and standard errors will be consistent. This is not the case in the non-linear model. There are several ways of accounting for the time invariant factors in this equation (1) depending on the specification of the error term in the underlying random utility function. The most flexible specification assumes jointly normally distributed errors. This approach leads to the Multiperiod Multinomial Probit (MMP). A major advantage of the MMP is that the covariance matrix allows for rich substitution patterns across time and across alternatives. A drawback of this estimation

[7] One can think of the set of characteristics as arguments in a random utility model.

strategy though is that it requires a multidimensional integration of the conditional likelihoods. Even though simulation methods have proved a useful alternative to expensive numerical integration, for the purposes of this paper, unless a fully parametric random effects structure is imposed, the normalized unrestricted covariance matrix has $T^2(J-1)^2/2$ (72) free parameters (where J is the number of alternatives and T is the number of time periods), making simulation computationally cumbersome (see Train (2003) for a discussion).

A second approach would be to estimate a Conditional Fixed Effects Multinomial Logit model (FEMNL), developed by Chamberlain (1980), and used by Börsch-Supan and Pollakowski (1990) to analyze housing consumption adjustments over time in the United States. This method conditions on the total number of possible choices of the households/individuals that change consumption in the panel at least once, and thus conditions out the time invariant factors[8]. For the purposes of this study, each household chooses the type of activity undertaken *(k=4)* for each child (*d=2* (orphan and non-orphan)) in each of the four different time periods *(t=4 waves)*. This gives us an aggregate choice sequence of $2^{4\times4}$=65536, which makes the method computationally infeasible. Due to these computational difficulties, for the purposes of this paper, I will estimate a set of multinomial logit models (MNL) with the standard errors clustered at the household level. A weakness of the MNL however is that the errors are assumed to be independent identically distributed according to a type I extreme value. The resulting error difference is logistically distributed, giving rise to the restrictive IIA assumptions.

[8] See Chamberlain (1980) and Börsch-Supan and Pollakowski (1990) for a detailed explanation of the FEMNL.

In this section, I also attempt to compare children before and after the death of their parents. Activity is estimated as a function of current and future orphan status and current household characteristics, where future orphan status is forward looking and means that orphanhood is not yet realized and will occur in the next survey period. It should be stressed however that all observations from the final round will not be used by this strategy because future orphan status can only be observed for children in the third survey period. A different estimation method was used by Evans and Miguel. In their specifications, they include both lagged and forward looking orphan status variables and control for student fixed effects. For the purposes of the present study, I estimate separate equations because of the fact that when children lose both of their parents, they can physically move to a different household. This means that the activities of children, when they are considered future orphans and when they are actually orphaned, are a function of different household characteristics. Therefore, including both terms in the same regressions would yield spurious results. However, this situation raises some identification issues that will be addressed in the next sub-section.

If it is found that future wave double orphans are no more likely than other children to be at work, work and attend school or to be idle, relative to attending school, then any change in their status after they become orphaned can be attributed to the changes induced by their relocation to a new household. Though this model would suffer from an omitted variable bias (household unobserved characteristics that are correlated with children's activities) the results can be contrasted with those in the literature. For robustness checks, I will also report the results of the separate linear fixed effects estimates of school attendance and child labor.

The second equation looks at household level schooling expenditures on biological versus orphaned children. These expenditures include those on books, UPE contributions, uniforms, other miscellaneous school expenditures (pocket money for instance) and total school expenditures. These expenditure categories are left truncated at zero, due to households where there are no school aged children, and those that chose not to send them to school. To account for this, I estimate a set of household fixed effects OLS and random effects tobit regressions. Both specifications have their strengths and weaknesses; while the random effects tobit model takes into account the left truncation of the data, it does not control for household unobserved heterogeneity, and provides biased estimates if the unobservables are correlated with the observed household characteristics. This unobservable heterogeneity is solved in the linear fixed effects case, but this model does not take into account the truncated nature of the data.

Finally, the third equation looks at the efficiency issue. Even if it is found that orphans receive less education (both in terms of going to school and expenditure on their education) than their non-orphaned peers, a question that still begs an answer is whether this is cause for concern. In other words, is this allocation of resources efficient? This is precisely one of the questions that motivated this paper. Indeed, if these resource allocation decisions are made on the basis of the children's abilities, then governments need not intervene at the host household level because orphans simply have a lower ability than other children. In that case, other ways of educating them, such as special educational programs, should be devised in order to help them. Conversely, if it is found that orphans as a group do not have a lower ability than other children, then these resource allocation decisions would clearly constitute a case of market failure, requiring a different form of government intervention. In order to answer this question, I estimate a set of reduced form linear household fixed effect regressions of children's reading, writing and mathematical abilities as a function of future and currently observed orphan status, and the independent variables used in all the other specifications[9]. As in the first specification, if future wave orphans prove to be no different than other children before the loss of their parents, then any change in their attributes would be evidence that their human capital only deteriorates once they join their host households.

The set of explanatory variables includes both child and household characteristics. The child specific characteristics include orphan status, the child's age and its squared term, the sex of the child and whether or not the child receives a subsidy. Household characteristics include the age of the head of the household, a measure of income, the number of children of school age and household size. To proxy for children's wages, I include a measure of farm land cultivated by the household in acres and the number of livestock owned by the household. These two variables are proxies for the opportunity cost of keeping children in school. Both of these variables have a substitution and an income effect. For example, if it is found that children in families with larger farms are more likely to be at work, it would simply mean that the substitution effect dominates the income effect; that is if children's schooling is considered a normal good while child labor is considered an inferior good. For an exposition of the inefficiencies of child labor, see Baland and Robinson (2000).

[9] [9] Unfortunately, reading, writing and math scores aren't available in this survey. The only questions that are asked in the survey are whether the person can read a newspaper, write a letter and perform numerical calculations. The same procedure was used by Akabayashi et al. (1999) to study the trade-off between child labor and human capital formation in Tanzania.

V.2. Identification Strategy

The estimation of equations 1 through 3 raises two key issues concerning the interpretation of the coefficient of *D.ORPHAN*. For example, if I get a negative coefficient $(\beta_{D.ORPHAN} < 0)$ after the estimation of school attendance and school related expenditures, this may simply reflect the fact that the recent death of a working adult may leave a temporary or even a permanent income vacuum, meaning that orphans will tend to live in households with lower socio-economic status. This, however, is not much of a concern in light of the income comparisons of table II which reveal that households with one orphan are generally richer, with no significant difference between the incomes of households with zero orphans and those with two or more orphans. Consequently, one might argue that if income was the only factor, then we should actually expect a positive sign for the coefficient of *D.ORPHAN*. Since in all of the specifications, I have also controlled for a direct measure of income, a measure of farm size and the number of livestock, the household fixed effects will take into account any variations in these measure and yield "a pure orphan effect".

A second issue relates to a problem mentioned above: double orphans may be placed in physically different households upon the death of their parents. If those new households are of lower socioeconomic status, then the coefficient of *D.ORPHAN* will actually pick up this effect. This is different than the case depicted above where only household income drops but the physical household remains the same. In the latter case, the linear household fixed effects will not account for this variation (the physically different household). A consistent estimation of the parameters would require the use of estimation techniques with error component methods that would distinguish between unobserved heterogeneity and individual dynamics. There are however many technical issues that would need to be addressed for a consistent estimation of the parameters, making it another research topic in its own respect.

VI. Results

1- Children's Activities: *Multinomial Logit Estimates*

Table V presents the results of the multinomial logit estimates of children's activities clustered at the household level with current school attendance as the comparison category. As indicated earlier, activity varies between school attendance, work, work and school and idle. The first three columns of table V look at the relationship between orphan status and the likelihood to undertake a particular activity relative to school attendance. The last three columns look at the activities of children who will be orphaned in the next survey period. Overall, both equations fit fairly well with respectively 69.66% and 69.83% of the outcomes predicted correctly.

Across all activities (columns I to III) we can see that double orphans are significantly more likely to be at work and to be idle relative to being in school, while the work and school category is not significant. Turning our attention to the results in columns IV to VI we can see that none of these activities are significant for future wave double orphans. This indicates that while orphans are no less likely to drop out of school before the death of their parents, they have an increased likelihood of dropping out once they join their host households. These results are largely confirmed by the OLS fixed effects regression results of school attendance and child labor in table VI, with the marginal effects bigger in the latter case[10] (respectively 15.3 and 6.3 versus 9.4 and 1.58 percentage points). Therefore, the timing of orphan status proves to be a deciding factor as to which activity children undertake. These results are even more relevant in the presence of the AIDS epidemic which is associated with a protracted illness before the death of the patient. While many studies hypothesize about the potential destabilizing effects of parental illness, the empirical results provided here indicate that this is not really a cause for concern. Children are kept in school even when their parents are ill. Intuitively, this should be the case. Children play little or no role in the treatment of their parents, a task generally undertaken by the patient's parents and other older relatives. In some cases, especially with the degrading nature of the AIDS epidemic, children could be purposely sent to school so that they won't witness their parents' agony. This is consequently a clear indication that children's fortunes change significantly once they lose both parents.

A number of other effects are also noteworthy. Age has a quadratic effect in all the three categories, meaning that the propensity to work or to be idle declines with age but then rises as children get older with the respective vertices located at around ages 11 and 13. The effect of age is not significant for the work and school category. As expected, children who receive a subsidy are significantly less likely to be at work or idle and surprisingly more likely to work and attend school than attend school alone. The opportunity cost of being in school, as indicated by the area of land cultivated by the household, has a negative and significant effect on the work and work and school categories relative to being in school only. This indicates that the income effect of

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[10] The marginal effects of the multinomial logit were computed at the mean and the results are not shown.

farmland dominates its substitution effect. Income has the expected negative effect on all three activity variables, but the relationship is significant only for the idle category. Children in larger households are no more likely to be at work than their peers, but they have a higher propensity to work and attend school. They also have a lower probability of being idle, all relative to being in school. The number of children of school age living in the household has the same effect as household size with the signs reversed for all three categories. This is to say that, while children in households that have a lot of children between the ages of 7 and 14 are less likely than their peers to work and attend school, they are also more likely to be idle. The effect of the head's age as a proxy for the discount factor is consistent with the predictions of the model. It indicates that the older the head of the household, the more likely children will be attending school rather than being at work or idle. The reason for this is intuitive theoretically; since older parents discount the future less, they will put more weight on future period utility than their younger counterparts. Also, more practically, older household heads are expected to have older children who can provide for them and also look after their siblings, therefore freeing resources to send their young siblings to school.

2- Resource Allocation Decisions: *School Expenditures*

Next, I turn to school expenditure decisions as indicated by expenditures on books, UPE, uniforms, other miscellaneous school expenditures (pocket money for instance) and total school expenditures. The results are displayed in tables VII and VIII. Table VII presents the results of the random effects tobit regressions, while table VIII presents the results of the linear fixed effects regressions. Across all expenditure categories, we can see that expenditures on double orphans are significantly lower than those on other children even when subsidies are controlled for. In other specifications considering only children that do not receive a subsidy (not shown), the results are the same and the marginal effects are even larger. The other variables have the expected signs, with age having an inverted U-shape. The results also indicate that children in households headed by a woman fare relatively better than their counterparts in households headed by a man, with no difference being found for girls and boys.

These results partly substantiate the model's claims, indicating that household school investment decisions are skewed towards biological children, and that the resulting effect means that orphans will get less investment.

3- Efficiency Issue: *Reading, Writing, and Mathematical Abilities*

To answer the efficiency question, I now turn to the results of equation 3. They are presented in table IX. The adjacent columns of the table respectively present the results for reading, writing and mathematical abilities of current and future wave orphan status. As suspected, the sign of the coefficient of *D.ORPHAN* is negative and significant while that of future wave double orphans is insignificant across all three learning categories. The results clearly indicate that while future orphans do not have a lower ability than other children before the death of their parents, their reading, writing and mathematical skills deteriorate thereafter. This is direct evidence that orphans do not systematically have a lower ability than other non afflicted children. The deterioration in their human capital accumulation is only induced by the distorted allocations in their host households. It is an indication that orphans are implicitly taxed once they lose their parents. The discussion in the next section will attempt to provide some policy guidelines to remedy the problem.

Another finding that is of potential interest is that girls seem to have superior abilities than boys both in terms of writing and reading. There is no significant difference in their mathematical abilities. In all the previous specifications, no difference was found in either their school attendance or the amount that is being invested in them. Numerous studies looking at education in Africa have found no difference in the education of boys and girls. Their conclusions have been that there is no preference for either sex (Kevane, 2004). These results are partly an indication that this is not the case. For the sake of efficiency, economic theory suggests that resources should be allocated where they have their most productive use. If girls learn better than boys, they should get a higher share of household expenditure on education. These shortcomings can therefore be interpreted as an indirect evidence of a preferential treatment for boys. This result is simply a byproduct of the topic considered and could be a fertile area for further investigation.

VII- Conclusion

This paper looked at the effects of losing a parent or both on the types of activities that those children subsequently engage in. It also looked at the differences in educational outlays of host households between children who have lost their parents and their non-afflicted peers. The results clearly indicate that orphanhood is of critical importance to human capital formation. The probability of engaging in child labor and being idle increase relative to being in school once children lose both parents. This has the same distortionary effect as a tax on children as a result of orphanhood. Even though these children do not have markedly lower abilities to read, write or perform written calculation before the death of their parents, they are outperformed in all three categories once they lose their parents and join a new household. This is attributed to a distortion in host household resource allocation decisions. As the model in section III shows, parents will favor their biological children if they place more weight in the fortunes of their own children or if it is thought that biological children are a more reliable safety net, providing a higher share of their income to their parents than orphaned children would.

The discussion in section III-2 indicates that this issue can be dealt with effectively by the provision of subsidies. However, this should not be mistaken with a blanket financial subsidy to households fostering orphans. Since host household resource allocation decisions are part of the problem why orphans are not in school, subsidies provided at the household level will not necessarily be channeled towards educating them. In other words, the provision of subsidies does not affect the incentive structure. Since these distortions arise because economic decision-making is granted to the family, the provision of in-kind subsidies that target orphans at the school level is more likely to have a bigger impact, and will probably constitute a more cost effective way of achieving the desired results.

An analogous topic would extend this discussion to fostering decisions. There are numerous issues that would arise in the case of fostering though. While the process of fostering orphaned children can be thought of as exogenous because people do not foresee the death of a family member, this is not the case when fostering and adoption decisions are made. Modeling and estimating such process would have to take into account the fact that fostering decisions are sometimes made at the same time as fertility decisions, making both decisions endogenous[11]. Also, another issue that is likely to arise in this type of study is that foster families may not just want to foster any child. They would instead choose to foster or adopt children who potentially would have relatively superior abilities. This gives rise to a selection issue that the researcher would have to take into account as well.

[11] This is not a far fetched claim if one considers the fostering and adoption process in the US. It is frequent to hear people assert that they do not want a child of their own but would instead resort to adoption.

Table I: Summary Statistics

Dependant variable	***Description Of Variables***	***Mean And Stand Dev.()***
Children's Activities	Categorical variable with a value of 1 if child was in school since the last survey period, 2 if child worked, 3 if child worked and attended school and 4 if child was idle.	2.17 (1.38)
Log Books	Log household expenditure on books on each child in schillings.	2.61 (2.63)
Log UPE	Log household expenditure on UPE on each child in schillings.	1.78 (2.51)
Log Uniform	Log household expenditure on uniforms on each child in schillings.	1.97 (3.17)
Log Other	Log miscellaneous school related household expenditures on each child in schillings.	1.57 (2.30)
Log Total	Log total school related household expenditures on each child in schillings.	3.84 (3.30)
Reading	Dichotomous 0-1 variable, 1 if child can read a newspaper, 0 otherwise.	0.43 (0.49)
Writing	Dichotomous 0-1 variable, 1 if child can write a letter, 0 otherwise.	0.35 (0.48)
Math	Dichotomous 0-1 variable, 1 if child can perform numerical calculations, 0 otherwise.	0.48 (0.50)
Independent Variables		
Child Characteristics		
Double Orphans_t	Dichotomous 0-1 variable, 1 if child is a double orphan, 0 otherwise.	0.08 (0.27)
Double Orphans_{t+1}	Dichotomous 0-1 variable, 1 if child will be a double orphan in the next survey period, 0 otherwise.	0.07 (0.26)
Paternal Orphans	Dichotomous 0-1 variable, 1 if child is a paternal orphan, 0 otherwise.	0.18 (0.38)
Maternal Orphans	Dichotomous 0-1 variable, 1 if child is a maternal orphan, 0 otherwise.	0.11 (0.31)
House Chores	Dichotomous 0-1 variable, 1 if child performs household related chores and 0 otherwise.	0.86 (0.35)
Hours Chores	Number of hours children spent on household chores in the past week.	10.31 (9.34)

Age	Age of the child in years.	10.7 (2.32)
Age Squared	Age of the child in years squared.	119 (49.0)
Male	Sex of child, 1 if boy, 0 if girls.	0.51 (0.49)
Subsidized	Dichotomous 0-1 variable, 1 if child receives subsidy, 0 otherwise.	0.25 (0.43)
Household Characteristics		
Head's Educ	Education of the head of the household in years.	4.20 (3.12)
Head Male	Sex of the head of the household, 1 if male, 0 if female	0.73 (0.44)
Household Size	Number of household members currently residing in the dwelling unit.	8.84 (3.90)
Children7-14	Number of children between age 7 and 14 living in the household.	3.75 (1.81)
Log HH Income	Log of total household income divided by 10000.	2.71 (0.91)
Farm Area	Farm area cultivated by household in acres.	6.45 (22.6)
Log Livestock	Log of number of livestock owned by the household	1.40 (1.75)

Table II: Distribution of Double Orphans by Stratified Households

N Orphans	Absolute Frequency	Relative Frequency	Mean Income	% Head Male	Head's Age	Dependency Ratio
0	2767	90.7%	203392	74%	49	1.64
1	187	6.7%	259599	57%	52	1.24
≥2	82	3.23%	197381	49%	57	1.04

Table III: Relative Proportion of Own Children and Orphans in School and at Work by Stratified Households

N Orphans	% Own Children	% of D. Orph.	% Own Child. in School	% D. Orph in School	% Own Child Working	% D. Orph Working
0	74%	0%	56%	-	11.3%	-
1	21%	50.4%	67%	52%	2.5%	12.8%
≥2	7.9%	74.5%	75%	53%	0%	13.3%

Table IV: Children Receiving Subsidy

Child Type	% Financial Subsidy		% External Benefactor		% Receiving In-kind		N
Non Orphan	(59)	1.36%	(302)	6.98%	(793)	18.34%	4322
Orphan	(34)	9%	(37)	9.89%	(93)	24.87%	374
Total	(93)	1.98%	(339)	7.22%	(886)	18.87%	469

Table V: Multinomial Logit Estimates of Children's Activities

	Current Orphan Status			***Future Orphan Status***		
	Work	Work & Sch	Idle	Work	Work & Sch	Idle
Age	-1.970***	0.116	-2.188***	-1.852***	0.005	-2.188***
	(0.446)	(0.339)	(0.229)	(0.539)	(0.398)	(0.253)
Age Squared	0.090***	0.002	0.086***	0.084***	0.007	0.086***
	(0.021)	(0.015)	(0.011)	(0.025)	(0.018)	(0.012)
Male	0.148	-0.182	-0.013	0.208	-0.060	-0.030
	(0.200)	(0.112)	(0.109)	(0.224)	(0.131)	(0.114)
Double $Orphan_t$	0.658**	-0.010	0.526**			
	(0.335)	(0.205)	(0.212)			
Double $Orphan_{t+1}$				0.205	-0.022	0.326
				(0.422)	(0.263)	(0.229)
Head Male	0.123	-0.010	0.571***	0.242	0.058	0.580***
	(0.245)	(0.146)	(0.133)	(0.298)	(0.179)	(0.140)
Subsidized	-2.720***	0.228**	-3.732***	-3.212***	0.218*	-3.708***
	(0.449)	(0.107)	(0.275)	(0.713)	(0.128)	(0.320)
Farm Area	-0.064**	-0.019*	0.002	-0.075**	-0.012	0.000
	(0.027)	(0.011)	(0.001)	(0.036)	(0.012)	(0.011)
Log Livestock	0.061	-0.018	-0.042	0.008	-0.016	-0.027
	(0.061)	(0.035)	(0.034)	(0.070)	(0.041)	(0.037)
Head's Educ.	-0.192***	-0.039*	-0.201***	-0.191***	-0.042	-0.205***
	(0.040)	(0.022)	(0.021)	(0.048)	(0.027)	(0.022)
Log HH Income	-0.171	-0.088	-0.110**	-0.175	-0.093	-0.051
	(0.126)	(0.077)	(0.055)	(0.143)	(0.087)	(0.058)
Household Size	0.025	0.088***	-0.050**	0.035	0.080***	-0.039
	(0.033)	(0.019)	(0.022)	(0.038)	(0.023)	(0.026)
Children7-14	-0.005	-0.108***	0.089**	-0.082	-0.125**	0.047
	(0.077)	(0.040)	(0.045)	(0.091)	(0.050)	(0.050)
Head's Age	-0.024***	-0.000	-0.021***	-0.025***	-0.000	-0.023***
	(0.008)	(0.004)	(0.004)	(0.008)	(0.005)	(0.004)
Constant	10.079***	-3.351*	14.674***	9.716***	-2.720	14.708***
	(2.396)	(1.889)	(1.206)	(2.902)	(2.199)	(1.339)
Observations	4696	4696	4696	3554	3554	3554

Robust standard errors in parentheses;
* significant at 10%; ** significant at 5%; *** significant at 1%

Table VI: OLS Fixed Effects Estimates of School Attendance and Child Labor

	School Attendance	School Attendance	Child Labor[12]	Child Labor
Age	0.447***	0.455***	-0.007	-0.014
	(0.035)	(0.030)	(0.025)	(0.023)
Age Squared	-0.018***	-0.019***	0.001	0.002
	(0.002)	(0.001)	(0.001)	(0.001)
Male	0.011	0.023	-0.007	-0.013
	(0.017)	(0.015)	(0.013)	(0.011)
Double $Orphan_{t+1}$	-0.045		0.018	
	(0.040)		(0.029)	
Double Orphan		-0.153***		0.063**
		(0.033)		(0.025)
Head Male	-0.060	-0.025	-0.083	-0.040
	(0.071)	(0.053)	(0.051)	(0.040)
Subsidized	0.191***	0.187***	0.028*	0.030**
	(0.020)	(0.016)	(0.014)	(0.012)
Head's Educ	-0.007	0.001	0.009	0.008
	(0.008)	(0.006)	(0.006)	(0.005)
Log Income	-0.004	-0.003	-0.014*	-0.007
	(0.012)	(0.010)	(0.008)	(0.008)
Log Livestock	0.015	0.018	0.006	0.001
	(0.019)	(0.016)	(0.014)	(0.012)
Farm Area	0.002	0.000	-0.002	-0.002
	(0.005)	(0.004)	(0.004)	(0.003)
Household Size	0.013*	0.001	0.006	0.014***
	(0.008)	(0.006)	(0.006)	(0.004)
Children7-14	-0.009	-0.009	-0.012	-0.015**
	(0.013)	(0.010)	(0.009)	(0.007)
Head's Age	0.009***	0.004**	-0.005***	-0.001
	(0.002)	(0.002)	(0.002)	(0.001)
Constant	-2.563***	-2.263***	0.349**	0.096
	(0.235)	(0.194)	(0.170)	(0.146)
Observations	3554	4696	3554	4696
R-squared	0.19	0.18	0.03	0.03

Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

[12] Here Child Laborers were defined to include children working and going to school because of the lack of variation in the crude measure. For the rationale, see discussion in section IV.

Table VII: Random Effects Tobit Estimates of School Expenditures on Children

	Books	UPE	Uniforms	Other	Total
Age	4.875***	6.743***	8.067***	5.140***	5.344***
	(0.293)	(0.512)	(0.783)	(0.453)	(0.302)
Age Squared	-0.185***	-0.269***	-0.323***	-0.202***	-0.208***
	(0.013)	(0.023)	(0.036)	(0.021)	(0.014)
Male	-0.134	-0.248	-0.121	-0.245	-0.009
	(0.127)	(0.212)	(0.300)	(0.190)	(0.136)
Double Orphan	-0.888***	-2.643***	-2.498***	-1.152***	-0.947***
	(0.264)	(0.468)	(0.611)	(0.389)	(0.293)
Head Male	-0.559**	-0.102	0.435	-0.321	-0.534*
	(0.250)	(0.365)	(0.391)	(0.317)	(0.305)
Subsidized	1.250***	1.408***	2.116***	1.871***	1.711***
	(0.134)	(0.221)	(0.336)	(0.199)	(0.146)
Farm Area	-0.002	-0.004	0.000	-0.002	-0.003
	(0.005)	(0.011)	(0.009)	(0.008)	(0.005)
Log Livestock	0.124*	0.121	0.067	0.026	0.144**
	(0.070)	(0.089)	(0.093)	(0.078)	(0.072)
Head's Education	0.266***	0.203***	0.309***	0.229***	0.276***
	(0.037)	(0.054)	(0.058)	(0.047)	(0.040)
Log HH Income	0.185**	1.338***	2.170***	0.844***	0.366***
	(0.082)	(0.136)	(0.188)	(0.123)	(0.090)
Household Size	0.072*	-0.142***	-0.179***	-0.026	0.039
	(0.037)	(0.049)	(0.057)	(0.045)	(0.035)
Children7-14	-0.085	0.055	0.313***	-0.018	-0.003
	(0.066)	(0.102)	(0.121)	(0.093)	(0.073)
Head's Age	0.023***	0.021*	0.028**	0.018*	0.025***
	(0.008)	(0.011)	(0.011)	(0.009)	(0.009)
Constant	-32.104***	-46.794***	-61.100***	-36.815***	-33.740***
	(1.650)	(2.867)	(4.313)	(2.523)	(1.678)
Observations	4696	4696	4696	4696	4696
Number of group	617	617	617	617	617

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table VIII: Linear Fixed Effects Estimates of School Expenditures on Children

	Books	UPE	Uniforms	Other	Total
Age	1.713***	1.606***	1.563***	1.021***	2.577***
	(0.145)	(0.160)	(0.209)	(0.149)	(0.178)
Age Squared	-0.058***	-0.061***	-0.059***	-0.036***	-0.095***
	(0.007)	(0.008)	(0.010)	(0.007)	(0.008)
Male	-0.040	-0.011	0.027	-0.036	0.065
	(0.072)	(0.080)	(0.103)	(0.074)	(0.088)
Double Orphan	-0.459***	-0.701***	-0.444*	-0.307*	-0.470**
	(0.162)	(0.179)	(0.232)	(0.166)	(0.199)
Head Male	-0.430*	0.094	0.420	-0.370	-0.467
	(0.260)	(0.287)	(0.373)	(0.267)	(0.319)
Subsidized	0.709***	0.492***	0.770***	0.676***	1.146***
	(0.080)	(0.088)	(0.115)	(0.082)	(0.098)
Farm Area	-0.009	-0.018	0.002	-0.017	-0.011
	(0.020)	(0.022)	(0.029)	(0.021)	(0.025)
Log Livestock	-0.128	-0.101	-0.087	-0.153*	-0.067
	(0.079)	(0.087)	(0.114)	(0.081)	(0.097)
Head's Education	0.034	-0.024	-0.012	-0.014	0.043
	(0.031)	(0.034)	(0.044)	(0.032)	(0.038)
Log HH Income	0.051	0.414***	0.510***	0.237***	0.175***
	(0.050)	(0.055)	(0.071)	(0.051)	(0.061)
Household Size	0.015	-0.174***	-0.313***	-0.066**	-0.076**
	(0.027)	(0.030)	(0.039)	(0.028)	(0.033)
Children7-14	-0.101**	-0.071	0.081	-0.086*	-0.132**
	(0.046)	(0.051)	(0.066)	(0.048)	(0.057)
Head's Age	0.003	0.013	0.003	0.001	0.009
	(0.008)	(0.009)	(0.012)	(0.008)	(0.010)
Constant	-8.538***	-7.823***	-7.030***	-4.337***	-12.040***
	(0.943)	(1.040)	(1.352)	(0.969)	(1.156)
Observations	4696	4696	4696	4696	4696
Number of group	617	617	617	617	617
R-squared	0.28	0.15	0.11	0.13	0.29

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table IX: Linear Fixed Effects Estimates of Children's reading, writing and Mathematical Abilities

	Reading	Reading	Writing	Writting	Math	Math
Age	0.140***	0.140***	-0.039	-0.041	0.257***	0.239***
	(0.030)	(0.026)	(0.030)	(0.026)	(0.030)	(0.026)
Age Squared	-0.001	-0.001	0.007***	0.007***	-0.007***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Male	-0.030**	-0.025*	-0.044***	-0.041***	-0.016	-0.007
	(0.015)	(0.013)	(0.015)	(0.013)	(0.015)	(0.013)
Double Orphan$_{t+1}$	-0.032		-0.046		-0.056	
	(0.034)		(0.034)		(0.034)	
Double Orphan		-0.074**		-0.048*		-0.093***
		(0.029)		(0.029)		(0.029)
Head Male	0.036	0.088*	-0.036	0.039	-0.070	-0.020
	(0.061)	(0.046)	(0.060)	(0.046)	(0.061)	(0.047)
Subsidized	0.154***	0.160***	0.126***	0.132***	0.172***	0.179***
	(0.017)	(0.014)	(0.017)	(0.014)	(0.017)	(0.014)
Head's Educ	-0.002	0.002	-0.002	0.001	0.003	0.004
	(0.007)	(0.005)	(0.007)	(0.005)	(0.007)	(0.005)
Log Income	-0.005	0.001	0.010	0.015*	0.003	0.007
	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)
Log Livestock	-0.011	-0.019	-0.011	-0.012	-0.001	0.001
	(0.016)	(0.014)	(0.016)	(0.014)	(0.017)	(0.014)
Farm Area	0.002	-0.002	0.003	-0.001	-0.001	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Head Age	0.002	0.001	0.003	0.000	0.002	0.001
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Household Size	-0.006	-0.009*	-0.019***	-0.014***	0.001	0.005
	(0.007)	(0.005)	(0.006)	(0.005)	(0.007)	(0.005)
Children7-14	-0.014	-0.003	-0.011	-0.004	-0.018	-0.019**
	(0.011)	(0.008)	(0.011)	(0.008)	(0.011)	(0.008)
Constant	-0.945***	-0.934***	0.006	0.009	-1.492***	-1.419***
	(0.201)	(0.168)	(0.200)	(0.167)	(0.203)	(0.169)
Observations	3554	4696	3554	4696	3554	4696
# of groups	601	617	601	617	601	617
R-squared	0.38	0.37	0.36	0.35	0.38	0.37

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Appendix

$$H(e_1, e_2, w, \psi, \alpha, \beta, \lambda, \delta_1, \delta_2)$$

$$G(e_1, e_2, w, \psi, \alpha, \beta, \lambda, \delta_1, \delta_2)$$

$$F = \frac{\partial V}{\partial e_1} = -U'(C_1)(w-\psi) + \beta U'(C_2)\delta_1 f'(e_1) + \alpha\lambda f'(e)$$

$$G = \frac{\partial V}{\partial e_2} = -U'(C_1)(w-\psi) + \beta U'(C_2)\delta_2 f'(e_2) + \alpha(1-\lambda) f'(e_2)$$

$$H_{e1} = \frac{\partial H}{\partial e_1} = -U''(C_1)\frac{\partial C_1}{\partial e_1}(w+\psi) + \delta_1\beta U''(C_2)\frac{\partial C_2}{\partial e_1} f'(e_1) + \delta_1\beta U'(C_2) f''(e_1) + \alpha\lambda f''(e_1)$$

$$H_{e2} = \frac{\partial H}{\partial e_2} = -U''(C_1)\frac{\partial C_1}{\partial e_2}(w+\psi) + \delta_1\beta U''(C_2)\frac{\partial C_2}{\partial e_2} f'(e_1)$$

$$H_\lambda = \frac{\partial H}{\partial \lambda} = \alpha f'(e_1)$$

$$H_{\delta 1} = \frac{\partial H}{\partial \delta_1} = \beta f'(e_1)[\delta_1 U''(C_2)\frac{\partial C_2}{\partial \delta_1} + U'(C_2)]$$

$$H_{\delta 2} = \frac{\partial H}{\partial \delta_2} = \delta_1\beta U''(C_2)\frac{\partial C_2}{\partial \delta_2} f'(e_1)$$

$$H_w = \frac{\partial H}{\partial w} = -U'(C_1)$$

$$H_\beta = \frac{\partial H}{\partial \beta} = \delta_1 U'(C_2) f'(e_1)$$

$$H_\psi = \frac{\partial H}{\partial \psi} = -U'(C_1)$$

$$G_{e2} = \frac{\partial G}{\partial e_2} = -U''(C_1)\frac{\partial C_1}{\partial e_2}(w+\psi) + \delta_2\beta U''(C_2)\frac{\partial C_2}{\partial e_2} f'(e_2) + \delta_2\beta U'(C_2) f''(e_2) + \alpha(1-\lambda) f''(e_2)$$

$$G_{e1} = \frac{\partial G}{\partial e_1} = -U''(C_1)\frac{\partial C_1}{\partial e_1}(w+\psi) + \delta_2\beta U''(C_2)\frac{\partial C_2}{\partial e_1} f'(e_1)$$

$$G_\lambda = \frac{\partial G}{\partial \lambda} = -\alpha f'(e_2)$$

$$G_{\delta 2} = \frac{\partial G}{\partial \delta_2} = \beta f'(e_2)[\delta_2 U''(C_2)\frac{\partial C_2}{\partial \delta_2} + U'(C_2)]$$

$$G_{\delta 1} = \frac{\partial G}{\partial \delta_1} = \delta_2\beta U''(C_2)\frac{\partial C_2}{\partial \delta_1} f'(e_2)$$

$$G_w = \frac{\partial G}{\partial w} = -U'(C_1)$$

$$G_\beta = \frac{\partial G}{\partial \beta} = \delta_2 U'(C_2) f'(e_2)$$

$$G_\psi = \frac{\partial G}{\partial \psi} = -U'(C_1)$$

Solving for the individual parameters,

$$\begin{pmatrix} H_{e_1} & H_{e_1} \\ G_{e_1} & G_{e_2} \end{pmatrix} \begin{pmatrix} e_{1\delta_1} \\ e_{2\delta_1} \end{pmatrix} = \begin{pmatrix} -H_{\delta_1} \\ -G_{\delta_1} \end{pmatrix}$$

$$\begin{pmatrix} H_{e_1} & H_{e_1} \\ G_{e_1} & G_{e_2} \end{pmatrix} \begin{pmatrix} e_{1\delta_2} \\ e_{2\delta_2} \end{pmatrix} = \begin{pmatrix} -H_{\delta_2} \\ -G_{\delta_2} \end{pmatrix}$$

$$\begin{pmatrix} H_{e_1} & H_{e_1} \\ G_{e_1} & G_{e_2} \end{pmatrix} \begin{pmatrix} e_{1\lambda} \\ e_{2\lambda} \end{pmatrix} = \begin{pmatrix} -H_{\lambda} \\ -G_{\lambda} \end{pmatrix}$$

$$\begin{pmatrix} H_{e_1} & H_{e_1} \\ G_{e_1} & G_{e_2} \end{pmatrix} \begin{pmatrix} e_{1w} \\ e_{2w} \end{pmatrix} = \begin{pmatrix} -H_{w} \\ -G_{w} \end{pmatrix}$$

$$\begin{pmatrix} H_{e_1} & H_{e_1} \\ G_{e_1} & G_{e_2} \end{pmatrix} \begin{pmatrix} e_{1\alpha} \\ e_{2\alpha} \end{pmatrix} = \begin{pmatrix} -H_{\alpha} \\ -G_{\alpha} \end{pmatrix}$$

where $e_{1\delta_1}$ is the partial derivative of e_1 with respect to δ_1. This amounts to solving an equation of the form $AX = B$. If A is a non-singular matrix, then $X = A^{-1}B$, where $A^{-1} = \frac{1}{\det A}\begin{pmatrix} G_{e_2} & -H_{e_1} \\ -G_{e_1} & H_{e_1} \end{pmatrix}$, $\frac{\partial e_i}{\partial x} = e_{ix}$, $\frac{\partial H}{\partial x} = H_x$, and x represents the parameters of interest, respectively $\delta_{1,}\delta_2, \alpha, \beta$ and w. The resulting vector is then:

$$\begin{pmatrix} e_{1x} \\ e_{2x} \end{pmatrix} = \frac{\begin{pmatrix} G_{e_2} & -H_{e_1} \\ -G_{e_1} & H_{e_1} \end{pmatrix}\begin{pmatrix} -H_x \\ -G_x \end{pmatrix}}{\det A} \tag{A1}$$

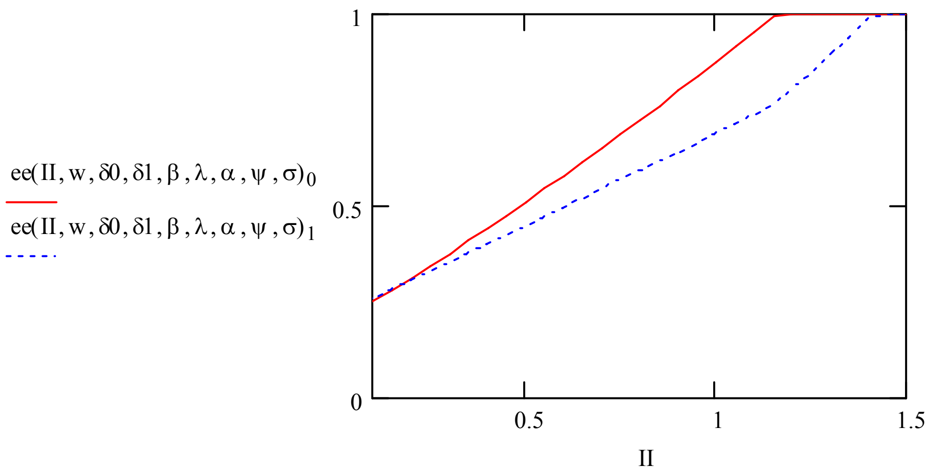
The next step in this exercise is straight forward. We simply substitute the partial derivatives found above into equation (A1). A quick glance at those partial derivatives however should indicate that these are prohibitive calculations with little marginal returns. Instead, I will illustrate the point by performing some numerical simulations.

Parameters

$\alpha := 0.2$	Altruism parameter (1=max care about kids' future)
$\lambda := 0.6$	Relative weight given to biol. vs. adopted children
$\beta := 0.95$	Time Discount Factor
$I := 0.8$	Income
$\psi := 0.3$	Cost education expense for own children
$\sigma := 0.3$	Cost education expense for orphan children
$\delta 0 := 0.5$ $\delta 1 := 0.3$	Share of child income given to parents in old age (biological, adopted)
$w := 0.25$	Wage rate (or MPL in household production)
$f(e) := 12\sqrt{e}$	Child second period income (depends on education)
$u(c) := \ln(c + 0.01)$	Utility function

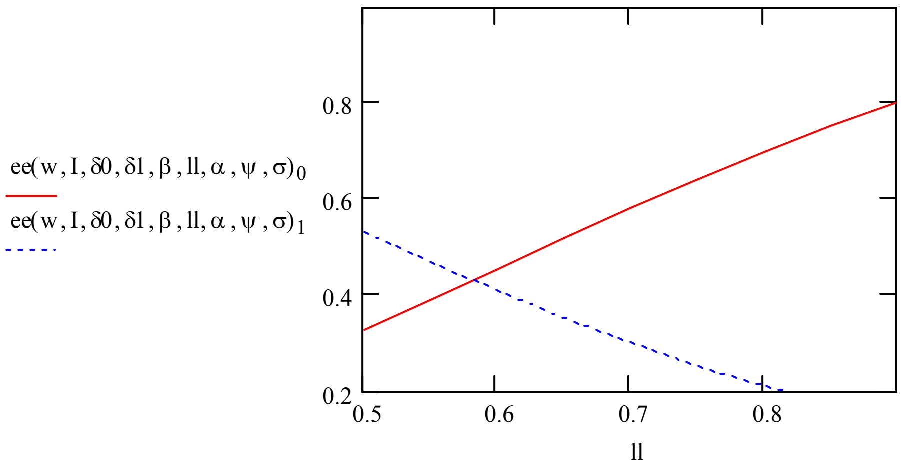
Maximizing the utility function with respect to the above parameters yields a value of 0.722 for e_1 and 0.592 for e_2.

Changing Income[13]

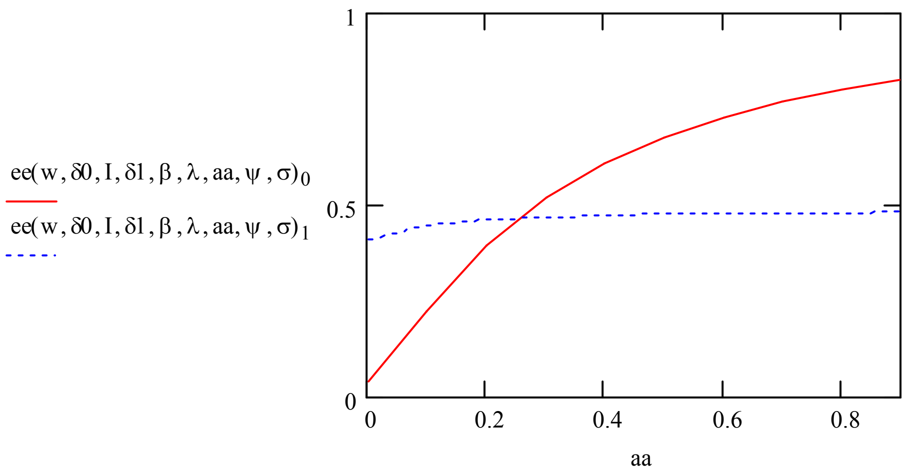


[13] The dashed lines represent the educational path of orphans.

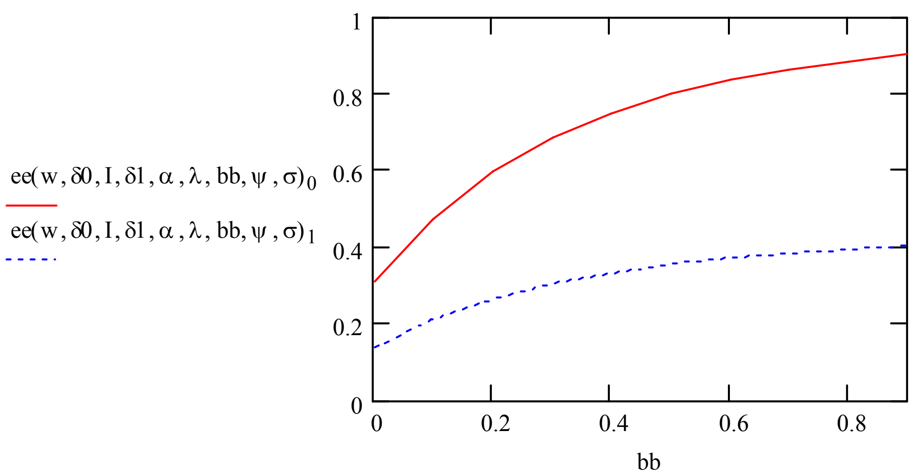
Changing the Weight on Children λ



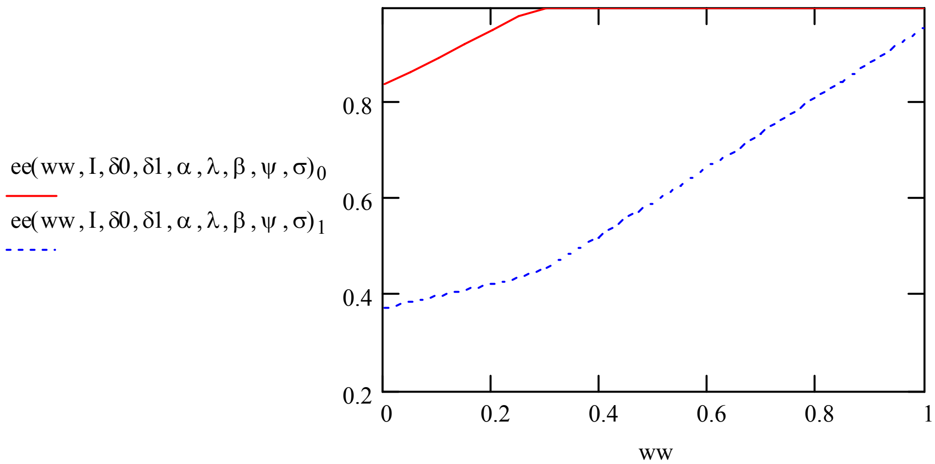
Changing the Altruism parameter



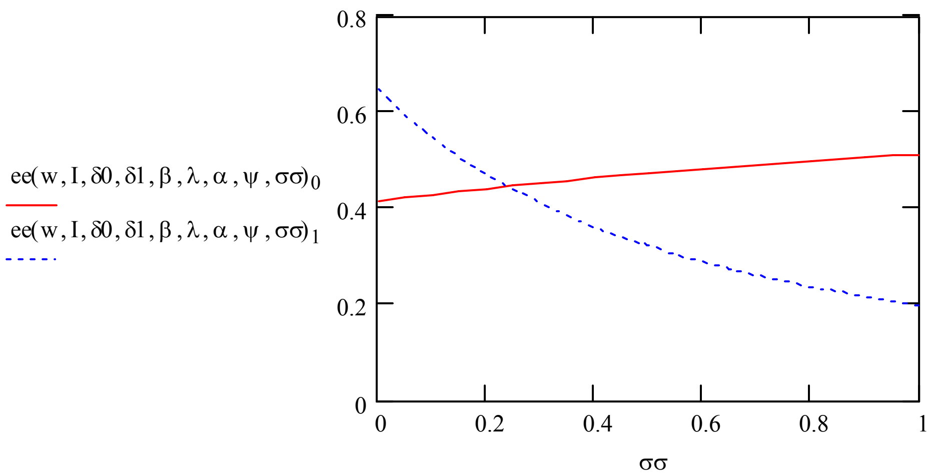
Changing the Discount Factor



Changing Children's Wages



Changing the Cost of Educating Orphaned Children



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