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Risk and Time Preference on Schooling: Experimental Evidence from a Low-Income Country

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Abstract

Educational investment involves risks and long-term commitment, and the degree of risk aversion or patience of parents could play a vital role in the schooling decision. Yet, there are few studies analyzing the impact of such preferences on educational investment. This paper utilizes a unique dataset with a large-scale field experiment of preferences and estimates the impacts of the patience and risk aversion of the parents on school attendance, delayed enrollment, and the education expenditure of their children in Uganda. Our results show that the risk aversion of the parent delays enrollment of young children, especially boys. This could be explained by parents' security concerns for their young children. Girls of impatient parents have high attendance rates when they are young (6 – 9 years old) but have low attendance rates when they are older (10 – 13 years old). Boys aged 10 to 13 have low attendance rates if their parents have a high present bias. Finally, the patience of the parents increases the education expenditure.

Keywords: Risk attitude, time preference, experiment, education, Sub-Saharan Africa

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1 Introduction

Despite the recent advancement in providing basic education to children in developing countries, 57 million children of primary school age remain out of school, including 30 million children in Sub-Saharan Africa (UNESCO, 2014). Among many potential barriers to children's education are parental preferences on risk and time. Educational investment involves risks because of uncertain futures and the difficulty in assessing children's abilities (Becker, 1964; Levhari and Weiss, 1974). In low-income countries, the risks are often further magnified due to poor schooling environments (Glewwe and Kremer, 2006; Porter et al., 2011). Education also requires long-term commitment in the sense that years of investment are required before the benefit can be realized (Hayami and Godo, 2004, Psacharopoulos and Patrinos, 2004).

Past studies have noted the role of the risk and time preferences of parents, and there are empirical studies conducted in developed countries such as Italy and Germany, but, to the best of our knowledge, no study has estimated the associations between the measured risk and time preferences of parents with the education decision of their children in low income countries (Leonardi, 2007; Wölfel and Heineck, 2012). Recent studies from low-income countries that have attempted to investigate the relationship between preferences and educational investment have been limited to those analyzing the reverse impact of educational attainment on the time preferences or the determinants of the stated parental preference for education (Bauer and Chytilova, 2010b; Lincove, forthcoming). If risk and time preferences as explanatory variables are omitted from the estimation models of the educational investment, the estimation results could be biased when such preferences are correlated with some of the determinants (Dohmen et al.,

2010). Indeed, due to the large variability in income and returns to schooling in rural areas, education could be considered a risky investment for which risk aversion is an important decision factor (Jacoby and Skoufias, 1997; Sawada and Lokshin, 2009). In addition, non-economic factors, such as poor school quality and security concerns, may affect parents' decisions (Glewwe and Kremer, 2006; Porter and Blaufuss, 2002). In developing countries, children often need to walk a long distance to attend school. Security along the roads to and from school is a serious concern, especially for young children, in particular girls (Porter et al., 2010). Thus, risk-averse parents may prefer delaying enrolment or taking their children out of school. Furthermore, myopic parents may prefer receiving immediate returns from their children's labor, instead of waiting for future returns.

In this paper, by using results from field experiments on risk and time preferences of survey respondents, we explicitly estimate the associations between risk and time preferences of the respondents, who are mostly fathers, and the investment in their children's schooling in Uganda. The survey and the economic experiment were conducted in Uganda, covering 1,289 households in 94 villages across the country. From the total sample, we use data from 583 households who have 1,586 primary-school-age children, aged 6 to 13, in order to examine the relationship between parental preferences and the educational outcomes of their children. The results in the paper indicate that risk-averse parents delay enrollment of young children, especially boys. Girls of impatient parents have a high attendance rate when they are young (6 – 9 years old) but a low attendance rate when they are older (10 – 13 years old). It appears that impatient parents want to start the schooling of their girls early and finish it early. When parents have a high present bias, boys aged 10 to 13 have a low attendance rate possibly

because their parents value present income more over future income. Finally, we find that patient parents spend more on education expenditure.

This paper is organized as follows. Section 2 presents the conceptual framework on the relationship between risk and time preferences and provides background information about the primary education system in Uganda. The key research questions of this paper are also presented in this section. Section 3 describes the data used in this paper, while Section 4 explains the methodology for our analysis. We discuss the empirical results in Section 5, before we conclude the paper in Section 6.

2 Role of Risk Aversion and Patience in Educational Investment in Uganda

Conceptual Framework

Educational investment can be risky due to the non-marketability of and difficulty in diversifying human capital accumulated from the investment (Becker, 1962; Levhari and Weiss, 1974). In developing countries, additional issues that arise from the uncertain quality of public schools, security concerns, and the intermittent need to withdraw children from school due to variable agricultural income make the educational investment even riskier for farming households (Glewwe and Kremer, 2006; Porter et al, 2010; Jacoby and Skoufias, 1997; Sawada and Lokshin, 2009). If education is a risky investment, the more risk-averse the parents are, the less they will invest in their children's education. Because formal education spans over many years, the degree of patience may also affect the parental decision for schooling.

Parent's Maximization Model

The optimization problem with risky education was first modeled by Levhari and Weiss (1974). Their main objective was to analyze the effect on the optimal investment of risks themselves, rather than the attitude towards risks. Therefore, the degree of risk aversion (or the discount rate) plays little role in their discussion. It is also a personal choice model instead of a household model. Nonetheless, their model highlights the role of uncertainty in educational investment, and the first-order conditions give some basis for the analysis. The mathematical illustration is given in Annex 1. The difference between Becker's (1964) model of human capital investment and that of Levhari and Weiss (1974) is that expectation is taken for the utilities due to uncertainty. In each period, the budget consists of own income and net assets. Here, the income in the future period depends on both the human capital accumulated from the schooling investment in period zero and the future unknown state of the world. In contrast, today's income is assumed to be exogenously given.

The model derives two main implications. First, the rate of substitution between the marginal utility from the present consumption and the expected marginal utility from the future consumption equals the rate of returns on the other assets, given that the rate is known. If subjective discounting is incorporated, this substitution ratio is the rate of returns on the other assets weighted by the discount rate. Therefore, all other things being equal, the higher the discount rate, the smaller the level of household consumption allocated to today than to the future at the optimum.

Second, the utility weighted expected marginal benefit of additional earnings in the future due to schooling investments equals that which is due to investments in other assets. The parent chooses the investment amount between the riskier and the safer assets so that the expected benefit from one equals the benefit from the other. Note that

the expected returns on schooling investments depend upon the individual's future income, which in turn depends upon the random variable representing future uncertainty. Therefore, depending on the variability of a child's future income and the degree of risk aversion, the choice of schooling investment may vary (Levhari and Weiss, 1974). Again, assuming that the rate of returns on the other assets is known, under certain conditions, the more risk averse the individual is, the less investment is allocated to education, which results in future income variability.[1]

Past empirical evidence from the field of agriculture shows a positive correlation between lower risk aversion and the higher likelihood of investment in modern technology (Binswanger, 1980; Liu, 2008). Patience is also associated with mothers that have more young children, implying the role of more forward-oriented preferences in ensuring the welfare of the children (Bauer and Chytilová, 2010a). Similarly, risk tolerance and the patience of the parents may also increase educational investment for their children and raise the children's future income.

Education in Uganda

In order to argue that education is a relatively risky investment, we need to look at the risks attached to schooling for our sample households in rural Uganda. After the abolition of school fees in public schools through the universal primary education policy introduced in 1997, the net enrollment ratio for primary school increased from around 60% to over 80%, but the sudden increase in enrollment was followed by a decrease in internal efficiency resulting in a substantial number of school drop-outs (Deininger, 2003; Nishimura et al., 2008).

[1] Further explanation is in Annex 1.

The situation is especially severe in rural areas. Parents and children in the villages cite various reasons for drop-out besides financial constraints including long distances, early pregnancies, and a lack of interest (Nishimura et al., 2008; Musisi et al., 2003). First, giving "long distances to school" as a reason for drop-out implies not only the high travelling cost of time and commuting expenses, but also that children often experience accidents and other dangers on the way that may put the children at risk, similar to the case in rural Ghana (Lincove, forthcoming; Porter et al., 2010). Second, the lack of interest could partly be attributed to overcrowding, teacher absence, or other poor school quality issues often found in rural public schools that add to the uncertainties of the returns to education so much so that it may even induce parents to send their children to private schools at additional cost (Musisi et al., 2003, Nishimura and Yamano, 2013). As of 2012, the Ugandan government target was to allocate 1 classroom for every 55 pupils in primary schools, but the actual average class size for Primary 1 is 64 pupils, and it increases to more than 80 pupils in some rural districts (Uganda MOES, 2012). Third, early pregnancies could also be considered as a risk in sending daughters to school since such an event often terminates the girl's education indefinitely. As Nishimura and Yamano (2013) illustrate, parents in developing countries may then have different preferences on the level of educational investment across gender.

Key Research Questions

The important question to be answered is whether parental risk and time preferences have an impact on the educational investment and outcomes of the children. If the more risk tolerant parent invests more in education, then the policy implication is that primary

education is indeed perceived as a risky investment, and policies should reduce such riskiness of education. As we discussed above, riskiness may derive from security issues, internal inefficiency, and variable returns from education. If low expected returns are not much of a concern for parents in Uganda as Lincove (forthcoming) suggests, then more resources should be allocated to improving the security and efficiency of schools. From the inter-temporal model, we also hypothesize that patience increases educational investment. Again, if patient parents invest more in education, then education is perceived as a long-term investment. In order to reduce the high expected cost, subsidies for the children who progress to upper classes may be an effective solution. Last but not least, we investigate whether the risk and time preferences affect the education of boys and girls differently. Depending on the result, gender-specific policies may need to be developed.

This study takes advantage of a nationally representative experiment carried out in rural Uganda and tests whether the measured risk aversion parameters and the discount rates of the parents are associated with the schooling performance of the children in the household such as attendance, delayed enrollment, and educational expenditure. To the authors' knowledge, this is the first study to carry out such an empirical analysis in a developing country.

3 Data and Descriptive Statistics

Data

The data we use in this paper were collected as part of the Research on Poverty, Environment and Agricultural Technology (R*e*PEAT) project. The project was conducted by Makerere University in Uganda and the Foundation for Advanced Studies

on International Development.[2] The risk and time preference data were collected in a field experiment conducted in March 2009. The details of the experimental design and the estimation method for the preference parameters are described in Tanaka and Munro (2014). The survey data regarding the children's education and the household characteristics were collected during the household surveys in 2009.

In total, data are available on 1,586 children aged 6 to 13 living in 583 households from 90 rural communities in the Western, Central, and Eastern regions of Uganda. The Northern region is excluded from the survey due to security concerns. The main livelihood of the surveyed households is agriculture, and on average, the farm income constitutes around 60 percent of the total household income (Yamano et al., 2004). Table 1 shows the descriptive statistics for the household. The average age of the household head is 46.5 years old. The highest grade completed by male and female adults in the household is 7.9 and 7.0 years for males and females, respectively. Around 11 percent of the household heads are female. As for the wealth indicators, the average land size is 7.4 acres, and the average asset value is USD 339.[3] The sampled children are aged 6 to 13. Since the investment decision for adolescents can be affected by the adolescents themselves, we do not include the analysis here.[4] In terms of the relationship to the head, around 73 percent of the sampled children are the children of the household heads. Other main relationships to the head include 'grandchild' and 'niece or nephew'. Half of our sampled children are female.

[2] This work is funded by the Global COE program at National Graduate Institute for Policy Studies, Japan (GRIPS).
[3] Note: 1USD=1930 Uganda shillings.
[4] The discussion on adolescents' schooling and their relationship to risk and time preferences are discussed in Munro and Tanaka (2014).

Risk and Time Preference

Table 1 includes the average preference parameters of the household heads who were participants in the field experiments. As we describe in the table, 73 % of the children in our study are the children of the household head, 18 % are grandchildren, and 9 % are others. Thus, in this paper, we assume that the household heads make schooling decisions of these children living in their households.[5] This is a limitation of this study in that we only have preference data from one household head or a care taker. We discuss more regarding this limitation later in this paper.

The mean risk aversion parameter, σ, is 1.30 which is comparable to earlier estimates, between 0.81 and 2.0, of an earlier study in another African country, Zambia, (Wik and Holden, 1998 as cited in Cardenas and Carpenter, 2008).[6] The loss aversion parameter, λ, is also included in the analysis. Loss aversion is a concept whereby losses loom larger than the gains of the same magnitude (Kahneman and Tversky, 1979), which Tanaka and Munro (2014) argue, could be a significant aspect of the attitude towards risks for rural farmers in Uganda. The average loss aversion of 3.22 implies that, on average, a decrease in utility from losing USD1 has an equal magnitude to an increase in utility from gaining USD 3. The average discount rate, r, is 49 percent.[7] This is substantially higher than those found in previous studies, which are usually measured in annual rates (Cardenas and Carpenters, 2008). A large part of the deviation probably comes from the hypothetical nature of the question. The focus, however, is not so much

[5] This assumption is reasonable in many developing countries where orphaned children are often fostered into extended families who take care of their welfare (Ainsworth and Filmer, 2002; Yamano et al, 2006).

[6] Assuming the CRRA utility function, $\frac{C^{1-\sigma}}{1-\sigma}$, the curvature of the utility function, σ_j, represents the risk attitude and is negative for the risk lovers, zero for the risk neutral, and positive for the risk-averse individuals.

[7] Note that $\frac{1}{1+r} = \beta$, the discount factor.

on the absolute values of the discount rates as on their relative sizes, which may affect schooling investment outcomes differently across households. Lastly, the average degree of present bias, d, is 0.75.[8] Around 60 percent of the household heads have present bias, indicating that for those household heads, the present consumption is weighted especially higher than the utilities derived from consumptions at any future dates.

Village and School Characteristics

Information about village and school characteristics were collected in a community survey, which was carried out along with the household survey in 2009. School teachers or others knowledgeable about the schools in their village completed the community survey. On average at the village level, the average distance to primary school is 2.5 km, although for one in five sampled villages, the distance is more than 3.5 km, and in six very remote villages, the distance is substantially longer, between 5 km and 10 km (Table 1). Considering 78 percent of main roads are dirt or murram, one can imagine the difficulty of commuting to school, especially in the rainy season when large puddles make roads impassable in hilly areas. The average number of primary schools, including small schools operated by communities, is 3.7. The average number of pupils per classroom is 69, which is close to the average class size of 64 pupils nationwide in 2012 (Uganda MOES, 2012), as we discussed in Section 2.

[8] Note that $u_T = m_T + d\sum_{t=1}^{t=\infty}\beta^t m_{T+t}$, where u_T is the utility derived at time T from streams of incomes m_{T+t} over time and d is the degree of present bias.

Children's schooling and parents' preference

The schooling status of our sample children is shown in Table 2. The overall school attendance rate is 89.6 percent, which is comparable to the national average of 91.3 percent in 2009 (UNESCO data, 2014). Among those attending, however, 71.8 percent have delayed enrollment by at least one year and 33.1 percent have repeated grades at least once. Only 16.9 percent have neither delayed enrollment nor repeated grades, suggesting a high level of inefficiency.

Comparing girls' and boys' performances, there is no statistically significant difference between their attendance rates. This is consistent with the finding that the universal primary education policy has reduced the gender parity in school access (Nishimura et al., 2008). However, the proportion of delayed enrollment is lower for girls at 70.1 percent than for boys at 73.6, though the difference is not statistically significant. Lastly, the difference across gender in the percentages of those who have ever repeated is minimal at 0.1 percentage points. These base results suggest that girls have better school progression than boys, but the difference may partly be due to the different preferences of the parents for girls and boys. In the later regression analysis, we will examine the effect of parental preferences on children's schooling separately for boys and girls.

In Table 3, we look at the schooling investment statistics by the preference groups of the household heads defined as follows. We categorized the household heads into four risk categories. The first category is "risk loving or neutral" which includes those subjects with σ equal to or less than zero. All other subjects that are risk averse by definition are divided into thirtile groups: the lowest thirtile "slightly risk averse" group includes those with $0 < \sigma \leq 1.1$, the middle thirtile "moderately risk averse" group

includes those with $1.1 < \sigma \leq 2.06$, and the highest thirtile "very risk averse" group includes those with $\sigma > 2.06$. Four categories are created for the time preference as well: the four quartile groups, "very patient", "moderately patient", "slightly patient" and "impatient", include those with discount rates, r ≤ 21.8, 21.8 < r ≤ 36.04, 36.04 < r ≤ 53.6, and r > 53.6 percent, respectively.

Comparing the children's schooling according to the household heads' risk preference, while attendance rates are highest for children with "very risk averse" household heads at 90.6 percent, delayed enrollment is again highest at 1.71 years on average for children with "very risk averse" heads. The descriptive results partly support our expectation that risk aversion decreases investment in risky education through delayed enrollment. The educational expenditure per school-age child shows no specific trend, although the "slightly risk averse" heads seem to invest the highest amount at USD 62.9 per child.

The descriptive statistics showing the relationship between children's education and household heads' time preference are also partly in line with our expectation that patience increases investment. The "very patient" household heads spend on average USD 66.4 per school-age child, which is higher than that of heads in any other time preference categories. However, the schooling of the children has an opposite trend. The children of "very patient" household heads have on average the lowest attendance rates and more delay in enrollment than children from other categories. The inconsistency in our base statistics may be due to uncontrolled factors. We examine the relationship more rigorously in the following regression analyses.

4 Empirical Model

In estimating the role of the risk and time preferences of the parents in the educational investment decisions for the children, we employ the reduced-form estimation method following Glewwe and Kremer (2009) and Weir (2011):

$$E = f(C, H, \mathrm{V}) \,, \tag{1}$$

where E represents the measure of educational investment inputs such as school attendance, delay in enrollment, and the dollar amount of educational expenditure per child; *C, H,* and *V* represent variables at the child, household, and village level, respectively. As Glewwe and Kremer (2006) argue, the parental choice of inputs includes the ensuring of the children's school attendance, timely enrollment and payment of school related expenses.[9]

Applying the above method, we first estimate the probability of attending school. A probit model is used for estimating the probability of attending school:

$$\Pr(A_{ij} = 1) = f(H_j, C_{ij}, V) \,, \tag{2}$$

where the outcome variable, A_{ij}, takes one if the child in household j attends school, and zero otherwise; H_j includes a set of the preference parameters, σ (risk aversion), λ (loss aversion), r (discount rate) and d (degree of present bias); and C_{ij} includes a set of characteristics of the child *i* from household *j*. Since the schooling risks and value of children's time may vary depending on the age and gender of the children, we estimate the model for all children as well as separately by gender and age group (6 to 9 years old and 10 to 13 years old).

[9] In our regression analyses, we exclude the analysis of grade repetition since grade repetition is highly affected by external factors such as results of school exams in the Ugandan educational system, resulting in the decision being made more by the school than by the parents.

Second, we estimate the probability of delayed enrollment. Again, the probit model is used:

$$\Pr(\mathrm{D}_{ij} = 1) = f(\mathrm{H}_j, \mathrm{C}_{ij}, V) \,, \tag{3}$$

where the outcome variable, D_{ij}, takes one if the child in household j has delayed enrollment by at least one year, and zero otherwise.

Last, we estimate the household educational expenditure per school-age child. Here, we use the Tobit model assuming that for many children, including those who are out of school:

$$\mathrm{E}_j = \begin{cases} E_j^* & if \;\; E_j^* > 0 \\ 0 & otherwise \end{cases} \,, \tag{4}$$

where E_j is the observed amount of educational expenditure per school aged child in household j.

As for the explanatory variables, H_j represents a set of household-related variables including the risk aversion, loss aversion and discount rate parameters of the household head, as well as his/her age and gender. The highest grade completed by male and female members, as well as the numbers of school aged children are included to control for the effect of competition among the children in the household for the educational investment (Sawada and Lokshin, 2009). The number of infants represents the demand for labor at home (Musisi et al., 2003). Household wealth is represented by the log of land size and the asset values.

We also control for a set of village level characteristics, V, including education-related variables such as the average distance to primary school, the number of primary and secondary schools, and the pupil to classroom ratio, and more general measures

such as population density, distance to nearest town, and a dummy variable representing whether the road to the nearest town is tarmacked or not.

For all the above estimations, we cluster the standard errors at the household level as the majority of the variables are at the household level, not to mention the variable of interest, namely the parent's risk and time preference parameters.

5 Results

Determinants of school attendance

The estimation results for the determinants of school attendance are shown in Table 4. Column (1) is the result for all sampled children. First, the result shows that after controlling for the child, household, and village characteristics, risk aversion and loss aversion are positively related to children's school attendance, though the results are not statistically significant. These results are opposite to our expectation. It may be possible that the parents are not less concerned about the riskiness of the current schooling but more about risks in losing better income opportunities that are attained only through educational investment. However, such argument for parental expectation in education is hardly convincing when the educational progress is poor and even completion of the primary level is doubtful for the majority of the children in the sampled households. Second, while the discount rate has a positive impact on children's school attendance, the degree of present bias has a negative impact on the attendance. The former result is puzzling in that it implies that impatient parents tend to send their children to school more than patient ones do. This may be due to patient household heads believing that older children learn better and have higher returns, thus lowering the total proportion of primary school age children going to school. The latter result is consistent with our

expectation that myopic parents are more interested in the immediate financial reward/saving gained through keeping children away from costly education.

Columns (2) to (5) show the results for the attendance by gender and age group. One of the interesting results is that parental risk aversion is only positively associated with the school attendance of older groups aged 10 to 13 for both boys and girls (column 4 and 5). In fact, the risk aversion is negatively associated with the school attendance of younger groups although the result is not statistically significant (column 2 and 3). These results suggest that risk-averse parents may especially be concerned about sending young children to school due to security concerns.

The impact of time preference on schooling also varies between different age groups. On one hand, older boys of less myopic household heads (with lower present biasedness) are more likely to attend school (column 4). Similarly, the more patient the parent is (with lower discount rate), the higher the chance that older girls attend school (column 5). On the other hand, impatience is positively associated with more schooling for younger girls (column 3). These results suggest that impatient and more myopic household heads cannot wait for children, both boys and girls, to complete basic education at older ages. Especially for girls, impatient parents may tend to send their girls to school early and pull them out early, too.

Other household characteristics that are significant are as follows. The log of assets value is positively associated with the attendance of older boys and younger girls, and negatively associated with that of older girls. It is possible that wealthier households tend to invest longer in boys' education than girls' education, while girls in poorer households tend to delay girls' enrollment in school due to the lack of necessary finances. The highest grade completed by male or female members in the household has

no significant impact with higher attendance, but this is due to controlling for village level variation as well as preferences which are correlated with the educational attainment of adults.[10] The age of the household head is negatively associated with school attendance, which may be because older parents require more help at home or are less sensitized about the importance of schooling. When there is a higher number of school aged children in the household, older girls tend to attend school, which is counter-intuitive if competition among siblings exists. This result is difficult to explain but may be due to selection by individual abilities which may be higher for girls. Interestingly, similar results showing a positive association between household size and girls' school attendance is found in Lincove (forthcoming). Nonetheless, the number of infants in a household negatively affects the attendance of girls, though the results are not statistically significant. Lastly, among village level characteristics, the outstanding result is that the average classroom size is negatively associated with higher attendance. This is consistent with previous studies showing that better school infrastructure improves schooling performance (Glewwe et al., 2013).

Determinants of delayed enrollment

The estimation results on delayed enrollment are reported in Table 5. Column (1) shows the result for all sampled children who are currently attending school. The risk aversion parameter is statistically significantly related with the probability of delayed enrollment as predicted by our model. This is probably due to aversion to risks attached to education in rural areas for children. Children may encounter danger while travelling

[10] When we look at the base regression without variables representing preferences or village level factors, the highest education level of female members is positively correlated with attendance, which is consistent with previous studies (Nishimura et al., 2008).

long distances to school, which may deter parents from sending children early. Alternatively, risk-averse farmers may prefer to keep young children for household or farm labor in order to cope with income shocks. This option may be morally easier than pulling a child out of school once attending. Column (2) and (3) are the results of the estimates for boys and girls respectively. Here, the risk aversion is significantly associated with the enrollment delay of boys but not that of girls. This may be due to boys being smaller in physical size at the enrollment age. Statistical evidence suggests that boys are more likely to be shorter and more underweight than girls when they are younger than 5 years old in Uganda and in Sub-Saharan Africa in general (Bahiigwa and Younger 2005, UBOS, 2012; UNESCO, 2014). No other preference parameters are statistically significant for either specification, although both impatience and the degree of present bias seem to correlate positively with the delay. Again, if parents believe that older children have better long-term school attainment, they may be induced to delay schooling.

In terms of other household level determinants of enrollment delay, first, the educational attainment of male household members lowers the chance of the delay, especially for boys. This result suggests that household heads in households with men with higher educational attainment may be more aware of the importance of timely enrollment, though it only affects the decision for boys and not for girls. Second, the larger number of school aged children and the existence of infants increase the probability of delayed enrollment, especially for boys. This is puzzling, but again it is possible that in a larger family the chance is higher that a boy grows slower than he does in a smaller family, hence the higher likelihood to delay schooling. Lastly, the children in households with higher asset values are delayed less in primary school

enrollment regardless of gender. Since the likelihood of older girls' attendance decreases with wealth (Table 4), the results put together support the argument that girls in wealthier households tend to spend less time in school than girls in poorer households, possibly because of financially better opportunity outside schooling such as marriage.[11]

In terms of children's characteristics, girls delay less in enrollment than boys. This is contrary to our expectation. Yet, this may suggest that due to parents' preference for girls to marry early, as it is still the norm in many rural areas, girls are enrolled more promptly than boys to basic education.

Determinants of educational expenditure

The estimation result on educational expenditure per child is reported in Table 6. After controlling for child, household and village characteristics, the discount rate is negatively associated with the amount of educational investment.[12] This result is consistent with the expectation that the more patient the parent is, the greater the investment in education. If education increases patience as previous studies have shown, our result indicates that there is a positive cycle of educational investment enhancing further education through more forward oriented preferences.

[11] Again, curiously, a similar result is found in Lincove (forthcoming) that the wealthier the household, the higher the probability of girls working.

[12] In the analysis of educational expenditure, we use the village dummy variables to fully control for village level factors. Such specification was difficult in the probit models of attendance and delayed enrollment because many observations were dropped due to collineality.

6 Conclusion

In this paper, we have investigated the relationship between the risk and time preferences of the survey respondents, mostly fathers, and their children's school performance. We have four main results. First, controlling for individual, household, and village characteristics, respondents' risk aversion is positively related to the delayed enrollment of their children, especially for boys. This could be because risk-averse parents or care-takers are concerned about their young children walking to and from school over a long distance. Boys tend to be smaller than girls when they are about to start schooling. This may explain why we find this result for boys. Delayed enrollment, however, is not a preferred option. Recent studies show that prompt enrollment is crucial for smooth progression through the primary level education (United Nations, 2014). In rural settings, the later the enrollment is, the more likely it is that the child is pulled out of school before the completion of primary level due to labor demands at home and on the farm.

Second, girls of impatient household heads have a high attendance rate when they are young, aged 6 to 9, but a low attendance rate when they are old, aged 10 to 13. It seems that impatient household heads want to start the schooling of their girls early and finish it early. Even impatient household heads realize the importance of basic education, such as reading and writing, but may want to limit the time and resources for the education of their girls.

Third, when household heads have a high present bias, boys aged 10 to 13 have a low attendance rate. This could be because the parents value present income more over future income. Boys in this age group can work on own farms or earn income

outside. Parents who have a high bias towards present income may not be able to wait for future income.

Finally, patient household heads spend more on education expenditure. This is consistent with the result on the third finding.

There are several limitations to our analyses in the paper. First, only one respondent participated in the risk and time preference experiments from one household. Most of the respondents are the fathers to the children studied in this paper. Thus, the estimation results in this paper are mostly about the risk and time preferences of fathers. If mothers had participated in the experiments, the results of this paper might have been different. Future studies should collect the risk and time preferences of both fathers and mothers. Another limitation of our analysis is that it is limited to data on a single period and may not fully capture the extent of investment or the changes in the constraint sets in the educational history of each child.

In this paper, we find that both the risk and time preferences of parents are important determinants of the schooling of their children. To encourage even risk-averse parents to invest in their children's education, policy makers need to make schools a safe place to study, make travelling to school secure, in addition to making school investment safe through economic development. Myopic parents need to be educated about future returns from their children's education. It is not surprising that parents' preferences affect their children's schooling. However, few studies have included them in empirical analyses because preference data were unavailable, especially in low income countries. Recent developments in eliciting people's preferences through experiments will enable researchers to include parents' preferences in the analyses of child education in the future.

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Table 1. Descriptive Statistics

	Mean	s.d.
Risk and Time Preferences of Household head		
Risk Aversion Parameter (σ)	1.30	(1.30)
Loss Aversion Parameter (λ)	3.22	(2.68)
Discount Rate Parameter (r)	49.0	(43.0)
Degree of Present Bias (d)	0.75	(0.26)
Household head Characteristics		
Female Headed (=1)	0.11	(0.31)
Head Age	46.5	(13.3)
Household Characteristics		
Highest Grade Completed – Male	7.9	(3.8)
Highest Grade Completed – Female	7.0	(3.6)
Number of school age children (aged 6 to 18)	3.7	(2.0)
Number of infants (aged 5 or younger)	1.4	(1.2)
Land (acre)	7.4	(24.5)
Assets Value (USD)[1]	338.9	(952.6)
Child's Characteristics (age 6 - 13)		
Age	9.6	(2.3)
Female (=1)	0.5	(0.5)
Relationship to Head (% of total)		
Child	0.73	(0.44)
Grand child	0.18	(0.39)
Nephew / Niece	0.05	(0.22)
Other relative / non-relative	0.04	(0.19)
Village and School Characteristics		
Average distance to primary school (km)	2.5	1.7
Number of primary schools	3.7	1.7
Number of secondary schools	2.5	1.4
Pupil to classroom ratio	69	27
Population density (per km^2)	317	410
Distance to nearest town (km)	20.2	16.3
Road to nearest town tarmacked (=1)	0.22	0.42
Sampled Villages	90	
Sampled Households	583	
Sampled Children	1546	

Note: 1. 1USD=1930 Ugandan shillings.

Table 2: Schooling Performance of Sampled Children aged 6 to 13

	Total no. of obs	Average	Girls	Boys	Difference[1]
		(% total)	(% total)	(% total)	
			(a)	(b)	(a)-(b)
Attendance Rate	1,546	89.6	90.2	88.9	1.3
% of those with at least 1 year Delay in Enrollment†	1,382	71.8	70.1	73.6	-3.5
No. of years delayed if delayed					
1 year	362	36.5	37.0	36.0	
2 years	317	32.0	31.2	32.7	
3 years or more	313	31.5	31.8	31.3	
% of those with at least 1 year Grade Repetition†	1,376	33.1	33.0	33.1	-0.1
No. of observation		1546	789	757	

Note: † only for those attending.

1. *** denotes significance at 1%, ** 5%, and * 10% in t-test comparing means of the girls' and boys' performance.

Table 3: Children's Schooling by Household Head's Preference

Preference of Household Head	Number of Household	Number of Children	Attendance Rate	Years of Delay in Enrollment †	Educational Expenditure Per School-Age Child (USD)
	no.	no.	%	mean	Mean
Risk Preference[1]					
Risk Loving or Neutral	108	290	89.0	1.54	24.6
Slightly Risk Averse	163	440	90.0	1.51	62.9
Moderately Risk Averse	157	410	88.5	1.58	48.3
Very Risk Averse	155	406	90.6	1.71	37.2
Time Preference[2]					
Very Patient	138	357	88.0	1.63	66.4
Moderately Patient	143	389	89.2	1.68	40.4
Slightly Patient	149	407	88.7	1.54	57.2
Impatient	153	393	92.4	1.53	18.6
Total	583	1546	89.6	1.59	45.1

Note: 1. For the risk preference: 'Risk Loving or Neutral' means the risk aversion parameter, $\sigma <= 0$, 'Slightly Risk Averse' means $0 < \sigma <= 1.1$, 'Moderately Risk Averse' means $1.1 < \sigma <= 2.06$ and 'Very Risk Averse' means $\sigma > 2.06$. 2. For the time preference: 'Very Patient' means the subjective discount rate $r <= 21.8\%$, 'Moderately Patient' means $21.8 < r <= 36.04\%$, 'Slightly Patient' means $36.04\% < r <= 53.6$ and 'Impatient' means $r > 53.6$. † Statistics for years of delay in enrollment are only for those attending school at the time of the interview.

Table 4: Determinants of School Attendance by Gender and Age Group (Probit Model)

Variables	All	Boys (age 6-9)	Girls (age 6-9)	Boys (age 10-13)	Girls (age 10-13)
	(1)	(2)	(3)	(4)	(5)
Risk and Time Preferences of Household Head					
Risk Aversion Parameter (σ)	0.047	-0.015	-0.071	0.719***	0.288*
	(1.06)	(-0.21)	(-0.88)	(2.99)	(1.72)
Loss Aversion Parameter (λ)	0.025	0.001	0.014	0.039	0.217*
	(0.93)	(0.03)	(0.34)	(0.38)	(1.82)
Discount Rate Parameter (r)	0.003*	0.002	0.010***	0.006	-0.020***
	(1.70)	(0.77)	(3.09)	(1.14)	(-2.91)
Degree of Present Bias (d)	-0.476**	0.243	-0.683	-2.755**	-0.143
	(-2.27)	(0.70)	(-1.56)	(-2.38)	(-0.18)
Household Head Characteristics					
Head Age	-0.012**	-0.010	-0.006	-0.062***	-0.040*
	(-2.26)	(-1.00)	(-0.62)	(-3.35)	(-1.68)
Female Headed (=1)	0.053	0.019	0.803	1.483***	-0.521
	(0.26)	(0.05)	(1.51)	(2.65)	(-0.75)
Household Characteristics					
Highest Grade Completed – Male	0.018	0.012	0.023	-0.042	0.126
	(0.96)	(0.44)	(0.70)	(-0.80)	(1.56)
Highest Grade Completed – Female	0.024	0.055	0.038	0.035	0.027
	(1.21)	(1.48)	(1.04)	(0.62)	(0.35)
Number of school-age children	-0.030	-0.089*	-0.065	-0.099	0.388**
(aged 6 to 18)	(-0.87)	(-1.71)	(-1.59)	(-1.22)	(2.41)
Number of infants (aged 5 or younger)	0.044	0.057	0.021	0.323**	-0.106
	(1.04)	(0.86)	(0.23)	(2.01)	(-0.48)
Log of land size (acre)	0.014	0.263	0.003	-0.335	0.194
	(0.20)	(1.62)	(0.04)	(-1.38)	(0.71)
Log of assets value (USD)[1]	0.134**	-0.106	0.294***	1.114***	-0.598***
	(1.98)	(-0.84)	(2.72)	(4.85)	(-2.64)
Child's Characteristics (age 6 - 13)					
Age	0.248***	0.524***	0.593***	-0.317**	-0.791***
	(8.38)	(6.02)	(5.51)	(-2.39)	(-3.70)
Female (=1)	0.096				
	(0.94)				
Relationship to Head:					
Grand child	0.229	0.323	-0.140	0.861**	0.939
	(1.23)	(1.02)	(-0.36)	(1.97)	(1.17)
Nephew / niece	0.269	0.349	-0.198	-1.681**	omitted
	(0.94)	(0.68)	(-0.39)	(-2.28)	
Other relative / non-relative	-0.642***	-0.141	-0.632	-3.151***	-2.898***
	(-2.70)	(-0.26)	(-1.43)	(-6.17)	(-2.90)
Village Characteristics					
Average distance to primary school (km)	0.016	-0.061	0.006	-0.041	0.452**
	(0.43)	(-1.03)	(0.09)	(-0.39)	(2.34)
Number of primary schools	-0.044	-0.087	-0.145*	0.277	0.155
	(-1.27)	(-1.53)	(-1.94)	(1.53)	(1.16)
Number of secondary schools	0.030	0.179**	-0.169*	0.256*	0.360*
	(0.60)	(2.13)	(-1.93)	(1.65)	(1.67)
Pupil to classroom ratio	-0.007***	-0.005	-0.011***	-0.013*	-0.033***
	(-3.00)	(-1.45)	(-2.78)	(-1.78)	(-3.80)
Population Density (per km^2)	0.000**	0.000	0.000	0.001	0.003*
	(2.27)	(1.21)	(1.49)	(1.29)	(1.84)

Distance to nearest town (km)	-0.001	0.005	-0.003	0.021*	-0.026*
	(-0.25)	(0.88)	(-0.35)	(1.87)	(-1.70)
Road to nearest town tarmacked (=1)	0.243	0.344	0.067	-0.948*	omitted
	(1.46)	(1.16)	(0.20)	(-1.78)	
Constant	-0.760	-2.701***	-3.121***	7.144***	14.496***
	(-1.26)	(-2.59)	(-2.65)	(3.11)	(3.97)
Agro-ecological zone dummies	Included	included	included	included	included
Pseudo R^2	0.187	0.202	0.298	0.518	0.506
No. of observation	1,336	310	342	337	242

Note: 1. Numbers in parentheses are t-values and *** indicates significance at the 1 % level, ** at the 5 % and * at the 10 %. 2. The base dummy for the relationship to head is ‘Child’.

Table 5: Determinants of Delayed Enrollment by Gender (Probit Model)

Variables	All	Boys	Girls
	(1)	(2)	(3)
Risk and Time Preferences of Household Head			
Risk Aversion Parameter (σ)	0.077*	0.123**	0.040
	(1.78)	(2.10)	(0.78)
Loss Aversion Parameter (λ)	0.010	0.011	0.009
	(0.49)	(0.38)	(0.36)
Discount Rate Parameter (r)	0.001	-0.000	0.003
	(0.96)	(-0.02)	(1.52)
Degree of Present Bias (d)	0.278	0.128	0.405
	(1.49)	(0.47)	(1.59)
Household Head Characteristics			
Head Age	0.008	0.011	0.006
	(1.47)	(1.56)	(0.82)
Female Headed (=1)	-0.193	-0.291	-0.113
	(-1.14)	(-1.31)	(-0.51)
Household Characteristics			
Highest Grade Completed – Male	-0.010	-0.041**	0.019
	(-0.65)	(-2.13)	(0.89)
Highest Grade Completed – Female	-0.003	0.012	-0.021
	(-0.18)	(0.48)	(-0.93)
Number of school-age children	0.026	0.056*	-0.008
(aged 6 to 18)	(1.14)	(1.81)	(-0.27)
Number of infants (aged 5 or younger)	0.061*	0.079	0.038
	(1.74)	(1.62)	(0.77)
Log of land size (acre)	-0.007	0.008	-0.033
	(-0.16)	(0.17)	(-0.59)
Log of assets value (USD)[1]	-0.132***	-0.147**	-0.122*
	(-2.60)	(-2.06)	(-1.92)
Child's Characteristics (age 6 - 13)			
Age	0.285***	0.279***	0.307***
	(11.78)	(7.83)	(9.38)
Female (=1)	-0.164*		
	(-1.94)		
Relationship to Head:			
Grand child	-0.387**	-0.489**	-0.364*
	(-2.40)	(-2.22)	(-1.67)
Nephew / Niece	-0.309	-0.711**	0.049
	(-1.39)	(-2.28)	(0.16)
Other relative / non-relative	-0.623***	-0.344	-0.947***
	(-2.77)	(-1.09)	(-2.74)
Village Characteristics			
Average distance to primary school (km)	0.044*	0.077*	0.020
	(1.76)	(1.88)	(0.65)
Number of primary schools	-0.005	-0.030	0.016
	(-0.14)	(-0.65)	(0.34)
Number of secondary schools	0.032	0.050	-0.004
	(0.76)	(0.80)	(-0.07)
Pupil to classroom ratio	0.003	-0.001	0.007***
	(1.63)	(-0.25)	(2.58)
Population Density (per km^2)	-0.000	0.000	-0.000
	(-0.48)	(1.31)	(-1.49)

Distance to nearest town (km)	0.003	0.000	0.005
	(0.80)	(0.04)	(1.16)
Road to nearest town tarmacked (=1)	-0.132	-0.026	-0.193
	(-0.97)	(-0.14)	(-1.02)
Constant	-2.457***	-2.137***	-3.073***
	(-4.81)	(-3.07)	(-4.42)
Agro-ecological zone dummies	included	included	Included
Pseudo R^2	0.207	0.219	0.235
No. of observation	1,187	571	616

Note: 1. Numbers in parentheses are t-values and *** indicates significance at the 1 % level, ** at the 5 % and * at the 10 %. 2. The base dummy for the relationship to head is 'Child'.

Table 6: Determinants of Educational Expenditure Per Schooling-Age Child (Tobit Model)

Variable	
Risk and Time Preferences of Household Head	
Risk Aversion Parameter (σ)	5.969
	(0.85)
Loss Aversion Parameter (λ)	-1.361
	(-0.33)
Discount Rate Parameter (r)	-0.480**
	(-1.97)
Degree of Present Bias (d)	27.890
	(0.98)
Household Head Characteristics	
Head Age	0.648
	(0.90)
Female Headed (=1)	-53.117
	(-1.35)
Household Characteristics	
Highest Grade Completed – Male	9.881***
	(3.11)
Highest Grade Completed – Female	12.123***
	(3.45)
Number of school-age children (aged 6 to 18)	-7.735
	(-1.64)
Number of infants (aged 5 or younger)	0.761
	(0.11)
Land (acre)	-4.795
	(-0.39)
Assets Value (USD)[1]	12.690
	(1.26)
Constant	-252.741**
	(-2.35)
Village dummies	included
Pseudo R^2	0.0439
No. of observation	576

Note: 1. Numbers in parentheses are t-values and *** indicates significance at the 1 % level, ** at the 5 % and * at the 10 %. 2. The base dummy for the relationship to head is 'Child'.

Annex 1: Mathematical model

Assume a two-period model: period zero, the schooling period, in which the educational investment is made and period one, the post-schooling period, in which the benefit from the investment is harvested. We adopt the Levhari and Weiss (1974) individual maximization problem and construct the household model. Thus, the parent maximizes:

$$\max_{C_0,C_1,S} \quad E[U(C_0, C_1)] \ , \qquad (1)$$

where C_0 and C_1 are consumptions in period zero and one respectively, and S is the schooling investment. $U(C_0, C_1)$, the utility function, is monotone and concave in both C_0 and C_1. Expectation, $E[.]$, is taken for the utility due to uncertainty. In our model, we further assume that current consumption is known so that the expectation is only taken for future utility:

$$\max_{C_0,C_1,S} \quad U(C_0) + E[U(C_1)]. \qquad (1')$$

We further add β that denotes the rate at which the parent discounts the future utility:

$$\max_{C_0,C_1,S} \quad U(C_0) + \beta\, E[U(C_1)]. \qquad (1'')$$

The budget constraints in the two periods are:

$$C_0 = Y_0^P + Y_0^C + A_0 - A_1 - S, \qquad (2a)$$

$$C_1 = Y_1^P + Y_1^C(H^C(S), \mu) + (1 + r)A_1, \qquad (2b)$$

where Y^P is the parent's income, Y^C the child's income, and A other assets including physical assets and net savings. Here, Y_1^C depends on the human capital H^C and the future unknown state of the world, μ. Assume that Y_0^C does not depend on human capital gained from schooling. Putting equations (2a) and (2b) together, the inter-temporal budget constraint is:

$$C_1 = Y_1^P + Y_1^C(H^C(S), \mu) + (1 + r)[Y_0^P + Y_0^C + A_0 - S - C_0]. \qquad (2c)$$

The first-order conditions for the maximization of (1'') subject to the constraint (2c) are:

$$U'(C_0) - E[U'(C_1)\beta(1 + r)] = 0, \qquad (3)$$

$$\beta E\left\{U'(C_1)\left[\frac{\partial Y_1^C}{\partial S} - (1 + r)\right]\right\} = 0. \qquad (4)$$

$U'(C_0)$ and $U'(C_1)$ denote the marginal utilities from C_0 and C_1 respectively. Condition (3) states that the ratio between the marginal utility from present consumption and the expected marginal utility from future consumption is determined by the expected rate of return on other assets $(1 + r)$ and the subjective discount rate β. Suppose that $(1 + r)$ and β are known with certainty, (3) can be written as

$$\frac{U'(C_0)}{E[U'(C_1)]} = \beta(1 + r), \qquad (3')$$

(3') states that the larger the value of β is, the larger $U'(C_0)$ is relative to $E[U'(C_1)]$. Therefore, all other things being equal, the more patient the parent is, the smaller the amount of household consumption allocated to today than to the future at the optimum.

Condition (4) states that the utility weighted expected marginal benefit of additional earnings in the future due to schooling investment equals that which is due to investment in other assets. Note that the expected marginal rate of return from the schooling investment, $U'(C_1)\left[\frac{\partial Y_1^C}{\partial S}\right]$, depends upon Y_1^C, which in turn depends upon the random variable μ representing future uncertainty. Therefore, assuming that the rates of return on the other assets are known, the more risk averse the individual is, the less investment is allocated to education than to other assets given that the rates of return are not so high that they more than compensate for the riskiness of the investment (Kihlstrom and Mirman, 1974).[13]

[13] Kihlstrom and Mirman (1974) illustrate how the impact of risk aversion on risky investment is indeterminate depending on the individual behavior in relation to rates of return. For example, if the individual decreases investment, when the return is certain, then the higher the risk aversion, the more investment he makes in the investment with risks.