# "Intrinsic Competition" and the Labor–Schooling Trade-off in Uganda

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**Abstract**

I argue that a household's interdependent decisions over their children's labor and school activities are not only a function of observable "hard facts" but also of its intrinsic values and beliefs. Applying econometric methods, after observable factors have been controlled for, the degree to which these joint decisions over these two activities are correlated can be seen as the "intrinsic competition" households and children face. This coefficient of the labor-school trade-off is not associated with any observable variables and should therefore be object of future research in the field.

In the empirical study, quite recent and hardly discussed data from Uganda is used for the joint estimation of child labor and school attendance applying a bivariate probit model. The results shed light on the degree of the unobserved or "intrinsic competition" between labor and school attendance. Results implying a stronger trade-off between these two decisions in urban than rural areas and stronger for girls than for boys are obtained. Especially rural boys have a considerably higher tendency to combine their labor activities with schooling while the obtained trade-off implies for girls to specialize. Results seem to be driven by unobserved cost-related factors, no clear explanation on this, however, is found.

**JEL classification:** C35, J82, O15.

**Keywords:** child labor, school attendance, education, decision trade-off, intrinsic competition, bivariate probit; Uganda

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# 1 Introduction

A substantial part of the literature on the determinants of and their effects on child labor has looked at children's work time only, assuming that schooling is the reverse of labor. Researchers, however, have recently begun to consider children's schooling decision jointly with the decision over their labor force participation. The decision over a child's education is thus not detached from its labor supply but seen as co–choice. Whereas determinants are subject to vivid discussions and have been a very well-researched area, the question of how this household's decision making process looks like has still not been fully elaborated. It is usually assumed that children may either go to school, go to work, or do nothing, however, when accepting that they are able to divide up their time endowment and allocate it to several different activities, combinations of these binary decisions are possible. But how do household's decide upon this? Are these decisions independent of each other? Is it a sequential decision with the question on whether children's income is needed considered before it can be decided upon whether or not the household can afford school? Or is it of a simultaneous nature with the "school–labor–idleness" decision being non–hierarchical?

Using a bivariate probit model, this paper examines this issue of interdependence of the joint labor and schooling decision which is assumed to be of simultaneous nature. Data from Uganda are used to determine the effects of income, property as well as children's individual and household characteristics on their labor–school probabilities.

Special attention is paid to what is not observable and thus not explicitly entering the econometric model. I argue that the correlation coefficient $\rho$ as by-product of the bivariate probit model be interpreted as unobservable or "intrinsic competition" between labor and schooling since it is driven by the unobserved error term in the joint estimation model. After all explanatory variables are controlled for, what is left is the degree to which the parents' decide in favor of labor and against school; or vice versa. This implies that the more pronounced $\rho$ the higher the trade-off the parents (in their decisions) and the children (in their activities) will be facing. The nature of the underlying joint decision making is discussed in more detailed in section 2, results will be reported in section 5. This study is dedicated to observe differences in the competition between the children's labor activities, special

emphasis is therefore put on differences of these effects in rural and urban households as well as with respect to gender.

The paper is structured as follows: Section 2 discusses the issue of a joint labor-schooling decision and the econometric methods to be applied; section 3 reviews the literature and results on the effects of child labor on school attendance and performance. It also gives a few results on the strand of literature that examines the trade-off between labor and school explicitly. Furthermore, whether or not children specialize in either of the activities or combine them is discussed. Section 4 gives a few basic properties of the applied data and discusses the descriptive statistics, emphasizing sub-sample specific results on specialization; results for the bivariate probit model are then reported. Section 5 reports on the evidence on competitive labor–school decisions and puts the obtained results in relation to existing literature. Section 6 finally concludes.

## 2 Joint time-allocation decision

The decision over a child's labor force participation and over its school attendance can either be seen as sequential or simultaneous. The former setting of this decision making process suggests that a household first decides over whether or not it can afford to send its children to school and only thereafter whether they are sent to work. This explicitly assumes that one of the two relevant activities has a higher priority to the household; in this example it is school attendance, whereas for a different household the sequential pattern might be reversed and labor is decided upon prior to school.

Which of these alternative patterns is eventually prevalent depends on the household's initial welfare situation as well as its utility ranking with respect to labor and schooling. Households that assign a high priority to their children's education—we assume this to be the case if school attendance is of higher value or utility to the household—may ask the question of whether school is affordable prior to considering labor as alternative activity. If, however, a household is budget constrained and its welfare situation is such that it needs to consider its children's income contributions before asking the question of the affordability of schooling, the sequential pattern is reversed.

As Canagarajah and Coulombe (1997), Maitra and Ray (2002) and others argue, a sequential choice is yet not necessarily the case in the labor-school decision. They rather assume a decision making process without a hierarchical structure. Thus, households decide simultaneously whether or not to send their children to work and whether or not to send them to school. These two decisions can be assumed either to be made independently or being contingent on each other.

I believe there is no dispute over whether the labor and school decisions, say $x$ and $y$, are in any way not dependent on each other, in fact I hypothesize and find evidence that these decisions heavily depend on each other. This dependence, however, is not perfect in the sense that for instance a one hour increase in time at work per week decreases school attendance by one hour per week. Hence, I do not assume that that school is the reverse of labor as mentioned above and applied in previous studies. I further do not assume the correlation to be just arbitrary as in the multinomial choice model (Ashford and Sowden 1970).[1]

With this in mind a joint estimation techniques seems to be the best empirical strategy. Zellner and Lee (1965) argue that given some correlation between two dichotomous dependent variables, joint estimation techniques yield asymptotically more efficient coefficient estimators than single equation methods applied to the individual equations in the system.[2]

Furthermore, the use of the bivariate model (in settings of full observability) in recognition of the dependence of two choice "systems" is suggested by Ashford and Sowden (1970). An example such as that of a drug which, when applied to a human, may have unanticipated side effects beside its

[1]Weeks and Orme (1998) discuss the statistical relationship between these two approaches and provide the appropriate parametric restrictions on the more general multinomial choice models under which the two approaches can be considered equivalent. This can be the case by recognizing that the two binary decisions generate four mutually exclusive choices. They argue that both this statistical as well as a possible behavioral relationship between these models have been given too little consideration when applying them in empirical research. In this paper, too, there will be no statistical discussion of why the bivariate probit is preferred over the multinomial setting; I rather concentrate on the behavioral distinction and derive the legitimation of the applied model from there.

[2]For large samples both approaches will yield the same point estimators. For instance, referring to the general results in Gouriéroux, Monfort, Renault, and Trognon (1987), Chiappori and Salanié (2000) apply both approaches and test for asymmetric information in insurance markets by computing generalized residuals and rejecting the null hypothesis for zero covariance in the simple probit as well as testing for a non-zero correlation coefficient $\rho$ in the bivariate probit case.

intended main effects, can easily be found for the considered labor-school setting. Lowering the marginal productivity of child labor on a peasant's farm by introducing the use of machinery lowers a potential urgent need of its labor force on the field; at the same time the opportunity costs of schooling decline, thus schooling incentives increase—or rather disincentives decrease. Also, the formal school system in rural Uganda generates smaller returns on education than it does in urban areas, implying a smaller difference between the utility of school participation and non-participation—given that returns on education positively enter the household's utility.[3] At the same time, the main source of household income in rural areas comes from agricultural enterprises. More property of productive assets increases the marginal productivity (and utility) of children's labor time, and it does so to a greater extent in rural than in urban areas. The decisions are thus correlated through the household's vicinity.

The two "systems" *labor* and *school* individually react to changes in their environment, observable factors of this environment, however, will only be one aspect in this paper. We do want to know how certain variables affect both systems, especially if there is an adverse effect, and section 4.4 will briefly discuss the effects of commonly used explanatory variables on child labor and school attendance, yet the explanatory variables of interest are those that are not observed. Ashford and Sowden (1970) emphasize the distinction between the bivariate model, which incorporates the dependence over two binary decisions that generate four mutually exclusive outcomes, and a single multinomial model which gives four outcomes with some arbitrary dependence structure. It is precisely this dependence structure that is the object of interest because we want to know how the two systems relate with respect to the unobservable, in a sense how these systems intrinsically interact.

Assuming simultaneous decision making and interdependence of the two decisions I will apply a bivariate probit model to jointly estimate a household's labor-school decision.[4] Underlying this are two binary choice variables, $x$ and $y$. In reality, labor-school decisions are not simply *yes or no* but are continuous. For a very simplified illustration, let $x$ represent the

[3] See (Gotschi 2004) for a detailed account of education and relevant policies in Uganda.

[4] See the standard literature such as Long (1997) or Greene (2003) for the technical details.

decision over a child's labor force participation with a choice set $X \equiv [0, e)$, where $e$ is the child's time endowment[5]; analogously, for the school decision $y$ the choice set is given by $Y \equiv [0, e)$. It is obvious that $x + y \leq e$. Let's further assume that the household's welfare is a function of its "environment" $\Omega$ and the time-allocation combination $(x, y)$ over which the utility is maximized, $\max_{(x,y)\in X\times Y} u(\Omega, (x, y))$ subject to $x + y \leq e$.

For this study, however, we only consider binary choice decisions $x$ and $y$. Let $X \equiv \{0, 1\}$, where $x = 1$ if the child works and $x = 0$ otherwise; analogously, for the schooling choice $y \in Y \equiv \{0, 1\}$ we observe $y = 1$ if the child attends school and $y = 0$ otherwise. These two decisions generate four mutually exclusive outcomes: $X \times Y \rightarrow (x, y) \in \{(1, 1), (1, 0), (0, 1), (0, 0)\}$. Again, households maximize $u(\Omega, (x, y))$ over these decision combinations.

Decisions over $x$ and $y$ are assumed to be made simultaneously. The household's labor decision, for instance, is based on the respective *labor* or *no labor* utilities given the school decision $y$, $u(\Omega, (1, y))$ and $u(\Omega, (0, y))$. The comparison of these two decision outcomes yields

$$u_x(\Omega, (x, y)) = u(\Omega, (1, y)) - u(\Omega, (0, y)). \tag{1}$$

The same is assumed for the school decision given $x$,

$$u_y(\Omega, (x, y)) = u(\Omega, (x, 1)) - u(\Omega, (x, 0)). \tag{2}$$

If $u_x(\Omega, (x, y)) > 0$ and $u_y(\Omega, (x, y)) > 0$ this decision structure implies that the child will both work and attend school; if $u_x(\Omega, (x, y)) > 0$ and $u_y(\Omega, (x, y)) < 0$, howver, the child will work but *not* attend school. Analogously, this probability of $(x, y) = (1, 0)$ can simply be characterized by $\pi_{(1,0)} = \text{Prob}[u_x(\Omega, (x, y)) > 0 \wedge u_y(\Omega, (x, y)) < 0]$.[6]

[5]Not included is time spent at sleep, eating, leisure, and similar activities.

[6]The same choice structure can be achieved by a single decision with these four choices. Weeks and Orme (1998) impose restrictions on this single decision multinomial choice model under which the methods are equivalent with respect to their utility maximization.

# 3 Labor and schooling trade-off in the literature - Some findings

The determinants of child labor have been a very well researched field and there is a number of thorough and insightful surveys on the central results.[7] There is also an extensive literature on the effects of child labor on school attendance and school performance; a few articles have explicitly raised the issue of a *trade-off* between labor and school. This section will highlight only a selective portion of the existing literature. For a more detailed discussion with respect to effects of the determinants of child labor and schooling and vice versa see the listed survey literature.

Quite a bit has been written on the effects of children's labor force participation on their school attendance and to what extent labor hampers education. While for instance Jensen and Nielsen (1997) assume that schooling is just the reverse of labor, many recent studies such as Cockburn (2001), Maitra and Ray (2002), or Ersado (2005) have made explicit use of the observation that children tend to combine school and labor. Also, Boozer and Suri (2001) find that a one hour increase of child labor leads to a 0.38 hour decrease in schooling, a result qualitatively supported by Ravallion and Wodon (1999).[8] Heady (2003), however, derives slightly different results for Ghana and concludes that child labor does not affect school attendance but substantially interferes with the quality of schooling with respect to children's reading and mathematics abilities. A similar result is obtained by Parikh and Sadoulet (2005) who argue that child and school are "not necessarily incompatible" but understand that due to children's "dual commitment" at work and in school their education progress may be impaired.[9]

The issue of to what extent school performance is affected by child labor has further been examined by Patrinos and Psacharopoulos (1995) who conclude for Paraguayan data that children can both attend school and work without evident effect on their schooling progress. It appears that child labor does not interfere with school work when looking at whether or not children

[7] A comprehensive book was edited by Grootaert and Patrinos (1999), recent articles with in-depth literature surveys are Basu and Tzannatos (2003), Bhalotra and Tzannatos (2003), Brown, Deardorff, and Stern (2003), or Beegle, Dehejia, and Gatti (2004).

[8] See also Rosenzweig and Evenson (1977) for evidence on the enrollment reducing effect of strong child labor markets.

[9] See Gunnarsson, Orazem, and Sanchez (2006) for a more detailed summary of existing literature.

have to repeat grades. In a later paper (Patrinos and Psacharopoulos 1997) on Zambia they find that child labor significantly predicts children's "age grade distortions", hence hampers the schooling progress.

In a study on Tanzania, Akabayashi and Psacharopoulos (1999) conclude that children's reading competence decreases with child labor hours. They find, for instance, that the probability of a girl being able to read a newspaper increases by eight percentage points as result of a one hour reduction of work. This results from both an increased time of study and a higher probability of school attendance. These findings are in line with Ray and Lancaster (2004) whose results give evidence for a negative impact of child labor on school outcomes which they find to be more detrimental for girls than for boys. Gunnarsson, Orazem, and Sanchez (2006) using a rich data set including data from eleven developing countries find that child labor significantly reduces test scores in every country.

Apart from the literature on the potentially negative effect of labor on school attendance and performance, yielding mixed evidence, there has been quite a vivid strand of literature on the question to what extent children tend to specialize in either one of the two activities.[10]

A positive effect of the number of children in the household on the levels of education of each individual child is observed by Chernichovsky (1985). He argues in favor of a notion of specialization due to possible diminishing returns to labor in a household for a given amount of assets. This reduces the (indirect) opportunity costs of schooling, potentially leading to a role assignment, with some children emphasizing on school and others on labor. Applying a multinomial logit model to data from Peru, Pakistan and Ghana, Maitra and Ray (2002) obtain results on the degree of labor-school specialization. They find a strong gender-role since girls are more likely than boys to specialize in either labor or school or do neither, whereas generally older children are more likely to be able to combine schooling with employment. Concerning a household's poverty status, a clear picture is obtained for Pakistani households where children tend to withdraw from a

[10]Only a few articles are known to the author that do not only find ambiguous results but explicitly doubt the notion of "bad child labor" that harms a child's educational attainment and prevents an escape from poverty. Rodgers and Standing (1981, p. 33) for instance write that "work itself may be an important component of 'education', especially in household-based production systems", Scoville (2002) calls for a model incorporating the *"benefits"* of child labor, and Ray and Lancaster (2004) refer to non-formal education out of the formal school system and put school-impairing child labor in a new perspective.

labor–school combination into specialization in labor or idleness when the household falls into poverty. Additionally, higher education of adult females in Ghanaian households increases the probability of a child moving from labor or idleness into the labor–school combination, thus having a positive effect on school attendance.

Are labor and schooling complements or is there a tradeoff that drives children into specializing? Nielsen (1998, p. __) interprets her significantly negative correlation coefficient as a negative relationship between attending labor and school, that means "some unobserved factors that increase the probability of attending school decrease the probability of working." While she does not further discuss this trade-off, Akabayashi and Psacharopoulos (1999) explicitly examine it and conclude that there is indeed a trade-off between child labor and school performance. In a study on 1998 Brazilian data Muniz (2001) finds a strong trade-off between school attendance and waged labor. The decisions of whether to send a child to school or non-waged work, however, are not interdependent. In a very recent study on 1992 Brazilian data Parikh and Sadoulet (2005) argue that since child work is responsive to opportunities of work, school attendance and labor are not necessarily incompatible, concluding there to be no real trade-off. Referring to Heady (2003) they do, however, understand that child labor may impair the quality of school due to children's "dual commitment."

Thus, Parikh and Sadoulet (2005) may not speak of a trade-off *per se* between school attendance and work, but assuming that parents anticipate the detrimental effect of their children's work time on their education, there is still a trade-off between the quality of school and child labor, which is reflected in the significant coefficient $\rho$ for both the urban and the rural sub-sample.

A last remark is to be made on the choice of bivariate probit over multinomial logit. Maitra and Ray (2002) briefly discuss joint estimation techniques that have been applied in the literature that recognizes the interdependence and simultaneity of the decisions over children's schooling and labor. They argue that the bivariate approach does recognize the decisions' interdependency but does not consider all the possibilities. They prefer the multinomial approach over the bivariate model because it seems that the estimation of one equation "is more easily understood." By doing so, however, they are not able to test whether there is in fact unobserved interdependency between the

two decision systems. In a two-step approach Bacolod and Ranjan (2005) first test for this unobserved correlation between labor and schooling and obtain a correlation coefficient that is not significantly different from zero. They therefore conclude the multinomial model to be the proper technique in this case.

# 4 Bivariate probit estimations for Uganda

This section briefly describes the data source and gives basic descriptive statistics with an emphasis on the combination vs. specialization question. I later discuss the specification of the bivariate probit estimations and finally give results of the effects of the determinants of child labor and schooling. Section 5 then discusses the results on unobservable or "intrinsic competition."

## 4.1 The data source

I use recent data from the Uganda National Household Survey 1999/2000 (UBOS 1999) collected over a time span of twelve months in 41 districts of Uganda. The clustered sample consists of roughly 15,500 children aged six to 15 in rural and 3,600 in urban households. Out of these, 49.2 percent are girls, 50.8 percent are boys.

The survey asks for the children's usual main and secondary activity (within the last 12 months) as well as their current main activity (within the last seven days). This gives sufficient data for the construction of labor and schooling indicators $(x, y)$ that are to be applied in the empirical investigations hereafter.[11]

The empirical literature has come up with various different ways of construction of the variables of interest when parents are only indirectly asked about the child labor status of their children. In order to obtain child labor policy compatible results, any indicators need to comply with internationally used standards and definitions[12], however, authors are usually constrained by the availability of the data. In general, Nielsen (1998) makes a strong

[11] See Akabayashi and Psacharopoulos (1999, p. 121) for criticism of survey that do collect data on main activity only.

[12] ILO Conventions 138 and 182 (OECD 2003) defines child labor as *"a) all economic activity done by children until age 11; b) all economic activity done by children aged 12 to 14 excluding 'light work' in the sense of Convention 138; c) all economic activity carried*

Table 1: Dependent variables

| **Dependent** | **sub–samples** | | | | |
|---|---|---|---|---|---|
| **variables** | **full** | **rural** | **urban** | **girls** | **boys** |
| labor | 0.101 | 0.114 | 0.046 | 0.079 | 0.122 |
| *labor incl. chores* | 0.192 | 0.197 | 0.167 | 0.197 | 0.186 |
| schooling | 0.890 | 0.887 | 0.923 | 0.883 | 0.897 |
| *Observations* | 19,325 | 15,658 | 3,667 | 9,518 | 9,807 |

*Simple mean of labor and schooling given for the sub–samples.*

case for a short–run child variable due to a potential *"memory effect"* if the long–run twelve months time span were used; Blunch and Verner (2000) for instance stress the question of whether or not child labor jeopardizes children's school attendance and define a child being at work only if it does not attend school as a potential secondary activity. Sakellariou and Lall (2000) among others finally suggest a child to be regarded as *"economically active"* if working a positive amount of time, which is in close accordance with ILO standards.

For the joint estimation of child labor and schooling I construct the following for child labor: The binary choice variable $x$ is equal to unity if the child is reported being economically active[13] either as main or secondary usual activity, zero otherwise. This allows for the consideration of child labor which is not perceived as a high priority activity of the child, i.e. also incorporates children that may go to school as their primary activity but have to work in their out–of–school time. In accordance with ILO standards, household chores are not associated with the notion of child labor and therefore not taken into account.

The school attendance variable is constructed in a similar manner. If either the primary or the secondary usual activity is "attending school", the variable $y$ is equal to unity, zero otherwise. As with the child labor indicator $x$, if no secondary usual activity is reported—which is the case in roughly 35 percent of the observations—the primary entry is regarded the only activity the child is pursuing.

Table 1 gives the incidence of reported child labor (both the aforementioned variable and, for reference, child labor including chores, based on

*out under hazardous conditions by children aged 15 to 17, and d) 'the worst forms' of child labour carried out under age 18.".*

[13]Economic activity in this context means "own account work", "unpaid family work", "private employment", or "unemployment", as dictated by the data.

children's current activity) and schooling for the full sample of children as well as for girls/boys and children from rural/urban households. Not much difference is observed in boys' and girls' schooling, whereas boys work substantially more than girls when household chores are not accounted for. When chores are taken into consideration girls exhibit a higher incidence of work than boys do. Controlling for intra–household activities can therefore substantially influence results and implications of an empirical exercise. The differences in school attendance of children from rural and urban households are not very pronounced. School attendance is by about four percentage points higher in urban than in rural households. Urban children, however, exhibit a much lower incidence of child labor than rural kids. These observations call for looking at these sub-samples in separate estimations.

### 4.2 Descriptive statistics

The main focus of this paper is to investigate the extent to which the individual decisions over child labor and schooling are correlated and how their determinants differ for various sub–samples. Table 2 tabulates school attendance in percent conditioned upon children's labor force participation; columns 2 and 3 give the school attendance rates for non-working children, columns 4 and 5 do so for working children, column 6 gives the share of children both attending school and working over the full sub–sample. The observable fact that if a child works its school attendance is substantially lower compared to the unconditional figures in table 1 implies a negative correlation between labor and schooling—a simple correlation coefficient of $-0.2226$ is obtained. Looking at the simple descriptive figures for the given sub–samples, two central observations can be made:

First, whereas unconditional schooling of urban is higher than of rural children, that is school attendance is relatively higher in urban households, children from rural households are more likely to combine schooling and labor. While roughly 70 percent of working rural children also go to school, only about 52 percent of urban children do so (column 5). Overall, only 2.4 percent of urban children both work and go school while 7.9 percent do so in rural areas (column 6). On the other hand the extent of idle children is also

Table 2: School attendance and child labor

| Sub–sample | no labor & no school | no labor & school | labor & no school | labor & school | both (uncond.) |
|---|---|---|---|---|---|
| full | 8.63 | 91.37 | 31.71 | 68.29 | 6.90 |
| rural | 9.36 | 90.64 | 30.19 | 69.81 | 7.94 |
| urban | 5.75 | 94.25 | 47.65 | 52.35 | 2.43 |
| girls | 9.09 | 90.91 | 41.63 | 58.37 | 4.65 |
| boys | 8.17 | 91.83 | 25.40 | 74.60 | 9.08 |
| rural girls | 9.66 | 90.34 | 39.18 | 60.82 | 5.43 |
| urban girls | 6.85 | 93.15 | 64.00 | 36.00 | 1.45 |
| rural boys | 9.06 | 90.94 | 24.59 | 75.41 | 10.36 |
| urban boys | 4.60 | 95.40 | 34.74 | 65.26 | 3.42 |

*Numbers in percent; school attendance rates are conditional on labor; columns 2 & 3 as well as 4 & 5 add up to 100%. Column 6 gives percentage of "combining children", i.e. children that both work and go to school.*

higher in rural households (8.3 percent compared to 5.5 percent)[14] implying a smaller extent of a specialization in either school or labor.

Second, a similar pattern is observed with respect to gender sub–samples. Working girls exhibit substantially lower degrees of school attendance (58.4 percent) than working boys (74.6 percent); only 4.6 percent of all girls can combine schooling and labor whereas this is done by roughly 9 percent of the boys in the sample. Consequently, the share of children combining both labor and school is lowest when looking at urban girls (1.5 percent) and highest when considering the rural boys sub–sample (10.4 percent).[15] As already mentioned by Maitra and Ray (2002) girls tend to specialize in either labor or school, an observation also found in Uganda.

There may be different reasons for this pattern: It could be assumed that boys' duties are less time consuming and therefore more time is left for schooling activities. There is, however, no convincing reason for this; it seems rather more plausible to assume that since in general (under the applied labor indicator) boys are more likely to work than girls the incidence of a combination of these activities is higher for boys because at the same time their school attendance is given higher priority than the girls'.

[14]See Biggeri, Guarcello, Lyon, and Rosati (2003) for a detailed discussion on children that neither attend school nor work, or Bacolod and Ranjan (2005) for a theoretical model and empirical account using data from the Philippines. See also table (3) and the subsequent discussion of reasons not attending school.

[15]Out of rural boys, 13.7 percent work, whereas only 8.9 percent of rural girls are economically active. The figures for urban boys are 5.3 percent and 4 percent for urban girls.

Table 3: Reasons for never attending school

| | **Sub–samples** | | | | |
|---|---|---|---|---|---|
| | **full** | **rural** | **urban** | **girls** | **boys** |
| too young | 57.84 | 58.87 | 48.24 | 57.96 | 57.65 |
| indifferent | 14.97 | 15.84 | 7.06 | 14.52 | 15.42 |
| need to work | 3.23 | 3.39 | 1.76 | 3.72 | 2.73 |
| costs | 10.39 | 8.60 | 26.47 | 12.08 | 8.66 |
| others | 13.57 | 13.30 | 16.47 | 11.72 | 15.54 |
| *observations* | *1,704* | *1,534* | *170* | *861* | *843* |

*Figures are in percent of the number of observations.*

This is especially the case when the decision over schooling depends on the associated costs.

Table 3 gives reported reasons for children never having attended school. For the 861 girls out of the entire sample that have never attended school, 12 percent did not do so because of high *costs* whereas this was the reason for only 8.7 percent of the boys' sub–sample. Parents are not as willing to make sacrifices for the sake of girls' school attendance as they are for boys', whose education thus implicitly exhibits higher priority. This line of argument is especially applicable in urban households suggested by the figures in table 3: more than 26 percent of urban children never having attended school give high costs as the main reason.[16]

Costs, however, may have two different facets. Direct costs of schooling, such materials and school uniforms[17], seem to be the most obvious, yet costs are also associated with opportunity costs of schooling. With this respect, Cain (1977) distinguishes between opportunity costs accruing from two different natures of child labor: (directly) productive labor that produces a positive output per se, and "enabling" child labor suggesting that if children take over household chores or activities that are usually performed by their mothers (or also fathers), these are then freed from those and can pursue (directly) productive activities.[18] Hence, if the opportunity costs (foregone

[16]Notice that empirical findings do not necessarily reflect these descriptive statistics: for Zambian data, Nielsen (1998) obtains surprising results concerning the effects of school expenditures on child labor and schooling. There, the decisions are only "moderately sensitive" to changes in these variables.

[17]In 1997, Uganda declared a policy of Universal Primary Education (UPE) that waives school tuition and textbook fees for up to four children of primary-school age (6 to 12) per family. (USDoL 2002)

[18]See also Levison (1991).

income of, for instance, the mother) of children's school attendance exceed a certain acceptable level, no schooling takes place.

As opposed to direct costs of schooling, in table (3) opportunity costs are most likely not captured by *costs* but by the children's *need to work* as has become clear by the reasoning above. This *need to work* as reason for no schooling at all plays a greater role in rural households than in urban, which is exactly the reverse pattern to direct costs that played a greater role in urban households. Since agricultural income has a much greater impact in rural than in urban areas[19] we can conclude that the *need to work* is partially associated with a household's income source and that opportunity costs are higher in households with a farming or other agricultural business.

The given figures shed some light on why children do not attend school and how this decision interacts with their labor force participation. Specific data on direct or indirect school costs are not given, neither is information on the priority assigned to education by the parents. However, proxies can be found to capture it. The effects of (direct) schooling costs are expected to be controlled for by a household's income situation (through constrained household expenditures), (direct) opportunity costs as induced by directly productive activities can be argued to be proxied by the property of time–intensive productive assets such as land or livestock (Canagarajah and Coulombe 1997, Jensen and Nielsen 1997, and others); opportunity costs that are associated with "enabling" child labor are proxied using household structure variables such as the number of infant siblings that are to be taken care of. The more housework a child can perform in lieu of its parents, the higher the opportunity costs of schooling will be.

Further, parents' education is not only assumed to explain their income potential but may also serve as proxy variable for their *indifference* with respect to schooling. The average educational attainment of fathers and mothers is 5.4 and 3.5 years, respectively. For the children never having attended school it is 3.4 and 1.7, respectively; for the children that have never attended school due to their parents' indifference it is a at a low 0.75 and 0.30. The low educational level of "indifferent" parents can thus serve

[19] Almost 97 percent of children in rural areas live in households that report some source of agricultural income, whereas only 21 percent do so in households that report employment or wage income sources.

Table 4: Definitions of variables

| Variable | Description |
|---|---|
| *Dependent variables* | |
| labor | 1, if the child's primary or secondary usual activity is work (12 months) |
| schooling | 1, if child's primary or secondary usual activity is school (12 months) |
| *Individual characteristics* $\mathbf{R}_i$ | |
| sex | 1, if a boy; 0 otherwise |
| age | child's age in years |
| age$^2$ | age squared |
| ownchild | 1, if child is household's heads natural/own child; 0 otherwise |
| *Household characteristics* $\mathbf{R}_h$ | |
| income | household heads' total employment income per adult equivalent, total of last twelve months |
| income$^2$ | income squared |
| education father | educational attainment of father, in years |
| education mother | educational attainment of mother, in years |
| land | previous year's land property, in acres per adult equivalent |
| land$^2$ | land squared |
| cattle | previous year's cattle property per adult equivalent, in pieces |
| cattle$^2$ | cattle squared |
| urban | 1, if household is situated in urban neighborhood; 0 otherwise |
| female head | 1, if household head is a woman; 0 otherwise |
| farming | 1, if household owns a crop raising enterprise; 0 otherwise |
| bicycle | 1, if household owns one or more bicycles; 0 otherwise |
| under 5 | number of children aged 5 years or younger in the household |
| under 10 | number of children aged 10 or younger in the household |
| adults | number of adults (aged 16 or older) in the household |
| childratio | children–adult ratio in the household |
| girlratio | share of girls in the household |
| *Dummy variables indicating household's district and month of interview* | |

*Source: Socio–Economic Survey Questionnaire (UBOS 1999).*

as an additional determinant of the school attendance decision and will be used for sub-sample specific model specifications.[20]

## 4.3 Specification

A bivariate probit model is applied to estimate the school attendance and working behavior in a reduced form model, focusing on a combination of demand and supply side variables. Due to the fact that especially in rural areas of Uganda agricultural activities are the main "source" of child labor, dummy variables indicating the month of the household's interview are included to control for the demand side (harvest time!). Further, acknowledging that most children work on a family's farm, productive household

[20]For detailed descriptive statistics on income or education variables as well as household characteristics see Mwebaze (2004) and Ganglmair (2005).

assets can be assumed to comprise another crucial source of labor demand (i.e. the household's own demand).[21]

The labor and schooling decisions as denoted by equations (3) and (4) are functions of individual characteristics $\mathbf{R}_i$ and household characteristics $\mathbf{R}_h$, where $\mathbf{R} = \mathbf{R}_i \cup \mathbf{R}_h$. Table 4 briefly describes the applied variables. The coefficient vector $\beta_{l,i}$ contains the coefficients of the individual characteristics for the labor equation, $\beta_{s,i}$ the ones for the schooling equation, where $l = x$ and $y = s$; analogously for the household characteristics.

$$\begin{aligned} \text{Prob}\left[u_l\left(\Omega,(\text{l},\text{s})\right) > 0\right] &= \Phi\left[\mathbf{R}_i\beta_{l,i} + \mathbf{R}_h\beta_{l,h} + \varepsilon_l\right] \quad (3) \\ \text{Prob}\left[u_s\left(\Omega,(\text{l},\text{s})\right) > 0\right] &= \Phi\left[\mathbf{R}_i\beta_{s,i} + \mathbf{R}_h\beta_{s,h} + \varepsilon_s\right]. \quad (4) \end{aligned}$$

As before, $\text{Prob}\left[u_l\left(\Omega,(l,s)\right) > 0\right]$ denotes the probability that the utility of the simple labor decision is positive, analogously for schooling $s$, where $\Phi$ is the standardized cumulative distribution function with error terms $\varepsilon_l$ and $\varepsilon_s$ for labor and school, respectively. These two decisions are jointly estimated by bivariate probit and marginal effects are reported. An underlying assumption of the bivariate probit model is the joint distribution of the error terms $\varepsilon_l$ and $\varepsilon_s$, $\begin{pmatrix} \varepsilon_l \\ \varepsilon_s \end{pmatrix} \rightarrow N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix}\right)$ where $\rho = cov\left(\varepsilon_l, \varepsilon_s\right)$. For the null of $\rho = 0$ the $\ell$-ratio test statistic is reported.

I estimate two different models, because I want to determine both the effects of household's employment income net of children's contributions ("poverty explanation") and parents' educational levels. It can be expected that the education variables will be capturing a substantial part of the income effect due to high correlation between these variables[22], however, using both sets allows us to separately look at fathers' and mothers' education effects on labor–school decisions. The marginal effects of parents' educational attainment are reported in table 7 where only the income variables in the

[21] The (structural) demand and supply equations for the individual decisions are assumed to depend on possibly non–identical sets of regressors. The nature of the applied data, however, does not allow for a full specification of the child labor demand equation since no detailed market and employer data are available. Reduced form equations—the analogous is true for the school equation—are therefore applied.

[22] A simple OLS regression with household heads' income as dependent variable and mother's education, fathers' education, district and monthly dummy variables yields positive marginal effects for the education variables (significant at the 1% level) with an $R^2$ of 0.12.

specification used for tables 5 and 6 are replaced by the educational attainment variables.

### 4.4 Empirical results

This section gives the basic results for determinants of child labor and schooling from the joint labor–school estimation using the specification given in equations (3) and (4). There has been little empirical research on child labor in Uganda, in fact there are only three studies known to the author that did so, however, used older data (Angemi 2002, using data from a survey from 1992) or applied a single estimation approach (Mwebaze 2004, applying probit on older and recent data).[23] Empirical results on the effects of in general very well researched determinants of child labor shall therefore be briefly presented—without major deviations from the established literature. Section 5 will eventually focus on the trade-off between labor and school.

Tables 5 and 6 give results for the specifications using households' employment income for different sub–samples, table 7 gives the marginal effects of parents' education attainment.

***Individual characteristics and household structure:*** As already suggested in section 4.2, boys have higher probabilities of labor and school in both urban and rural households, as is seen in table 5. Age also plays a dominant role, where older children have higher probabilities of both labor and school in rural households. For urban households a positive, diminishing effect on the school decision can be observed, while the point estimate for the labor equation yields a negative, virtually linear marginal effect (p-value: 0.104).

The household's structure seems to be more relevant for girls' decisions than boys' (table 6). The number of siblings aged five or younger decreases girls' schooling, but does not affect their labor decisions. As was indicated earlier this may be due to the opportunity costs of schooling that increase with house work load. On the other hand, younger siblings drive boys into the labor force. Siblings between six and ten increase girls' schooling but again do neither affect their labor force participation nor do they have a significant impact on the decision over boys' activities. This increase of schooling can be thought of arising from a loosened labor force constraint

[23] See also Ganglmair (2005) on probit results for the determinants of child labor using these data.

Table 5: Results for rural and urban sub–samples

| | Rural | | | Urban | | |
|---|---|---|---|---|---|---|
| **Variable** | **Mean** | **labor** | **school** | **Mean** | **labor** | **school** |
| sex | 0.5110 | 0.0345** | 0.0136* | 0.4941 | 0.0026* | 0.0142† |
| | | [7.4471] | [2.4294] | | [2.2457] | [1.9167] |
| age | 10.187 | 0.0213** | 0.1850** | 10.335 | -0.0025 | 0.0776** |
| | | [3.3437] | [28.839] | | [1.6274] | [8.8147] |
| age$^2$ | 111.99 | 0.0002 | -0.0084** | 115.05 | 0.0002** | -0.0037** |
| | | [0.7293] | [27.564] | | [2.9940] | [9.0270] |
| ownchild | 0.7598 | -0.0039 | 0.0188** | 0.6998 | -0.0049** | 0.0579** |
| | | [0.7189] | [3.1930] | | [3.8520] | [8.0722] |
| income | 0.0285 | -0.0118 | 0.1044** | 0.1846 | -0.0010 | 0.0150 |
| | | [0.3289] | [3.2589] | | [0.4594] | [1.1947] |
| income$^2$ | 0.0127 | 0.0017 | -0.0396** | 0.2481 | 0.0001 | -0.0005 |
| | | [0.1430] | [2.7716] | | [0.5699] | [0.5098] |
| female head | 0.2280 | 0.0137† | 0.0110 | 0.3016 | -0.0007 | 0.0093 |
| | | [1.9218] | [1.5677] | | [0.4325] | [1.2101] |
| farming | 0.9667 | 0.0233 | 0.0183 | 0.4687 | 0.0063** | 0.0130† |
| | | [1.5857] | [1.0100] | | [4.1839] | [1.8018] |
| bicycle | 0.5596 | -0.0107† | 0.0335** | 0.3998 | -0.0011 | 0.0053 |
| | | [1.8136] | [5.6879] | | [0.7879] | [0.7201] |
| land | 0.8318 | 0.0012 | 0.0098** | 0.5576 | -0.0002 | 0.0032 |
| | | [0.3376] | [3.3788] | | [0.5288] | [0.9149] |
| land$^2$ | 4.9601 | -0.0003 | -0.0002** | 8.1187 | 0.0000 | 0.0000 |
| | | [1.4357] | [4.0025] | | [0.1480] | [1.2630] |
| cattle | 0.3514 | 0.0189** | 0.0002 | 0.2104 | -0.0001 | 0.0029 |
| | | [5.2161] | [0.0536] | | [0.0858] | [0.4611] |
| cattle$^2$ | 1.4952 | -0.0008** | -0.0004† | 1.0253 | 0.0000 | -0.0002 |
| | | [3.4354] | [1.8881] | | [0.5564] | [0.6809] |
| under 5 | 1.3707 | 0.0021 | -0.0015 | 1.0733 | 0.0015* | -0.0071 |
| | | [0.7726] | [0.5322] | | [2.3861] | [1.5840] |
| under 10 | 1.9312 | 0.0001 | 0.0022 | 1.9614 | 0.0007 | 0.0030 |
| | | [0.0474] | [0.6549] | | [1.1761] | [0.8145] |
| adults | 3.0407 | -0.0019 | 0.0027 | 3.3653 | -0.0009* | 0.0076** |
| | | [0.7760] | [1.1349] | | [2.0710] | [2.6829] |
| childratio | 0.6160 | -0.0084 | 0.0272 | 0.5958 | -0.0070 | 0.0163 |
| | | [0.2628] | [0.8242] | | [1.0956] | [0.4130] |
| girlratio | 0.4890 | -0.0176* | 0.0137 | 0.5059 | -0.0004 | 0.0054 |
| | | [2.0057] | [1.5289] | | [0.1491] | [0.4360] |
| *Results for regional and monthly dummy variables are suppressed* | | | | | | |
| Pred. prob. | | 0.0641 | 0.9243 | | 0.0039 | 0.9611 |
| log pseudo–$\ell$ | | -8354.11 | | | -1257.53 | |
| $\rho$ | | -0.6205 | | | -0.7758 | |
| $\chi^2$ ($\ell$-ratio test for $\rho = 0$) | | 381.42 | | | 129.61 | |
| # of obs. | | 15642 | | | 3657 | |
| # of clusters | | 611 | | | 118 | |

Marginal effects reported for bivariate probit estimations. Robust z statistics in brackets, standard errors control for cluster design; significance levels: ** : 1%; * : 5%; † : 10%. Extreme values are dropped from the sample.

for girls, which means that mid-aged children are more likely to take over their sisters' rather than their brothers' activities. With this respect boys and girls are "competing" over mid-aged siblings to take over their duties.[24]

The number of adults in the household increases school attendance probabilities for girls and boys (p-value: 0.109) and generally children in urban households. Loosening a household's labor resource constraint yields positive effects on children's schooling only in urban households. It does so, however, not in rural households as can be seen from the insignificant marginal effect of adults on school and labor in the rural sub–sample. This suggests that children's labor force does not necessarily serve as a substitute for adults'.

The share of children over all household members has virtually zero effects on both school and labor in the reported sub–samples. In rural households and for girls, the share of girls relative to all children has significant effects on both school and labor. The higher the share of girls, the more likely children as well as girls are to attend school and the less likely they are to work. For urban children as well as for boys no such effect is observable. Girls thus do not substitute for boys in their labor activities, suggesting a gender–specific "role order" in a household's assignment of child labor and school attendance.

***Household income and property:*** It is further interesting to observe that none but one of the variables capturing income and asset property has a significant effect on either schooling or labor in the urban sub–sample. The farming indicator positively affects both decisions implying some entanglement of income and productivity effects that are labor–reducing and labor–increasing, respectively.[25]

In rural households, income positively affects the decision over school but has no significant impact on child labor. This possibly captures school costs that are more constraining in rural than in urban areas whose binding effect is alleviated when income increases. Similar effects on school only are obtained for land property whereas a household's property of cattle significantly increases labor only, as seen in Cockburn (2001) for small animals. Cattle thus seems to exhibit some sort of productivity effect that is labor–

[24]For a thorough analysis of sibling composition and child labor see for instance Edmonds (2006).

[25]See Ganglmair (2005) for a more detailed discussion of this issue.

Table 6: Results for girls and boys sub–samples

| | Girls | | | Boys | | |
|---|---|---|---|---|---|---|
| **Variable** | **Mean** | **labor** | **school** | **Mean** | **labor** | **school** |
| urban | 0.1948 | -0.0277** | 0.0389** | 0.1844 | -0.0448** | 0.0335** |
| | | [4.0615] | [3.6381] | | [4.3431] | [3.3923] |
| age | 10.205 | -0.0022 | 0.1790** | 10.225 | 0.0327** | 0.1512** |
| | | [0.4123] | [22.202] | | [4.1011] | [21.593] |
| age$^2$ | 112.34 | 0.0008** | -0.0082** | 112.80 | -0.0003 | -0.0068** |
| | | [3.4932] | [21.553] | | [0.8817] | [20.360] |
| ownchild | 0.7391 | -0.0129** | 0.0480** | 0.7574 | -0.0030 | 0.0135* |
| | | [2.9203] | [6.5286] | | [0.4660] | [2.0457] |
| income | 0.0625 | 0.0251 | -0.0090 | 0.0537 | -0.0838* | 0.2052** |
| | | [1.1524] | [0.4123] | | [2.4359] | [6.0288] |
| income$^2$ | 0.0774 | -0.0060 | 0.0038 | 0.0378 | 0.0227* | -0.0609** |
| | | [0.4581] | [1.2172] | | [2.0136] | [4.8466] |
| female head | 0.2464 | 0.0024 | 0.0179* | 0.2377 | 0.0183* | 0.0017 |
| | | [0.4654] | [2.4560] | | [2.1550] | [0.2309] |
| farming | 0.8661 | 0.0242** | 0.0292* | 0.8784 | 0.0422** | 0.0130 |
| | | [3.1020] | [2.3385] | | [3.5823] | [0.9838] |
| bicycle | 0.5286 | -0.0137** | 0.0384** | 0.5301 | -0.0009 | 0.0199** |
| | | [2.9125] | [6.0178] | | [0.1489] | [2.9927] |
| land | 0.7544 | 0.0073 | 0.0159** | 0.8045 | -0.0012 | 0.0043 |
| | | [1.5963] | [3.7273] | | [0.3280] | [1.5439] |
| land$^2$ | 4.3671 | -0.0016† | -0.0003** | 6.7136 | -0.0001 | -0.0001† |
| | | [1.8102] | [3.7268] | | [0.4942] | [1.9361] |
| cattle | 0.3185 | 0.0029 | 0.0044 | 0.3308 | 0.0280** | -0.0048 |
| | | [1.1913] | [0.7737] | | [6.0351] | [1.3182] |
| cattle$^2$ | 1.3931 | -0.0001 | -0.0006* | 1.4188 | -0.0013** | -0.0001 |
| | | [0.4832] | [2.1765] | | [3.7774] | [0.3943] |
| under 5 | 1.3250 | 0.0004 | -0.0059† | 1.3040 | 0.0053 | -0.0015 |
| | | [0.1998] | [1.7468] | | [1.5707] | [0.5005] |
| under 10 | 1.9428 | 0.0006 | 0.0086* | 1.9311 | 0.0003 | -0.0014 |
| | | [0.2234] | [2.5258] | | [0.0896] | [0.4316] |
| adults | 3.0844 | -0.0025 | 0.0071* | 3.1194 | -0.0021 | 0.0042 |
| | | [1.2415] | [2.4398] | | [0.8961] | [1.6008] |
| childratio | 0.6130 | 0.0056 | 0.0071 | 0.6113 | -0.0280 | 0.0519 |
| | | [0.1984] | [0.1863] | | [0.8000] | [1.3838] |
| girlratio | 0.6822 | -0.0151† | 0.0301* | 0.3081 | -0.0145 | 0.0116 |
| | | [1.7730] | [2.5520] | | [1.1107] | [0.9653] |
| *Results for regional and monthly dummy variables are suppressed* | | | | | | |
| Pred. prob. | | 0.0359 | 0.9273 | | 0.0658 | 0.9350 |
| log pseudo–$\ell$ | | -4459.16 | | | -5193.43 | |
| $\rho$ | | -0.7117 | | | -0.5961 | |
| $\chi^2$ ($\ell$-ratio test for $\rho = 0$) | | 349.65 | | | 261.94 | |
| # of obs. | | 9499 | | | 9800 | |
| # of clusters | | 669 | | | 671 | |

Marginal effects reported for bivariate probit estimations. Robust z statistics in brackets, standard errors control for cluster design; significance levels: ** : 1%; * : 5%; † : 10%. Extreme values are dropped from the sample.

increasing and as with land does not increase opportunity costs of schooling, as was suggested in an earlier section. It rather seems that the positive effect of the income obtained from these agricultural assets compensated for the negative effect on schooling associated with opportunity costs.

A similar picture for agricultural assets is obtained for the girls and boys sub-samples. Land has a stronger effect on the former and cattle on the latter implying a possible gender role effect in (agricultural) households.[26] Only cattle negatively affects boys' schooling; more property of livestock increases the opportunity costs of schooling beyond the additional agricultural income.

Table 7 gives the marginal effects of parental education for all four samples. There are three central observations to make: The effects of parents' education on both labor and schooling are more pronounced in rural than urban households. Further, mothers' educational attainment has relatively and absolutely stronger marginal effects on the two decisions than fathers' education, which is also observed for example by Duraisamy (2000) in a study using data from rural India. Third, the effect on the school decision is stronger for girls than for boys, however, the latter react more sensitively to parents' education in their labor decisions. It is girls' schooling and boys' labor that react to parents' education rather than vice versa. These results are in general in line with those by Cockburn (2001) and Emerson and Portela (2001) who observe a similar pattern, while the findings of Pal (2003) are even more pronounced.

# 5 Labor-school trade-off and intrinsic competition

The aim of this study is to examine the trade-off between labor and schooling, and it is intended to shed light on the degree of "competition" between these two systems in a household's utility maximization. For such, a household bases its decision upon its perceived environment $\Omega$ and will choose $x = l$ and $y = s$ such that its overall utility is maximized. The household has its individual, private knowledge over the observable environment and its intrinsic values, the researcher, however, only gets a rough picture of the environment and can at best proxy intrinsic values. Consequentially,

[26] See for instance Mueller (1984) for an early or Cockburn (2001) and Bhalotra and Heady (2003) for a detailed recent discussion of child labor and a household's property of agricultural assets.

Table 7: Effects of parents' education

| | | Rural | | | Urban | |
|---|---|---|---|---|---|---|
| **Variable** | **Mean** | **labor** | **school** | **Mean** | **labor** | **school** |
| education father | 4.984 | -0.0012$^{\dagger}$ | 0.0058$^{**}$ | 7.368 | -0.0003$^{**}$ | 0.0021$^{**}$ |
| | | [1.7333] | [8.2833] | | [2.6428] | [2.8847] |
| education mother | 2.985 | -0.0022$^{**}$ | 0.0080$^{**}$ | 5.456 | -0.0005$^{**}$ | 0.0056$^{**}$ |
| | | [2.5996] | [9.8168] | | [4.0486] | [6.4428] |
| *other variables suppressed* | | | | | | |
| Pred. prob. | | 0.0634 | 0.9316 | | 0.0032 | 0.9603 |
| log pseudo–$\ell$ | | -8206.28 | | | -1190.92 | |
| $\rho$ | | -0.6135 | | | -0.7569 | |
| $\chi^2$ ($\ell$-ratio test for $\rho = 0$) | | 360.31 | | | 123.65 | |

| | | Girls | | | Boys | |
|---|---|---|---|---|---|---|
| **Variable** | **Mean** | **labor** | **school** | **Mean** | **labor** | **school** |
| education father | 5.424 | -0.0013$^{*}$ | 0.0061$^{**}$ | 5.447 | -0.0015$^{*}$ | 0.0045$^{**}$ |
| | | [2.4291] | [8.5840] | | [2.0371] | [6.1173] |
| education mother | 3.481 | -0.0019$^{**}$ | 0.0094$^{**}$ | 3.427 | -0.0033$^{**}$ | 0.0067$^{**}$ |
| | | [2.9924] | [10.680] | | [3.4090] | [6.9131] |
| *other variables suppressed* | | | | | | |
| Pred. prob. | | 0.0349 | 0.9395 | | 0.0650 | 0.9393 |
| log pseudo–$\ell$ | | -4301.77 | | | -5122.81 | |
| $\rho$ | | -0.7106 | | | -0.5858 | |
| $\chi^2$ ($\ell$-ratio test for $\rho = 0$) | | 337.93 | | | 252.84 | |

Marginal effects reported for bivariate probit estimations. Robust z statistics in brackets, standard errors control for cluster design; significance levels: $**$ : 1%; $*$ : 5%; $\dagger$ : 10%. Extreme values are dropped from the sample.

*Note: Income and its squared value in specifications of tables (5) (upper part) and (6) (lower part) is replaced by parents' educational attainment and only these marginal effects are reported.*

competition between labor and school can be detected in two forms. For observable factors we obtain the direction of the effect a particular variable has on labor and school attendance. The factors are *substituting* if the signs of the estimation coefficients are adverse, and *complementing* if they are equal. A particular factor of the former kind does not benefit (or e.g. positively affect) both activities but leads to one activity driving out the other—that is, one is a substitute for the other—, a factor of the latter kind has the same effect on both labor and school. This approach is very similar to the one chosen by Akabayashi and Psacharopoulos (1999, pp. 133ff) in their study on the trade-off between work and study time at home.

Our results in tables 5 and 6 give various examples for *substituting* and *complementing* factors: Whether or not a girl or boy lives in an urban household has a strong substituting effect on the labor-schooling decision,

whereas the gender of the child is a complementing factor when considering rural and urban households separately. We also observe factors that have different effect patterns for different sub-amples. The child's age, for instance, is complementing in rural but substituting in urban households.[27] The older children in urban areas get the more they are able to specialize, while their fellows in rural households experience a higher rate of combining labor with school attendance; their probability of work increases at the same time, however, they are more likely to work.

As aforementioned, the household structure is an important factor in the determination of labor participation and school attendance rates. Both the number of infant siblings and the number of adults have a substituting effect, though of opposite directions, for urban households only. Only the girls' sub-sample shows a similar pattern for the number of adults. Table 7 gives strong evidence for the substituting nature of parents' education which has a significant positive effect on education in all sub-samples, the most consistent result for all variables we expected to capture the schooling cost constraint and *indifference*, as indicated in table 3 and the discussion thereafter.

Of greater interest than the substituting or complementing nature of the used explanatory variables, however, is the unexplained correlation between labor and school which is denoted by the coefficient $\rho$. Roughly speaking, $\rho$ gives the extent to which school attendance increases—unobservably—if labor decreases. After all explanatory variables are controlled for, what is left is then a non-explainable degree of interdependence of the two decisions, driven by unobservable factors. Such unobserved household characteristics for example may be the perceived improvement of income opportunities in case of children's school attendance (rather than the statistical return on education); perceived availability of schooling relative to the ease or urge of sending children into the labor force; or simply the parents' utter wish or desire to send their children to school, an effect which may not be captured by any of the used variables. Lopez-Calva (2003) further considers social norms and social stigma costs in addition to the usual "children-as-assets type analysis."

These partially intrinsic factors give rise what I refer to as unobserable

[27] Canagarajah and Coulombe (1997) report results for their sample of Ghanaian children that support the findings for urban Uganda; they report a higher trade-off coefficient $\rho$ for older children. See table 9 and discussion below.

Table 8: $\rho$ for vicinity and gender sub-samples

| **Sub-sample** | $\rho$ | $\chi^2$ | **N** |
|---|---|---|---|
| full | -0.6252 | 489.66 | 19,299 |
| rural | -0.6205 | 381.42 | 15,642 |
| urban | -0.7758 | 129.61 | 3,657 |
| girls | -0.7117 | 349.65 | 9,499 |
| boys | -0.5961 | 261.94 | 9,800 |
| rural girls | -0.6926 | 281.28 | 7,649 |
| urban girls | -0.8984 | 73.98 | 1,850 |
| rural boys | -0.5630 | 205.82 | 7,993 |
| urban boys | -0.8028 | 63.64 | 1,807 |

[a]: $\chi^2$ for the likelihood-ratio test of $\rho = 0$.

*Note: Coefficient $\rho$, $\chi^2$ and the number of observations N are reported for the various vicinity and gender sub-samples, based on the specification of table (5).*

or "intrinsic competition": the labor-school trade-off beyond what can be explained by the explanatory variables in our econometric setting.[28]

The "competition coefficient" $\rho$ for the full sample as well as the gender and vicinity sub-samples is given in table 8. The main results are a higher trade-off in urban than in rural households and for girls than for boys. Hence, rural boys experience the least intrinsic competition in their parents' decisions. That means, for them work and school attendance are least incompatible with each other after all observable factors have been controlled for. On the other hand, girls in urban households face an "either/or" decision; if they are to increase their labor force participation in response to factors other than the observed, their school attendance rates drop more than those of boys.[29]

Two observations are noticeable: The results in table 8 very closely relate to the figures in column 6 of table 2. Urban girls have the lowest labor-school combination rate, rural boys the highest. It is of no surprise, though, to obtain the least intrinsic competition coefficient for the sub-sample with the highest combination rate. Nonetheless, for girls the two choices are more (mutually) exclusive than for boys, indeed suggesting a school–jeopardizing

[28] An important side remark: This study does not intend to reveal a causal relationship between labor and schooling, that means the results allow no conclusion with respect to whether labor hampers school or school draws children out of the labor force. The results discussed hereafter are simply an account of the correlation due to unobserved factors.

[29] The coefficients obtained in table 7—parents' education was used as explanatory variables in lieu of non child labor household income—do not substantially differ from the initial results that are given in table 8.

nature of child labor. Similar is true for urban households where children tend to be less able to combine labor and schooling. A clear difference in trade-offs across sub–samples is given.

What is of greater interest, though, is the close correspondence of the obtained results with table 3. The correlation coefficients roughly reproduce the pattern given by *costs* as reason for never attending school. The sub-samples exhibiting the highest rates of costs as reason also yield the strongest competition factors. It seems that the obtained results are driven by perceived costs of schooling. Even after controlling for income, wealth, or the number of siblings (affecting relative costs of schooling) there is still a considerable portion of the trade-off that is unexplained but seems to be cost-related. There is thus a need for further research in this direction in order to identify the nature of these costs and their properties as labor-school determinants. The observed correspondence of $\rho$ with costs exemplifies the need to understand the driving forces behind the proclaimed "intrinsic competition" to fully understand the labor-school decision. Only then will we be able to discuss policy measures that alleviate households' costs constraint and decrease "bad" child labor while at the same time increase school attendance and performance.

In order to get a glimpse of where this study is to be seen within the literature, table 9 collects the correlation coefficients as obtained by recent studies using data from three continents and various years. The coefficients range from zero (Bacolod and Ranjan 2005) to close to negative unity (Kambhampati and Rajan 2004) and give very ambiguous results. Except for Nielsen (1998) and Kambhampati and Rajan (2004) (and Lopez-Acevedo (2002) for the vicinity sub-samples) the authors obtain a low trade-off for the full samples, which is not consistent with the findings in this study. More meaningful than the absolute figures, however, are the difference across the sub-samples. The results of Canagarajah and Coulombe (1997) for instance exhibit a pattern that is similar to our results for Uganda when considering the stronger trade-off for urban than for rural households. They do, however, not get a stronger trade-off for girls as this study suggests. Furthermore, the results of Nkamleu (2004), Kambhampati and Rajan (2004) and Parikh and Sadoulet (2005) are of noticeable similarity.

Through table 9 it becomes clear that there are no unambiguous cross-country results on "instrinsic competition" for specific sub-samples of the

Table 9: Coefficient $\rho$ in recent studies for various sub-samples

| **Country** | **Year** | **Age** | **full** | **rural** | **urban** | **girls** | **boys** |
|---|---|---|---|---|---|---|---|
| Cote d'Ivoire[a] | 2002 | 6–14 | -0.167 | | | -0.195 | -0.141 |
| Ghana[b] | 1987–92 | 7–14 | -0.1252 | -0.0217 | -0.3479 | -0.1340 | -0.1776 |
| | 1987–92 | 7–10 | -0.1291 | | | | |
| | | 11–14 | -0.1778 | | | | |
| Ghana[c] | 1987–92 | 7–14 | -0.1527 | -0.1228 | -0.3080 | -0.1140 | -0.1473 |
| Zambia[d] | 1993 | 7–14 | -0.63 | -0.65 | -0.44 | -0.64 | -0.62 |
| Zambia[e] | 1993 | 7–14 | | -0.78 | -0.40 | | |
| India (rural)[f] | 1987–89 | 5–15 | | | | -0.46 | -0.43 |
| India (rural)[g] | 1987–89 | 5–15 | | | | -0.44 | -0.39 |
| India[h] | 1993 | 5–15 | -0.9929 | | | -0.9536 | -0.9977 |
| Philippines[i] | 1994–95 | | | | 0.0 | | |
| Brazil[j] | 1992 | 10–14 | | -0.227 | -0.311 | | |
| Brazil[k] | 1996 | 10–14 | | | | -0.1794 | -0.2079 |
| Brazil[l] | 1996 | 10–14 | | | | -0.2471 | -0.2425 |
| Brazil[m] | 1998 | 5–15 | -0.1582 | | | | |
| Brazil[n] | 1998 | 5–15 | -0.2554 | | | | |
| Brazil[o] | 1998 | 5–15 | -0.0363 | | | | |
| Ecuador[p] | 1998 | 10–14 | | -0.572 | -0.526 | | |
| | | 15–17 | | -0.484 | -0.441 | | |
| Mexico[q] | 1994–98 | 12–16 | | | -0.4154 | | |

The table gives the coefficient $\rho$ as obtained by recent studies; for the full sample, as well as rural, urban and girls and boys sub-sample. Non-zero coefficients are listed if significant or if significance levels are not reported in the respective studies.

*[a]: Nkamleu (2004); [b]: Canagarajah and Coulombe (1997) and [c]including school expenditures; [d]: Nielsen (1998) and [e]with random effects; [f]: Pal (2003) with parents' labor participation rates and [g]with wage rates; [h]: Kambhampati and Rajan (2004); [i]: Bacolod and Ranjan (2005); [j]: Parikh and Sadoulet (2005); [k]: Emerson and Portela (2001) with positive hours at work and [l]with at least 20 hours; [m]: Muniz (2001), [n]with waged work and [o]with non-waged work; [p]: Lopez-Acevedo (2002); [q]: Lopez-Calva (2003).*

population. It is rather the case that results to a great extent hinge on the choice of explanatory variables. The research objective for this study was to identify the trade-off for Uganda, how and how much one can speak of a pattern that is observable across countries and continents is up to future research.

# 6 Conclusion

This paper jointly estimates a household's child labor and child school attendance decision applying a bivariate probit model to recent household data from Uganda that has not been used before in this particular research context. Individual characteristics, household's income and asset variables, variables denoting household composition and number of siblings as well as

district and monthly control variables were used as regressors in this two-equation system and their marginal effects on each of the decisions as well as the correlation coefficient $\rho$ reported. Three central questions have been looked at in more detail:

First, the issue of child labor has become a vivid field in economic research. Part of this is motivated by the argument that labor deprives children of their childhood and jeopardizes both their school attendance and performance. This is said to have both private and social costs: Lack of education would not allow children to escape from the poverty trap, and impaired accumulation of human capital would eventually lead to worse prospects of a society's economic growth. This empirical study shows that there is in fact "competition" between labor force participation and school attendance, however, for Uganda this trade-off is less severe than suggested by authors who have assumed mutual exclusiveness of the two choices (e.g. Jensen and Nielsen (1997)) or than shown in other empirical studies (e.g. Canagarajah and Coulombe (1997)). Especially boys and children in rural households are able to combine their labor activities with school attendance. No conclusions, however, can be drawn with respect to any common cross-country results, nor is there anything to be said about effects on the *quality* of children's school attendance. The observation that boys tend to combine both activities while girls specialize gives rise to a possible structural gender specific difference in school performance if child labor indeed affects the quality of education.

Second, determining the effects of wage income and income from self–employment as well as households' property positions has been an extensive field of empirical literature. Central to this work is the notion of the poverty hypothesis of child labor, suggesting that poverty drives children into labor and out of school. Bhalotra and Heady (2003) have recently used the term "wealth paradox" to describe the initially paradoxical observation of a higher incidence of child labor in households that are rich in land and other agricultural assets, shedding new light on the poverty explanation. The results for Uganda give partially supportive results with respect to the "wealth paradox", but do not strongly support the traditional poverty notion: Income does neither affect girls' decisions nor is it relevant in urban households. It has a significant impact on boys' decisions, though, suggesting some degree of "gender attitude." Boys' schooling and labor reacts more sensitively to in-

come, that means a larger portion of available additional income is denoted to them.

This finally leads to the third conclusion of this paper. There are substantial differences in child labor and school attendance across the used sub–samples. With respect to gender, a strong bias is observed: Girls are less likely to combine labor with school attendance whereas the chance to attend school while working is indeed given to boys. Though girls have a lower probability of labor, this result is due to the fact that they are extensively involved in intra-household activities. Further, parents are more cost-sensitive with respect to girls' school attendance, rather withdrawing *them* than their brothers. One explanation for this is their involvement in chores or household–near activities, as is suggested by the negative effect of infant siblings on school attendance—in general, their sensitivity with respect to household composition and number of younger siblings. Further empirical research is necessary to shed more light on the role of gender and its interrelation with income and property.

## References


Akabayashi, H., and G. Psacharopoulos (1999): "The Trade-off between Child Labour and Human Capital Formation: A Tanzanian Case Study," *Journal of Development Studies*, 35(5), 120–140.

Angemi, D. (2002): "Labour Market Efficiency and the Determinants of Agricultural Child Labour," *Poverty Monitoring and Analysis Unit, Ministry of Finance, Planning and Economic Development, Kampala, Uganda*.

Ashford, J., and R. Sowden (1970): "Multi-Variate Probit Analysis," *Biometrics*, 26(3), 535–546.

Bacolod, M. P., and P. Ranjan (2005): "Why Children Work, Attend School, or Stay Idle: The Roles of Ability and Household Wealth," Unpublished manuscript, University of California - Irvine.

Basu, K., and Z. Tzannatos (2003): "The Global Child Labor Problem: What Do We Know and What Can We Do," *World Bank Economic Review*, 17(2), 147–173.

Beegle, K., R. Dehejia, and R. Gatti (2004): "Why Should We Care About Child Labor? The Education, Labor Market, and Health Consequences of Child Labor," *NBER Working Paper No. 10980*.

Bhalotra, S., and C. Heady (2003): "Child Farm Labor: The Wealth Paradox," *The World Bank Economic Review*, 17(3), 197–227.

Bhalotra, S., and Z. Tzannatos (2003): "Child Labor: What Have We Learnt?," *World Bank Social Protection Discussion Paper Series No. 0317*.

Biggeri, M., L. Guarcello, S. Lyon, and F. Rosati (2003): "The Puzzle of 'Idle' Children: Neither in School nor Performing Economic Activity. Evidence from Six Countries," *Understanding Children's Work. An Inter–Agency Research Cooperation Project*.

Blunch, N.-H., and D. Verner (2000): "Revisiting the Link Between Property and Child Labor: The Ghanaian Experience," *World Bank Working Paper Series No. 2488*.

Boozer, M., and T. Suri (2001): "Child Labor and Schooling Decisions in Ghana," Unpublished manuscript, Yale University.

Brown, D., A. Deardorff, and R. Stern (2003): "Child Labor: Theory, Evidence and Policy," in *International Labor Standards. History, Theories, and Policy Options*, ed. by K. Basu, H. Horn, L. Roman, and J. Shapiro, chapter 3. Blackwell Publishers, Oxford.

Cain, M. T. (1977): "The Economic Activities of Children in a Village in Bangladesh," *Population and Development Review*, 3(3), 201–227.

Canagarajah, S., and H. Coulombe (1997): "Child Labor and Schooling in Ghana," *World Bank Working Paper Series No. 1844*.

Chernichovsky, D. (1985): "Socioeconomic and Demographic Aspects of School Enrollment and Attendance in Rural Botswana," *Economic Development and Cultural Change*, 32(1), 319–332.

Chiappori, P.-A., and B. Salanié (2000): "Testing for Asymmetric Information in Insurance Markets," *Journal of Political Economy*, 108(1), 56–78.

Cockburn, J. (2001): "Child Labour versus Education: Poverty Constraints or Income Opportunities," *CREFA Working Paper No. 0116, Université Laval, Québec.*

Duraisamy, M. (2000): "Child Schooling and Child Work in India," *Econometric Society Eighth World Congress.*

Edmonds, E. V. (2006): "Understanding Sibling Differences in Child Labor," *Journal of Population Economics*, forthcoming.

Emerson, P., and A. Portela (2001): "Bargaining Over Sons and Daughters: Child Labor, School Attendance and Intra-household Gender Bias in Brazil," Unpublished manuscript.

Ersado, L. (2005): "Child Labor and Schooling Decisions in Urban and Rural Areas: Comparative Evidence from Nepal, Peru, and Zimbabwe," *World Development*, 33(3), 455–480.

Ganglmair, B. (2005): "A Note on the Effects of Income and Property on Child Labor in Rural Uganda," Unpublished manuscript, University of Bonn.

Gotschi, E. (2004): *Education Policies in Uganda. Struggling and Empowerment through Distance Learning*. Universitaetsverlag Trauner, Linz.

Gouriéroux, C., A. Monfort, E. Renault, and A. Trognon (1987): "Generalised Residuals," *Journal of Econometrics*, 34, 5–32.

Greene, W. (2003): *Econometric Analysis*. Prentice Hall, Upper Saddle River, 5 edn.

Grootaert, C., and H. A. Patrinos (eds.) (1999): *The Policy Analysis of Child Labor. A Comparative Study*. St. Martin's Press, New York.

Gunnarsson, V., P. F. Orazem, and M. A. Sanchez (2006): "Child Labor and School Achievement in Latin America," *World Bank Economic Review*, forthcoming.

Heady, C. (2003): "The Effect of Child Labor on Learning Achievement," *World Development*, 31, 385–398.

Jensen, P., and H. S. Nielsen (1997): "Child Labour or School Attandance? Evidence from Zambia," *Journal of Population Economics*, 10(4), 407–424.

Kambhampati, U. S., and R. Rajan (2004): "Economic Growth: A Panacea for Child Labour?," *Economics and Management Discussion Papers No. 012-2004, University of Reading*.

Levison, D. (1991): "Children's Labor Force Activity and Schooling in Brazil," Ph.D. dissertation, University of Michigan.

Long, J. S. (1997): *Regression Models for Categorical and Limited Dependent Variables*. SAGE Publications, London.

Lopez-Acevedo, G. (2002): "School Attendance and Child Labor in Ecuador," *World Bank Policy Research Working Paper No. 2939*.

Lopez-Calva, L.-F. (2003): "Social Norms, Coordination and Policy Issues in the Fight Against Child Labor," in *International Labor Standards.*

*History, Theories, and Policy Options*, ed. by K. Basu, H. Horn, L. Roman, and J. Shapiro, commentary 3.2. Blackwell Publishers, Oxford.

Maitra, P., and R. Ray (2002): "The Joint Estimation of Child Participation in Schooling and Employment: Comparative Evidence from Three Continents," *Oxford Development Studies*, 30(1), 41–62.

Mueller, E. (1984): "The Value and Allocation of Time in Rural Botswana," *Journal of Development Economics*, 15, 329–390.

Muniz, J. O. (2001): "An Empirical Approach for Child Labour in Brazil," Unpublished manuscript, Centro de Desenvolvimento e Planejamento Regional, Universidade Federal de Minas Gerais.

Mwebaze, T. (2004): "Extent and Determinants of Child Labour in Uganda," Ph.D. dissertation, University of Linz.

Nielsen, H. S. (1998): "Child Labor and School Attendance: Two Joint Decisions," *Centre for Labour Market and Social Research Working Paper No. 98-15*.

Nkamleu, G. B. (2004): "Children at Risk in the Agricultural Sector in Subsaharan Africa: Determinants of Child Labor Participation in the Cocoa Farming of Cote dÕIvoire," *Global Development Awards 2004: Conflict, Human Security and Immigration*.

OECD (2003): *Combating Child Labour. A Review of Policies*. Organization for Economic Co-operation and Development, Paris.

Pal, S. (2003): "How Much of the Gender Difference in Child School Enrollment Can Be Explained? Evidence from Rural India," *Bulletin of Economic Research*, 56(2), 133–158.

Parikh, A., and E. Sadoulet (2005): "The Effect of Parents' Occupation on Child Labor and School Attendance in Brazil," Unpublished manuscript, University of California at Berkeley.

Patrinos, H. A., and G. Psacharopoulos (1995): "Educational Performance and Child Labor in Paraguay," *International Journal of Educational Development*, 15(1), 47–60.

——— (1997): "Family Size, Schooling and Child Labor in Peru: An Empirical Analysis," *Journal of Population Economics*, 10(4), 387–405.

Ravallion, M., and Q. Wodon (1999): "Does Child Labour Displace Schooling? Evidence on Behavioral Responses to an Enrollment Subsidy," *World Bank Working Paper No. 828*.

Ray, R., and G. Lancaster (2004): "Does Child Labour Affect School Attendance and School Performance? Multi Country Evidence on SIMPOC Data," *Econometric Society 2004 Australasian Meeting*, 68.

Rodgers, G., and G. Standing (1981): "The Economic Roles of Children: Issues for Analysis," in *Child Work, Poverty and Underdevelopment*, ed. by G. Rodgers, and G. Standing. International Labour Organization, Geneva.

Rosenzweig, M. R., and R. Evenson (1977): "Fertility, Schooling and the Economic Contribution of Children in Rural India: An Econometric Analysis," *Econometrica*, 45(3), 1065–1079.

Sakellariou, C., and A. Lall (2000): "Child Labour in the Philippines: Determinants and Effects," *Asian Economic Journal*, 14(3), 233–253.

Scoville, J. G. (2002): "Segmentation in the Market of Child Labor. The Economics of Child Labor Revisited," *American Journal of Economics and Sociology*, 61(3), 713–723.

UBOS (1999): "Uganda National Household Survey 1999/2000. Socio–Economic Survey Questionnaire," Uganda Bureau of Statistics, Kampala, Uganda.

USDoL (2002): *The Department of Labor's 2001 Findings on the Worst Forms of Child Labor.* U.S. Department of Labor, Bureau of International Labor Affairs, Washington, D.C.

Weeks, M., and C. Orme (1998): "The Statistical Relationship Between Bivariate and Multinomial Choice Models," University of Cambridge.

Zellner, A., and T. H. Lee (1965): "Joint Estimation of Relationships Involving Discrete Random Variables," *Econometrica*, 33(2), 382–394.