



IFS

# THE EFFECTS OF RISK ON EDUCATION IN INDONESIA

---

*Emla Fitzsimons*



THE INSTITUTE FOR FISCAL STUDIES  
WP02/07

# The Effects of Risk on Education in Indonesia\*

12th November 2004

## Abstract

We study the effects of risk and uncertainty on educational attainment in Indonesia. The underlying idea is that households that face more uncertainty, and with limited or no access to formal insurance, will have a higher motive for self-insurance and this may have adverse consequences for child education. The model predictions are tested using Indonesian data. A negative effect of risk on education would constitute some evidence of children being used as insurance tools to smooth consumption. On the other hand, whilst a negligible effect of risk may indicate that formal insurance markets are well-functioning, it might also reflect the fact that households are using a wide range of other self-insurance mechanisms instead. A key contribution of the paper is to decompose risk into aggregate village and idiosyncratic household components using five years of wage data on the main earner of the household. These measures are then used to test the response of education to the two forms of risk. The results indicate that in

---

\*I extend my sincere thanks and appreciation to Orazio Attanasio and Costas Meghir, my supervisors, for their help and guidance. I also thank Emanuela Galasso at the World Bank and Christine Peterson at RAND for help with the data. I am also grateful for discussions with Manuela Angelucci, Erich Battistin, Jere Behrman, Timothy Besley, Renata Bottazzi, James Heckman, Elena Martinez, Mark Rosenzweig, Barbara Sianesi, Eric Strobl and Marcos Vera-Hernández. I also thank seminar participants at the 7th Spring Meeting of Young Economists, the 17th European Economic Association Annual Congress and the 2003 Econometric Society Winter European Meeting, for useful comments. Financial support from the ESRC is gratefully acknowledged. This work was also supported by the IFLS Small Grants Program, which is made possible by funding provided to RAND by the U.S. National Institute of Child Health and Human Development. All errors are my own.

small rural villages where one might expect formal insurance markets to be thin or lacking, idiosyncratic risk has no significant effect on the child's education. There is evidence however, that aggregate village risk affects education adversely in these villages. These findings are in line with a range of literature which shows that aggregate risk is more difficult to diversify than idiosyncratic risk and provides some evidence on the functioning of inter- and intra-village insurance. This suggests that policy should carefully consider the relative efficiency of household self-insurance mechanisms vis-à-vis the crowding out of such mechanisms by formal insurance provision.

# 1 Introduction

In light of the widely documented disparities in the levels of child labour between high and low income economies, it is natural to suppose that observed divergent decisions on the use of a child's time are largely the result of the incongruent economic settings underlying economic choices in both types of economy. In particular, the presence of risk and the ability of households to deal with such risk and to smooth consumption across time may be constrained by thin insurance markets for income and higher borrowing constraints in less developed countries (LDCs), thus cutting off important risk diversification channels. These distinguishing features of low-income settings create the need for households and villages to form alternative ways of coping with uncertainty.<sup>1</sup>

In this paper, we consider whether investment in education is affected by virtue of living in an intrinsically risky and uncertain environment. The key contribution is to decompose underlying risk into that which is specific to the household, idiosyncratic risk, and that which is common to the village, aggregate village risk and to investigate whether they have differential effects on the stock of human capital of children. The distinction between the two types of risk is fundamental, given the extensive evidence on the differing responses of economic agents to both.<sup>2</sup>

The underlying channel through which one might expect risk to affect education is as follows. The riskier the environment, the greater is the incentive of the household to build up a buffer stock against unforeseen adverse

---

<sup>1</sup>There is an extensive literature that examines the importance of the family unit in coping with uncertainty, and the incorporation of risk into the economic choices and behaviour of households. See for example Rosenzweig (1988), Rosenzweig and Stark (1989), Paxson (1992), Rosenzweig and Binswanger (1993) and Kochar (1995).

<sup>2</sup>Townsend (1994) presents evidence that whilst agents are successful in insuring against non-covariant (idiosyncratic) forms of risk, pervasive uncertainty is more difficult to insure against. Rosenzweig and Binswanger (1993) similarly find evidence that common shocks appear to have substantially greater consequences for consumption than does idiosyncratic risk, with comparable findings by Udry (1994).

events. Children are one means of allowing the household to do this. This is due to their instantaneous earnings potential and/or the option of curtailing expenditure on their education. The motive to amass a buffer stock will be higher, the less well-functioning are formal insurance markets.<sup>3</sup> In this sense, any finding that risk affects education, would be indicative of incomplete insurance markets. Moreover, the availability of insurance against risk is likely to depend on its pervasiveness. Therefore by separately considering the effects of household-specific risk and village-wide risk on education, we can shed some light on the presence of insurance for dealing with different types of risk to which households are exposed.

To our knowledge, this paper is amongst the first to explicitly examine the extent to which living in an inherently risky environment, affects investment in education. In this sense, it is distinct from the emergent literature that examines the role of children as ex-post mechanisms of smoothing out income shocks. The general findings in this literature - that unanticipated shocks have positive effects on child labour - are informative as to the presence of liquidity constraints.<sup>4</sup> This paper on the other hand, is more insightful as to the presence of insurance against intrinsic risk.

We find evidence in Indonesia that children in households facing higher village-level risk do indeed have lower educational attainment than their counterparts in low-risk environments. To the extent that labour is a substitute for schooling, this may translate into higher child labour in these

---

<sup>3</sup>As Morduch (1995) discusses, the general consensus regarding insurance markets is that even if household income is partly insurable, as is most likely the case, full insurance is highly unlikely in LDCs. Gertler and Gruber (2002) find evidence of household illnesses affecting consumption in Indonesia, suggesting that there is scope for intervention in the provision of insurance against illnesses.

<sup>4</sup>See Jacoby and Skoufias (1997), Pörtner (2001), Ranjan (2001), Sawada and Lokshin (2001) and Beegle et al (2003). The role of a child as an insurance tool against unforeseen circumstances was proposed by Cain (1982), and work by Grootaert and Kanbur (1995) discusses how child labour may be part of a strategy to minimise the risk of interruption of a household's income stream. Thomas et al (2003) find adverse effects of the Indonesian crisis on the investment in education of young relative to older children, amongst the poorest households.

households. The effect is observed to be strongest for 10 to 12 year olds. We do not find any evidence of idiosyncratic risk affecting children's education. These findings are indicative of pervasive village risk being more difficult to insure against than idiosyncratic risk, and provide some insight into the functioning of insurance markets in these villages. In particular, whilst household-level risk is being diversified away, whether through formal or informal mechanisms, without resorting to children, evidence that aggregate village risk affects education, propels an argument for favouring intervention in the market for insurance against such risk.

The remainder of the paper is structured as follows: in section 2 we outline a simple two-period model of investment in human capital in a risky environment. We show that under certain plausible conditions, investment in human capital is negatively related to the degree of earnings risk facing the financier of the child's schooling (the parent). The theory does not however, rule out possible offsetting positive effects of risk on education, and these are also discussed. In section 3 the Indonesian data used in the empirical analysis is described. In section 4 we discuss how we identify both idiosyncratic household risk and aggregate village risk. Section 5 describes the main results and section 6 concludes.

## 2 Theory

In order to consider the theoretical implications of 'risk' on human capital investment, we consider a simple two-period framework in which education is an investment good, financed by parental income in the first period, but with the pecuniary payoffs accruing to the child in the second period, upon reaching adulthood. We show how the volatility of parental income ('risk') adversely affects education if we assume that there are no transfers or bequests between the adult and the parent in the second period [A1]<sup>5</sup> and that

---

<sup>5</sup>This assumption allows us to focus on altruism that acts only through human capital investment. Of course, this is a strong assumption. For example, land is another important form of intergenerational transmission from parents to children, that has been emphasised as an alternative to schooling (see Quisumbing (1994)) but that is not considered here. In

adults face no income uncertainty in the second period [A2].

The set up is such that in the first period, a household consists of one parent and one child.<sup>6</sup> The parent works and earns an exogenous income,  $y_1^p$ . A child's one unit of time may be allocated between work and school. This decision is made by the parent, jointly with the consumption choice. The parent, due to imperfect capital markets and/or debt aversion, does not borrow to invest in schooling. The amount of time spent in school in this period,  $D_1$ , increases the total stock of human capital of the child,  $H_1 = g(D_1)$ , at a decreasing rate. In the second period the child has become an adult and earns  $y_2^a$ , which is increasing in the stock of human capital,  $y_2^a = f(g(D_1))$ . The parent earns an exogenous income,  $y_2^p$ .

The parent chooses household consumption and child education at the beginning of period 1, without knowing its income for the next period,  $y_2^p$ .<sup>7</sup> Assuming that preferences are intertemporally additive, the parent's problem is to

$$\max_{c_1^{hh}, D_1} U(c_1^{hh}) + \beta E_1 U(c_2^p) + \beta \gamma U(c_2^a) \quad (1)$$

subject to the life-cycle budget constraint

$$Y_L = c_1^{hh} + c_2^p + (p^D + w_1^c)D_1 \quad (2)$$

addition, the old-age security motive of education, important in LDCs, is not considered. However, it is important to note that the assumption of no transfers from the adult to the parent can be relaxed so long as the parent cannot credibly enforce repayment from the adult for investment in education (see Baland and Robinson (2000)). More generally, we rule out transfers that are a *function of education*. The key is that parental income in the second period is in no way affected by the education of the adult. This rules out a situation in which, for example, the adult works with his parent on the family enterprise in the second period, as in this case his human capital would be likely to affect parental income.

<sup>6</sup>This enables us to abstract from issues concerning intra-household bargaining amongst parents concerning the child's activity (see Galasso (1999) and Basu (2001)) and compensating and reinforcing human capital decisions amongst siblings (see Becker (1991)).

<sup>7</sup>Even if current incomes across households are the same, heterogeneity across households enters through their risk profiles. These risk profiles may be thought of as measuring the volatility of past income. We return to this in section 4.

where  $c_i$  denotes consumption in that period,  $i = 1, 2$ , the superscripts  $hh$ ,  $p$  and  $a$  refer to the household, parent and adult respectively,  $D_1$  is the fraction of child time spent in school in period 1,  $\beta = \frac{1}{1+r}$  is the parental discount rate,  $r$  is the interest rate,  $0 < \gamma < 1$  measures the weight the parent places on the adult's utility, the expectations operator  $E_1$  reflects uncertainty (as at time 1) about  $y_2^p$ , and the individual period subutility functions are increasing and concave in their arguments.  $Y_L$  is the present value of the lifetime income of the parent, assuming that the labour market earnings of the child in period 1 are pooled with parental resources. Therefore  $Y_L = y_1^p + y_2^p + w_1^c$ , where  $w_1^c$  is full child income in period 1 and  $p^D$  is the direct cost of schooling.<sup>8</sup>

The first order condition for investment in education equates the utility-weighted expected marginal cost of schooling to the parent with the utility-weighted marginal benefit of additional earnings to the adult in period 2, as a result of schooling, and may be written as

$$(p^D + w_1^c)E_1[U'(c_2^p)] = \gamma[U'(c_2^a)f'(g(D_1))] \quad (3)$$

From (3), it can be seen that the risk in second period parental income affects education in the first period insofar as it affects the expected second period marginal utility of the parent. To isolate the effect of risk on investment in education, we follow Sandmo (1970) by defining a pure increase in dispersion as a combination of additive and multiplicative shifts in the distribution of parental income: the additive shift,  $\theta$ , increases the mean whilst holding all other moments constant, and the multiplicative shift,  $\delta > 1$ , stretches the distribution on the right side of zero (assuming that income is non-negative).<sup>9</sup> We can thus think of the expected parental income in period 2 as  $E[\delta y_2^p + \theta]$  and in order for the increase in risk to be mean-preserving, it

---

<sup>8</sup>Similar to previous authors (see for example, Jacoby and Skoufias (1997)), we assume that the child wage is not a function of human capital. This assumption is likely to be invalid in the case in which for example, the child works on the family business as well as attending school. In this case his human capital may lead to an increase in his marginal productivity on the family enterprise.

<sup>9</sup>In all of what follows, derivations follow closely on Sandmo (1970) and are detailed in the appendix.



must be the case that the change in the expected value of future parental income is 0, i.e.  $E[y_2^p d\delta + d\theta] = 0$ .<sup>10</sup> The effect of a mean-preserving increase in risk on investment in education is therefore

$$\left. \frac{\partial D_1}{\partial \delta} \right|_{\frac{d\theta}{d\delta} = -\xi} = \beta(p^D + w_1^c)U''(c_1^{hh})E_1[U''(c_2^p)(y_2^p - \xi)] \quad (4)$$

Under the assumption of decreasing absolute risk aversion, we show in the appendix that (4) is negative for all values of  $y_2^p$ : parental income risk leads to lower investment in human capital. Apart from parental prudence, this result is contingent on assumptions [A1] and [A2]. We now consider the effects on education of relaxing these assumptions.

**Transfers [A1]** Incorporating transfers from the adult to the parent - that are increasing in education and that are anticipated by the parent - provides the parent with an incentive to increase investment in education in order to receive higher transfers (as a form of self-insurance) in the event of a possible future income shock (see footnote 5). The use of children as a buffer against short-term income shortfalls on the other hand, continues to provide a motive for decreasing investment in human capital.

We re-define adult utility in period 2 as  $U(c_2^a) = V(c_2^a) + \lambda E_1 U(c_2^p)$ , where  $0 < \lambda < 1$  represents adult altruism towards the parent in period 2. The parent's problem in period 1 is now to

$$\begin{aligned} \max_{c_1^{hh}, D_1} & U(c_1^{hh}) + \beta(1 + \gamma\lambda)E_1 U([Y_L - c_1^{hh} - (p^D + w_1^c)D_1 + T(H_1)]) \\ & + \beta\gamma V(c_2^a) \end{aligned} \quad (5)$$

where  $T(H_1)$  are transfers from the adult to the parent in period 2, which are increasing in  $H_1$ . A mean-preserving increase in risk affects education as follows

$$\left. \frac{\partial D_1}{\partial \delta} \right|_{\frac{d\theta}{d\delta} = -\xi} = \beta(1 + \gamma\lambda)[(p^D + w_1^c) - T'(H_1)]U''(c_1^{hh})E[U''(c_2^p)(y_2^p - \xi)] \quad (6)$$

Unlike (4), the sign of (6) is ambiguous, depending on the relative magnitude

---

<sup>10</sup>Note that this implies that  $d\theta/d\delta = -E[y_2^p] = -\xi$ .

of education costs,  $p^D + w_1^c$ , and the effect of human capital on transfers,  $T'(H_1)$ .<sup>11</sup>

**Adult income risk [A2]** We allow adult returns to education to have a stochastic component to them. For simplicity, we assume that they are a function of  $\delta$ , the variable that captures the *a priori* unknown state of the world facing the parent.<sup>12</sup> Therefore  $y_2^a = f(H_1; \delta)$ , and the right hand side of the first order condition for education (3) becomes  $\gamma E_1[U'(c_2^a) f'(g(D_1; \delta))]$ , to incorporate uncertainty over the marginal benefit of schooling to the adult. The implication is that risk also affects the education choice through its effect on the expected utility-weighted marginal benefit of schooling to the adult.

The implications of this for investment in education are ambiguous.<sup>13</sup> However, what is important to note is that allowing for a stochastic element to adult income in the model, may mitigate or even offset the adverse effect of risk on education in (4). This would be the case if for example, earnings risk is decreasing in education level. The altruistic parent would have an incentive to increase education so as to minimise the future earnings risk of the adult.

The above framework lays out one set of conditions that is consistent with risk adversely affecting investment in education through a precautionary savings motive. The theoretical findings have potentially important implications for the perpetuation of persistent poverty in LDCs. However, one

---

<sup>11</sup>In the above, it is assumed for simplicity that transfers are given exogenously by the adult in period 2. See Raut and Tran (1998) and Baland and Robinson (2000) for a more complete analysis of intergenerational transfers and their effect on child labour.

<sup>12</sup>It is reasonable to expect the parent to use its own earnings risk history to assess the randomness facing future adult earnings, or the parent may simply perceive risk to vary by education level.

<sup>13</sup>This is because it is in general not possible to theoretically determine the response of education to an increase in own future income risk, with the effects depending on the way in which risk is incorporated into the earnings function. See Levhari and Weiss (1974), Eaton and Rosen (1980) and Kodde (1986).

might argue that the more relevant model to consider is that in which parents invest in education for the purposes of eliciting higher future transfers from offspring<sup>14</sup>, in which case the effects of risk on education are ambiguous. Whilst this old-age security motive is certainly true in LDCs generally, in the Indonesian context that we consider here, there is empirical evidence to show that transfers from offspring to parents are not related to the education level of the donor.<sup>15</sup> This renders the purely altruistic incentive for parental investment in human capital more plausible in this context.

### 3 Data

The data used in the empirical analysis is the 1993 wave of the Indonesian Family Life Survey (IFLS) data. The IFLS is an ongoing multi-purpose longitudinal survey carried out by *Lembaga Demografi* of the University of Indonesia and RAND. It encompasses over 30,000 individuals in 7,224 households, spread across 13 provinces and 321 communities in Indonesia. Extensive community data can be linked to households, which is important given the importance of village-level constraints for education choices. The communities are diverse, varying greatly in size, with some resembling large urban sprawls and others resembling close-knit villages.<sup>16</sup>

Ideally we would like to be able to distinguish between villages in which formal insurance mechanisms exist and those in which they do not. The sample could then be split on this basis, on the assumption that in the latter, households have more of a need to self-insure. However, comprehensive information on the availability of insurance within villages is not observed. As an alternative, we restrict the analysis to rural villages with less than 1,000 households, which represent around 29% of the overall sample. Such communities are likely to be relatively more close-knit and to be affected

---

<sup>14</sup>However as pointed out in footnote 5, [A2] amounts to assuming that the parent faces enforcement problems in eliciting transfers from the adult in return for investment in education, rather than that there are no transfers from the adult at all.

<sup>15</sup>See Raut and Tran (1998) and Cameron and Cobb-Clark (2001).

<sup>16</sup>There are approximately 3,000 households in urban areas compared to just under 1,000 in rural areas.

by common village-wide shocks. Further, rural areas are likely to be intrinsically relatively more risky than urban areas and to have fewer formal risk-reducing mechanisms.<sup>17</sup>

The definition of a ‘child’ is by no means clearcut, and we consider two possible age ranges. The first age range of 7 to 12 corresponds to primary school ages. After age 12, leaving school is relatively common.<sup>18</sup> The second age range of 10 to 14 is chosen on the basis of an increased likelihood of working for children.<sup>19</sup> Table 1 displays a number of key household and village characteristics for these two samples.

The outcome variable of interest is the education of the child. We consider two measures of this. The first is whether the child is currently attending school. This is observed for 1,366 7 to 12 year olds and 1,136 10 to 14 year olds, across 79 villages. Approximately 92.3% of 7 to 12 year olds and 83.0% of 10 to 14 year olds are enrolled in school.<sup>20</sup> However, by focusing only on current schooling status, account is not necessarily taken of past temporary interruptions to schooling, which are a potentially important way of dealing with risk. Indeed, in this paper we are interested in examining whether there is an effect of intrinsic and persistent risk on investment in education and for this reason, we focus more specifically on

---

<sup>17</sup>See Besley (1995a, 1995b) for evidence that formal credit markets are highly imperfect in rural areas in low-income economies. In the IFLS data, small rural villages have a substantially higher proportion of households owning farms, a lower proportion of business owners and a lower availability of banks, compared to all other regions.

<sup>18</sup>Primary education in Indonesia is free, compulsory and almost universal. School enrolment drops for both males and females at the end of primary education (around the age of 12 - see Manning (2000)). Relatively high dropout rates from primary school have also been observed, with 20% dropping out before completion of grade 6. Efforts to increase the availability of secondary education have been significant in recent years, with a current secondary school enrolment rate of just under 50%.

<sup>19</sup>The minimum legal working age in Indonesia is 15 years. The relevant ILO Convention was ratified by Indonesia in 1999. Surveys by Asra (1993, 1996) suggest that work participation of children in Indonesia under age 10 is very low compared to those aged 10 plus. In the IFLS data, information on the individual’s main activity - which can be work, look for work, housework, school or other - is only asked of those aged 10 plus.

<sup>20</sup>Amongst 10 to 14 year olds, almost 12% are either working or looking for work.

the child’s current stock (years) of education, which is more directly informative as to his/her accumulated educational attainment. It reflects both permanent and temporary withdrawals from education. The average number of years of education for 7 to 12 year olds is 2.7 years, compared to 4.3 years for 10 to 14 year olds.

## 4 Estimation

Thus far, ‘risk’ has broadly denoted the overall volatility of the household earnings stream.<sup>21</sup> We use past earnings to proxy risk profiles. Underlying this approach is a belief that households use the *volatility of their past earnings stream* to predict future volatility. However, earnings are exposed to fluctuations on (at least) two different levels. In the first instance, household-specific factors, such as illnesses, affect earnings and therefore its variability through time. In the second instance, factors that are common to the village in which the household resides, such as weather shocks, are also likely to impinge on earnings in the same way for all households in the village. Therefore total earnings variability may be decomposed into two components: household (idiosyncratic) volatility and village (aggregate) volatility.

However, the variability of total household earnings may under-estimate ex-ante risk, through confounding labour supply responses to risk. This is because total household earnings  $Y^{hh}$  (for non self-employed households) are  $Y^{hh} = w_m L_m + w_f L_f + w_c L_c$ , where  $w_i$  and  $L_i$  are wages and labour supply for males, females and children respectively ( $i = m, f, c$ ). If a household has anticipated a bad draw of income, this will be reflected in its labour supply, and household earnings will reflect behaviour that has been taken to minimise exposure to, or to reduce the effects of, risk. Therefore the volatility of  $Y^{hh}$  across time would under-estimate ex-ante risk.

In order to deal with ex-post labour supply adjustments, we measure the variability of the hourly wage of the head of the household. The earnings

---

<sup>21</sup>In the model in section 2, it referred to the volatility of the parental earnings stream, as the parent was the only (non-child) earner in the household.

of the household head will not incorporate labour supply adjustments that are a reaction to uncertainty, if one believes that the head of the household is the main earner and that his/her observed work status at the extensive margin is exogenous to any risk. Estimating the variability of the hourly wage nets out any labour supply responses to risk that might contaminate annual earnings.

However, ex-post labour supply adjustments remain problematic for self-employed household heads, particularly for those with a family enterprise. This is because the head's reported annual earnings are the net profits of the enterprise,  $Y^h = \Pi$ , which may be inclusive of the opportunity costs of family labour.<sup>22</sup> Their earnings measure is therefore not comparable to that of non self-employed individuals, rendering it invalid to pool both groups to estimate wage volatility. Any observed differences in the variability of their earnings would partly reflect the differing incorporation of family labour contributions into the earnings measures, rather than true differences in ex-ante risk. For this reason, we omit household heads who report that they use family labour. They constitute just under 40% of the overall sample.<sup>23</sup> A comparison of mean household characteristics of the two groups in table 2 shows that they are very similar across both samples, with the obvious exception of business and farm ownership.

We observe up to five years of retrospective earnings and labour supply data for key household members, across 79 small rural villages, from which

---

<sup>22</sup>Ideally, if we knew the marginal product of each family member, we could calculate their wages and net out labour supply responses to risk from  $Y^h$ . Unfortunately data limitations preclude this option.

<sup>23</sup>An advantage of the data is that we observe the type of labour used by self-employed household heads on the enterprise - we know whether they use no labour, family/temporary labour or hired regular labour. The reported net profit of heads who do not use any labour or who employ hired workers, is net of both household labour supply and the wages of employed workers, so the earnings for these groups are comparable to earnings of non self-employed heads. It is important to note that even though we omit households that use family labour from the measurement of risk, they are not omitted from the schooling equations. We will see this further below.

we construct the past stream of wages for each household head.<sup>24</sup> In order to estimate the variability of the observed earnings streams, at both household and village levels, we first net out changes in wages that are predicted and observed. We pool data within each village, across individuals and years, and estimate separate village-level OLS regressions, in which the dependent variable,  $\ln w_{hvt}$ , is the log of the hourly primary wage of the household head in village  $v$  in year  $t$ ,

$$\ln w_{hvt} = \beta_v X_{hvt} + \beta_{vt} + \epsilon_{hvt} \quad (7)$$

where  $X_{hvt}$  denotes age, age squared and years of education,  $\beta_{vt}$  is a village time dummy that captures the component of the wage in period  $t$  that is common to all individuals in the village and  $\epsilon_{hvt}$  includes both unobserved and unanticipated individual and village characteristics that affect the wage of the head.

#### 4.0.1 Idiosyncratic Risk

The estimates of the residual  $\hat{\epsilon}_{hvt}$  in (7) represent the household-specific unexplained variation in the wage of the household head, including the components of the wage that are unobserved and/or unanticipated, as well as measurement error in the wage. Its variability across time, estimated for each household using the coefficient of variation of  $\exp(\hat{\epsilon}_{hvt})$ , which we denote  $\hat{c}v_{hv}$ , will therefore comprise all of these effects.<sup>25</sup>

<sup>24</sup>Monthly earnings are converted to an hourly wage using data on the number of weeks worked per year and the number of hours worked per week. Only the wage of the household head's primary job is used. This is because a secondary job (if observed) may be a reaction to risk. The sample of household heads is restricted to those who are currently between the ages of 25 and 65, in an attempt to capture those who have most likely been the main household earner for each of the past 5 years.

<sup>25</sup>The coefficient of variation for household  $h$  in village  $v$  is  $\hat{c}v_{hv} = \sigma(\exp \hat{\epsilon}_{hvt}) / \mu(\exp \hat{\epsilon}_{hvt})$  for  $t = 1988 \dots 1992$ , where  $\sigma$  denotes the standard deviation and  $\mu$  denotes the mean. The coefficient of variation is multiplied by  $\frac{1}{\sqrt{m_h + 1}}$ , where  $m_h$  is the number of years of missing wage data for household head  $h$ . The top and bottom 1% of wage observations are excluded from the calculation of volatility. Note that any household fixed effects that affect wages are swept out in the standard deviation of the residual and will not bias the estimates of the effects of risk on education.

## 4.0.2 Aggregate Village Risk

Estimating separate time dummies by village separates out the common village component to earnings in each year. We estimate the variation in these time dummies across 1988 to 1992, separately for each village using the coefficient of variation of  $\exp \hat{\beta}_{vt}$  from (7). This estimate of aggregate village risk is denoted  $\hat{c}v_v$ .<sup>26</sup>

In order to examine the extent to which  $\hat{c}v_v$  measures pervasive village-wide uncertainty, in table 4 we present OLS estimates from a regression of  $\hat{c}v_v$  on a range of village characteristics.<sup>27</sup> The correlations largely conform to expectations. Controlling for village wealth, aggregate village risk is higher on average in villages in which there is no formal access to credit. This is consistent with such villages being less well developed and therefore likely to be more susceptible to pervasive shocks. It is also positively correlated with the proportion of farming households in the village. Further, the coefficient on the number of adverse shocks in the village over the past 5 years, and the amount of rainfall in 1991/1992, are of the expected sign, although not statistically different from zero at conventional levels.

## 4.1 Effects of Risk on Education

The equation that we use to estimate the effect of risk on investment in education is

$$S_{ivt} = \alpha_0 + \alpha_1 \hat{c}v_{hv} + \alpha_2 \hat{c}v_v + \alpha_3 W_{ivt} + \eta_{ivt} \quad (8)$$

where  $S_{ivt}$  is a measure of human capital of child  $i$  in village  $v$  at time  $t$  ( $t = 1993$ ),  $\hat{c}v_{hv}$  is the estimate of idiosyncratic risk of the household in which person  $i$  lives,  $\hat{c}v_v$  is the estimate of aggregate risk of the village in which individual  $i$  resides,  $W_{ivt}$  includes individual, household and village characteristics that affect the schooling of the child, and  $\eta_{ivt}$  includes unobserved individual and village characteristics that affect the education of

---

<sup>26</sup>Aggregate risk of village  $v$  is estimated as  $\hat{c}v_v = \sigma(\exp \hat{\beta}_{vt})/\mu(\exp \hat{\beta}_{vt})$  for  $t = 1988 \dots 1992$ .

<sup>27</sup>I am grateful to Timothy Besley for this suggestion.



individual  $i$  in period  $t$ .

However,  $\widehat{c}v_{hv}$  in (8) is likely to be correlated with the error term,  $\eta_{ivt}$ . This is because whilst  $\widehat{c}v_{hv}$  includes volatility that is due to unanticipated (risk) factors, it also includes predicted but unobserved (non-risk) factors that affect wages. Such non-risk factors may also have a direct but unobserved effect on education and may therefore comprise part of the error term,  $\eta_{ivt}$ .<sup>28</sup> The problem is how to distinguish the effects of true risk on education from the effects of unobserved heterogeneity.

## 4.2 Identification

We use an instrumental variable strategy to deal with this potential correlation between idiosyncratic risk and the error term. We pool all villages and predict the component of  $\widehat{c}v_{hv}$  that is due to observed heterogeneity. In this way, we net out unobserved non-risk factors in  $\widehat{c}v_{hv}$  that are likely to also affect education, as well as smooth out any measurement error in  $\widehat{c}v_{hv}$

$$\widehat{c}v_{hv} = \lambda_v + \gamma Z_{hvt} + u_{hvt} \quad (9)$$

Note that we assume that there is a common component to the idiosyncratic risk of all households within a village, as captured by  $\lambda_v$  in equation (9). We also allow for heterogeneity in idiosyncratic risk across households within the village, through  $Z_{hvt}$ . The instrumented measure of idiosyncratic risk as estimated from equation (9) is  $\widehat{\lambda}_v + \widehat{\gamma}Z_{hvt}$ .<sup>29</sup>

In order to estimate the effect of idiosyncratic risk on education, the key identification assumption is that conditional on observed characteristics  $W_{ivt}$  in (8), *past household shocks* have no independent effect on human capital accumulation, i.e. they are uncorrelated with  $\eta_{ivt}$  in (8).<sup>30</sup> The main

---

<sup>28</sup> $\alpha_1$  would therefore yield a downward-biased estimate of the effect of true risk on education.

<sup>29</sup>In this way we also predict idiosyncratic risk for self-employed household heads who use family labour. As discussed already, this is important so as not to exclude children of such households from the schooling regressions.

<sup>30</sup>Data on adverse shocks is collected retrospectively - yearly back to 1988 - and display

channel through which this is likely to be violated is if there is a direct impact of a shock in a particular period on school attendance in that period, in which case years of education, being a stock measure of human capital, may be directly affected by past shocks. However, our fundamental claim is that a shock in a particular period affects school attendance in that period, *only through its effect on earnings*. Therefore over time, shocks affect education through their effect on earnings variability. Once we control for this variability (idiosyncratic risk), there is no direct impact of past shocks on years of education.

Further, in order for the identification assumption to hold, it is important to control for any other variables that may be correlated with past shocks and that are likely to affect education. In particular, the current non-labour income of the household is likely to be a function of past shocks, to the extent that it has been used (ex-post) by the household as a means of buffering consumption. Therefore failure to control for the current non-labour income of the household in the schooling regressions could lead to biased estimates of the effects of idiosyncratic risk on education: non-labour income, itself likely to be a function of past shocks, would comprise part of the error term, thus rendering the identification assumption invalid.

The output from the first stage regression in equation (9) is displayed in table 3. The p-value for the joint significance of the key instruments in the first-stage regression is less than 0.04. The number of household shocks is positively and significantly associated with the estimated measure of idiosyncratic risk. An interesting finding is that farm ownership, regardless of farm size, is associated with significantly lower idiosyncratic risk compared to non-ownership of either a farm or a business. This suggests that it is individuals who are employed as labourers on another farm or enterprise, who face the highest idiosyncratic risk levels.

---

some recall bias, with the number of reported shocks being higher, the closer it is to the survey year. Almost 17% of households report at least one form of adverse shock in 1992.

## 5 Results

As discussed in section 3, we consider two different measures of  $S_{iwt}$ : current school attendance and accumulated years of education. Tables 5 through 8 present the estimation results - for different sub-samples - from equation (8), replacing  $\widehat{c}v_{hv}$  with its instrumented value as estimated in equation (9). In each of the specifications, we also control for age and gender of the child, gender of the household head, religion of the household, missing parent, unschooled parents, household size, log of household expenditure, mean income of the head, current household non-labour income, log value of liquid assets, farm ownership, business ownership, number of primary, junior and senior high schools in the area, distance to the nearest school, presence of bank in the area, log of village expenditure, village size, and average village level wages for males, females and children. To summarise the effects of these characteristics on education choices, the most notable factors having an adverse effect on education include having a higher number of younger siblings, unschooled parents, living farther from a bank and living in a village with a relatively lower number of junior high schools.<sup>31</sup>

We now turn to the effects of aggregate and idiosyncratic risk variables on education. To begin with, marginal effects from a probit estimation in which the dependent variable is whether the child is currently in school, are presented in table 5, separately for 7-12 and 10-14 year olds. This first set of results shows that for both 7-12 and 10-14 year olds, idiosyncratic risk has a negative but insignificant effect on the probability that the child is currently enrolled in school.<sup>32</sup> The effect of aggregate risk on the current school attendance of 7-12 year olds is negative and of borderline statistical significance. For the older age group however, aggregate risk appears to have no effect on school attendance.

However, as discussed in section 3, a more direct measure of investment

---

<sup>31</sup>These are in line with previous findings in this literature (see for example Grootaert (1999)) and are available upon request.

<sup>32</sup>Note that standard errors on the risk coefficients have been adjusted for the first-stage prediction.

in human capital is current years of education, which captures past temporary (and permanent) interruptions to schooling.<sup>33</sup> Table 6 shows the effects of risk on years of education, for both the 7-12 and 10-14 year old samples. For both samples, aggregate risk has a significantly negative effect on the current years of education of the child.<sup>34</sup> On the other hand, the effects of idiosyncratic risk are not statistically different from zero in either case. The results are consistent with children being used as a form of insurance in response to aggregate village risk, and with idiosyncratic risk being diversified away without being detrimental to education, in line with previous findings that aggregate risk is more difficult to insure against than idiosyncratic risk. The implications of this finding are extremely important for understanding factors in education - and possibly child labour - choices in LDCs. Below, we probe this result further to assess its robustness across different subsamples.

First, we examine the effects of risk across more refined age ranges. We examine the effects of risk on years of education separately for age groups 7-9, 10-12, 13-14 and 15-17. Results in table 7 show that most of the adverse effect of aggregate village risk is for 10-12 year old children.

Second, in an attempt to capture those villages in which consumption smoothing is limited by borrowing constraints, the sample is further restricted to small rural villages that do not have access to credit. Credit represents some type of formal credit, whether it is for consumption or investment purposes. From table 8 we see that in villages without any access to credit, the pattern is the same as for the overall sample, with idiosyncratic volatility having a negative but insignificant effect on years of education. Despite the decrease in sample sizes, the effect of aggregate village risk is

---

<sup>33</sup>If the individual is observed to have repeated a year of school, this is not counted as a year of education. Thus the years of education variable captures any delays in the education process through having to repeat, through late enrolment, or through withdrawal for one year (or more). It does not directly pick up seasonal interruptions to schooling, except through seasonal interruptions leading to the child having to repeat a year of schooling.

<sup>34</sup>The standard deviation of the estimate of aggregate village risk,  $\hat{c}v_v$ , is 0.16. From table 6, a one standard deviation increase in aggregate village risk therefore decreases years of education by approximately 0.17 years.

negative and even stronger when the sample of villages is restricted to those without formal credit. This pattern of results conforms to children serving as a consumption-smoothing device in areas where one might expect household diversification strategies to be most important, i.e. areas without any formal credit.<sup>35</sup>

The result emerges most strongly for the 10 to 12 age group. It is in line with previous literature which finds that aggregate village risk is more difficult to insure than idiosyncratic risk. To the extent that this lower schooling is substituted by work, one can infer risk feeding through to child labour, in the form of a possible buffer stock for the parent. However, this is not possible to conclude here. Ideally, one would like to observe the child's activity at a number of points in time in order to draw any conclusions about the direct effect of risk on child labour. For the moment, one can only suggest that the human capital accumulation reductions, with their adverse dynamic effects, may be facilitating the occurrence of child labour.<sup>36</sup>

As discussed above, the identification assumption that household shocks have no direct effect on education, may be challenged on the grounds that household shocks may affect current school attendance and therefore years of education. In that case, the lack of any effect of idiosyncratic risk may be due to an invalid instrument rather than due to the lack of any real effect of household level risk. Whilst - for reasons discussed already - we believe this not to be the case, the identification assumption is of course not testable. However, the key finding of this paper is that *aggregate village risk* has an adverse effect on child human capital accumulation. An important issue

---

<sup>35</sup>Note that a number of other robustness checks have been carried out, including the sensitivity of the results to the age cutoff of the household head, and to the precise cutoff for village size. The same pattern of results holds.

<sup>36</sup>It is important to point out that flexibility in schooling as part of a household's insurance strategy, does not necessarily mean that the child is any worse off because of the delay. The insurance strategy may simply be to shift expenditure on education to a future period, and hence delay the educational process, with no adverse effect on the end stock of human capital. However, there is evidence to show that withdrawal from education is often an absorbing state, with a low likelihood of the child returning.

is thus to what extent this result may be driven by the instrumental variable estimation and underlying identification assumption. In order to assess whether the adverse effects of aggregate risk are robust to the instrumenting of idiosyncratic risk, we estimate the effects of aggregate village risk on years of education, whilst directly controlling for the number of household shocks in each of the years 1998 through 1993, rather than using an IV estimation. The results of this estimation are shown in table 9. We see that the key finding - the adverse effects of aggregate risk on education - generally persist. The effect of aggregate risk on years of education is negative and statistically significant (at the 5% level) for 10-14 year olds, and of a similar magnitude to the result from the IV strategy. Compared to the IV estimation, the effect decreases slightly for 7-12 year olds, but is nonetheless of borderline statistical significance.<sup>37</sup>

## 5.1 Interpretation and Validation of Results

The lack of any effect of idiosyncratic risk on education may be due to the availability of insurance against such risk, whilst the negative effect of aggregate village risk may be indicative of inadequate formal insurance mechanisms.<sup>38</sup> However, as discussed in section 2, there are two important factors other than insurance that are related to risk and that also affect education investment decisions. Depending on the empirical importance of such factors - insofar as it can be estimated - they may have a role to play in interpreting the effects of risk on education.

First, transfers from grown-up children to their parents that are increasing in the education level of the child and that are a function of risk, are likely to affect the education choices of parents. Increased risk would be likely to increase investment in education and the observed effects of risk on education might comprise this positive effect.<sup>39</sup> We empirically test whether

---

<sup>37</sup>It is also worth noting that the effects of past household shocks on education are not statistically different from zero, thus reinforcing their validity as instruments.

<sup>38</sup>It may be that households can pool non-covariant (idiosyncratic) forms of risk, whilst common forms of risk are more difficult to insure against and households may be forced to rely on formal mechanisms instead.

<sup>39</sup>However, it is not possible to say to what extent this channel would differentially

transfers are increasing in education level. We estimate a probit in which the dependent variable is equal to one if the parent is a net transfer recipient. Controlling for a range of household characteristics, table 10 shows that transfers are not systematically related to the education level of the donor.<sup>40</sup> This provides empirical evidence that the observed effects of risk on education are not substantially affected by the parent increasing education in order to increase future (anticipated) transfers in a risky environment.

Second, if earnings risk varies by education level, investment in education may be a means for the parent of reducing the future exposure of the adult to earnings risk. The level of investment depends on whether the parent perceives risk to be increasing or decreasing in education level. If the parent assesses the uncertainty of the future environment for the adult on the basis of his/her own experiences, we can assess this by considering the relationship between idiosyncratic risk and education, as estimated from equation (9). Table 11 shows that there is a negative correlation between them. This suggests that an increase in risk would lead the parent to increase investment in education. However, it is unlikely that this positive effect is sufficient to completely explain the lack of any effect of idiosyncratic risk on education (i.e. to offset completely any negative effect that may exist in the absence of this correlation between risk and education). Instead, it seems more plausible to us that the observed effects of risk are due to a lack of insurance markets for aggregate risk, with idiosyncratic risk being diversified away through means other than children.

As further evidence of thin insurance markets for income underlying the results, we estimate the effects of risk on human capital for children living in large urban areas, in which it is reasonable to expect insurance markets to be better-functioning.<sup>41</sup> In table 12 we see that controlling for a range of

---

influence the effects of idiosyncratic and aggregate risk on education.

<sup>40</sup>This is in line with findings by Raut and Tran (1998) and Cameron and Cobb-Clark (2001), also using the IFLS data.

<sup>41</sup>Apart from formal insurance and subsequent moral hazard and information problems, it may also be the case that individuals are less susceptible to covariant forms of risk in large urban areas, and therefore informal insurance arrangements amongst individuals are

area characteristics, the coefficients on idiosyncratic and aggregate risk are not statistically different from zero. This is suggestive of the negative effect of aggregate village risk in small rural areas being largely due to insurance market failures.

Finally, if risk is not fully insurable, one would expect it to affect the accumulation of tangible forms of buffer stock. To investigate this, we estimate whether idiosyncratic and aggregate risk affect the ownership of jewellery, which is an important form of precautionary saving in Indonesia. Table 13 shows the marginal effects of risk on the probability that the household currently owns jewellery. The results provide evidence that in households in small rural villages with at least one 10-14 year old, higher levels of aggregate village risk increase the probability that the household owns jewellery, suggesting that households save more in response to pervasive risk. The effect of idiosyncratic risk is not statistically different from zero at conventional levels. Whilst these findings are merely suggestive of a plausible range of mechanisms being used by the household to deal with uncertainty, we view them as providing a motivation for further research into the myriad of ways that households cope with risk, with important consideration for the role of children in this risk-coping portfolio.

## 6 Conclusion

A repeated finding in the literature on uncertainty and consumption choices in LDCs, is that idiosyncratic forms of risk are generally diversified away by households, whilst aggregate forms of risk are more difficult to insure against and generally feed through to affect household consumption and savings decisions. However, whilst the importance of distinguishing between different forms of risk is by now well-documented, the implications of such risk - specifically distinguishing between different forms - for the human capital accumulation of children have been less widely examined.

In this paper, we have estimated the earnings risk facing households at  

---

more likely to be successful.



two levels - that due to village-wide uncertainty and that due to household-specific uncertainty - and have shown that children fulfill a possible insurance role to protect household consumption against aggregate village risk, with detrimental effects on human capital accumulation. There is evidence that idiosyncratic risk is being diversified by households without having to resort to the labour of their children. These findings have new and important implications for the perpetuation of persistent poverty in LDCs. Policy must be carefully crafted in order to consider the relative efficiency of household self-insurance mechanisms vis-à-vis the crowding out of such mechanisms by formal insurance provision.

## 7 Tables

Table 1: Mean Characteristics by Household Type

	(1)	(2)
	<b>At least one</b>	<b>At least one</b>
	<b>7 to 12 year old</b>	<b>10 to 14 year old</b>
Age of the child	9.5032 (1.6562)	11.9766 (1.4213)
Male child	0.4887 (0.5000)	0.5102 (0.5001)
Child is attending school	0.9232 (0.2663)	0.8300 (0.3758)
Unschooling mother	0.3206 (0.4668)	0.3214 (0.4672)
Unschooling father	0.2876 (0.4528)	0.2928 (0.4552)
Household size	5.9973 (1.9528)	6.0996 (2.0114)
Farm ownership	0.6946 (0.4606)	0.7247 (0.4468)
Business ownership	0.3236 (0.4679)	0.3243 (0.4683)

Table 1 contd.

	(1)	(2)
Number of households in village	554.55 (244.02)	551.04 (249.57)
Number of senior high schools	1.3526 1.1625	1.4182 (1.1982)
Distance to nearest school (km)	3.8222 (3.1263)	3.8046 (3.1814)
Presence of bank	0.1109 (0.3141)	0.1119 (0.3154)
	$N = 1,366$	$N = 1,136$

Notes: N is the number of children. Standard deviations in parentheses.

Table 2: Mean Characteristics of Households with Self-Employed Head

	<b>With Family Labour</b>	<b>Without Family Labour</b>
Age of head	46.17 (10.65)	45.19 (10.96)
Male head	0.8942 (0.3077)	0.8612 (0.3458)
Years of education of head	4.2478 (3.5740)	4.2578 (3.5584)
Liquid asset ownership	0.5160 (0.50)	0.5252 (0.4995)
Farm ownership	0.7882 (0.4087)	0.6354 (0.4814)
Business ownership	0.3869 (0.4872)	0.4708 (0.4993)
Fraction of adults working	0.7353 (0.2829)	0.6893 (0.2860)
Household size	4.9992 (2.0676)	4.7839 (2.0698)
	N=1,190	N=2,161

---

Standard deviations in parentheses. N is the number of households.

Table 3: Estimates from Equation (9)

	<b>Small Rural Villages</b>
	Idiosyncratic risk
Number of household shocks 1988 to 1992	0.0292* (0.0144)
Owens business	0.0152 (0.0176)
Owens small-sized farm	-0.0589* (0.0269)
Owens medium-sized farm	-0.1002** (0.0262)
Owens large-sized farm	-0.0679** (0.0244)
Age of household head	-0.0023* (0.0011)
	$r^2 = 0.2970$
	Number of villages = 79

Notes: Dependent variable is idiosyncratic risk,  $\hat{c}v_{hv}$ . The farm and business dummies may be interpreted relative to non-ownership of either a farm or a business. Also include the education and occupation of the household head and village dummy variables. \*\* statistically significant at the 1-percent level; \* statistically significant at the 5-percent level.

Table 4: OLS Estimates of Aggregate Risk on Village Characteristics

	<b>Small Rural Villages</b>
Log village expenditure	-0.0210 (0.0538)
Land type hilly	-0.0687 (0.0379)
Soil productivity average/high	0.0103 (0.0330)
Credit availability	-0.0679* (0.0320)
Presence of cottage industry	-0.0019 (0.0361)
Presence of factory	0.0583 (0.0538)
Proportion of hhs in village with farm	0.2021* (0.0817)
Proportion of hhs in village with business	0.0681 (0.1316)
Average number of village shocks 1988-1992	0.0053 (0.0052)
Average village rainfall 1991-1992	-0.0386 (0.0268)
Village has irrigated ricefields	-0.0242 (0.0449)
	$r^2 = 0.327$
	N=79

---

We also include controls for village size and province. N is the number of villages. \*\* statistically significant at the 1-percent level; \* statistically significant at the 5-percent level.

Table 5: Probit Estimates - Effects of Risk on School Attendance

<b>Small Rural Villages</b>		
Attend school		
	(1)	(2)
	7-12	10-14
Idiosyncratic risk	-0.0299 (0.0386)	-0.0791 (0.0794)
Aggregate risk	-0.0713 (0.0473)	0.0117 (0.1013)
	$r^2 = 0.1604$	$r^2 = 0.2240$
	$N = 1,366$	$N = 1,136$

Number of villages = 79

---

Notes: Also include standard household, child and village level controls. Reference category is not attend school. Standard errors corrected for clustering at the village level. N is the number of children. \*\* statistically significant at the 1-percent level; \* statistically significant at the 5-percent level.



Table 6: OLS Estimates - Effects of Risk on Years of Education

<b>Small Rural Villages</b>		
Years of education		
	(1)	(2)
	7-12	10-14
Idiosyncratic risk	0.0240 (0.3055)	-0.1358 (0.5534)
Aggregate risk	-0.8753* (0.3461)	-1.0746* (0.5044)
	$r^2 = 0.5207$	$r^2 = 0.4235$
	$N = 1,212$	$N = 1,026$

Number of villages = 79

---

Notes: Also include standard household, child and village level controls. Standard errors corrected for clustering at the village level. N is the number of children. \*\* statistically significant at the 1-percent level; \* statistically significant at the 5-percent level.

Table 7: OLS Estimates - Effects of Risk on Years of Education, by Age

	<b>Small Rural Villages</b>			
	Years of education			
	(1)	(2)	(3)	(4)
	7-9	10-12	13-14	15-17
Idiosyncratic risk	0.1564 (0.3364)	0.0789 (0.4628)	-0.1177 (0.8909)	-0.4826 (1.0281)
Aggregate risk	-0.2734 (0.4815)	-1.4546** (0.5073)	-0.8214 (0.7508)	-0.9136 (0.9038)
	$r^2 = 0.2652$ $N = 565$	$r^2 = 0.2597$ $N = 647$	$r^2 = 0.2278$ $N = 379$	$r^2 = 0.2649$ $N = 493$

Number of villages = 79

Notes: Also include standard household, child and village level controls. Standard errors corrected for clustering at the village level. N is the number of children. \*\* statistically significant at the 1-percent level; \* statistically significant at the 5-percent level.

Table 8: OLS Estimates - Effects of Risk on Years of Education

<b>Villages without Credit</b>		
Years of education		
	(1)	(2)
	7-12	10-14
Idiosyncratic risk	-0.0209 (0.2596)	-0.1052 (0.5048)
Aggregate risk	-1.4708** (0.5070)	-1.5807* (0.8048)
	$r^2 = 0.5201$	$r^2 = 0.4053$
	$N = 989$	$N = 849$

Number of villages = 60

---

Notes: Also include standard household, child and village level controls. Standard errors corrected for clustering at the village level. N is the number of children. \*\* statistically significant at the 1-percent level; \* statistically significant at the 5-percent level.

Table 9: Non-IV - Effects of Aggregate Risk on Years of Education

<b>Small Rural Villages</b>		
Years of education		
	(1)	(2)
	7-12	10-14
Aggregate risk	-0.5874	-0.9005*
	(0.3161)	(0.4468)
	$r^2 = 0.5198$	$r^2 = 0.4193$
	$N = 1,265$	$N = 1,069$

Number of villages = 79

---

Notes: Control for household level shocks. Also include standard household, child and village level controls. Standard errors corrected for clustering at the village level. N is the number of children. \*\* statistically significant at the 1-percent level; \* statistically significant at the 5-percent level.

Table 10: Probit Estimates - Effects of Education on Transfers

<b>Small Rural Regions</b>	
Net transfer recipient	
Elementary	0.0514 (0.0448)
Junior High	-0.0082 (0.0648)
Senior High	0.0222 (0.0573)
College	0.1078 (0.1252)

$$r^2 = 0.0508$$

---

Notes: Also include standard household, individual and village level controls. Omitted category is no education. Standard errors corrected for clustering at the village level. \*\* statistically significant at the 1-percent level; \* statistically significant at the 5-percent level.

Table 11: OLS Estimates - Effects of Education on Idiosyncratic Risk

<b>Small Rural Regions</b>	
Idiosyncratic Risk	
<b>Highest Education Level</b>	
Unschoolled	0.0620 (0.0328)
No Qualification	0.0675* (0.0286)
Elementary	0.0342 (0.0283)
Junior High	0.0348 (0.0377)
$r^2 = 0.2224$	

---

Notes: Also include standard household, individual and village level controls. Omitted category is senior high qualification or above. Standard errors corrected for clustering at the village level. \*\* statistically significant at the 1-percent level; \* statistically significant at the 5-percent level.

Table 12: OLS Estimates - Effects of Risk on Years of Education

<b>Large Urban Regions</b>		
Years of education		
	(1)	(2)
	7-12	10-14
Idiosyncratic risk	-0.5862 (0.4265)	-0.3895 (0.4826)
Aggregate risk	0.4750 (0.4682)	0.5299 (0.5053)
	$r^2 = 0.5857$	$r^2 = 0.5724$
	$N = 1,147$	$N = 989$

Number of villages = 118

---

Notes: Also include standard household, child and village level controls. Standard errors corrected for clustering at the village level. N is the number of children. \*\* statistically significant at the 1-percent level; \* statistically significant at the 5-percent level.

Table 13: Probit Estimates - Effects of Risk on Jewellery Ownership

<b>Small Rural Villages</b>		
	(1)	(2)
	Households with 7-12	Households with 10-14
	year olds	year olds
Idiosyncratic risk	-0.0309 (0.1055)	-0.0557 (0.1094)
Village risk	0.1093 (0.1138)	0.2306* (0.1155)
	$r^2 = 0.0440$ $N = 961$	$r^2 = 0.0543$ $N = 822$

Notes: Also include standard household, child and village level controls. Standard errors corrected for clustering at the village level. N is the number of households. \*\* statistically significant at the 1-percent level; \* statistically significant at the 5-percent level.



## 8 Appendix

The first order conditions for consumption and education are respectively

$$\Psi_{c_1^{hh}} : U'(c_1^{hh}) - \beta E_1 U'(c_2^p) = 0 \quad (10)$$

$$\Psi_{D_1} : \beta\gamma[U'(c_2^a)f'(g(D_1))] - \beta(p^D + w_1^c)E_1 U'(c_2^p) = 0 \quad (11)$$

### Effect of Parental Income Risk on $D_1$

$$\frac{\partial D_1}{\partial \delta} \Big|_{\frac{d\theta}{d\delta} = -\xi} = \frac{\begin{vmatrix} \Psi_{c_1^{hh} c_1^{hh}} & -\Psi_{c_1^{hh} \delta} \\ \Psi_{D_1 c_1^{hh}} & -\Psi_{D_1 \delta} \end{vmatrix}}{|H|}$$

where  $H$  denotes the Hessian,  $|H| > 0$  due to the second order condition for a maximum and

$$\begin{aligned} \Psi_{c_1^{hh} c_1^{hh}} &: [U''(c_1^{hh}) + \beta E_1 U''(c_2^p)] dc_1^{hh} \\ \Psi_{D_1 c_1^{hh}} &: [\beta(p^D + w_1^c)E_1 U''(c_2^p)] dc_1^{hh} \end{aligned}$$

$$\begin{aligned} \Psi_{c_1^{hh} \delta} &: -\beta E_1 [U''(c_2^p)(y_2^p - \xi)] d\delta \\ \Psi_{D_1 \delta} &: -\beta(p^D + w_1^c)E_1 [U''(c_2^p)(y_2^p - \xi)] d\delta \end{aligned}$$

where we have substituted  $\delta y_2^p + \theta$  for parental period 2 income and am evaluating the derivative keeping the mean of parental period 2 income constant.

$$\begin{aligned} \frac{\partial D_1}{\partial \delta} \Big|_{\frac{d\theta}{d\delta} = -\xi} &= \frac{\begin{vmatrix} U''(c_1^{hh}) + \beta E_1 U''(c_2^p) & \beta E_1 [U''(c_2^p)(y_2^p - \xi)] \\ \beta(p^D + w_1^c)E_1 U''(c_2^p) & \beta(p^D + w_1^c)E_1 [U''(c_2^p)(y_2^p - \xi)] \end{vmatrix}}{|H|} \\ &= \beta(p^D + w_1^c)U''(c_1^{hh})E_1 [U''(c_2^p)(y_2^p - \xi)] \end{aligned} \quad (12)$$

Risk aversion implies that  $U''(c_1^{hh}) < 0$ . The sign of  $E_1 [U''(c_2^p)(y_2^p - \xi)]$  is determined below for all values of  $y_2^p$ .

$$\boxed{y_2^p \geq \xi}$$

Under the assumption that risk aversion  $-\frac{U''(c_2^p)}{U'(c_2^p)}$  is decreasing in  $c_2^p$

$$-\frac{U''(c_2^p)}{U'(c_2^p)} \leq \left( -\frac{U''(c_2^p)}{U'(c_2^p)} \right)_\xi \quad \text{if } y_2^p \geq \xi \quad (13)$$

$$U'(c_2^p)(y_2^p - \xi) \geq 0 \quad \text{if } y_2^p \geq \xi \quad (14)$$

Multiply (13) by (14)

$$\Rightarrow U''(c_2^p)(y_2^p - \xi) \geq -\left( -\frac{U''(c_2^p)}{U'(c_2^p)} \right)_\xi U'(c_2^p)(y_2^p - \xi)$$

Take expected values on both sides

$$\Rightarrow E_1[U''(c_2^p)(y_2^p - \xi)] \geq -\left( -\frac{U''(c_2^p)}{U'(c_2^p)} \right)_\xi E_1[U'(c_2^p)(y_2^p - \xi)] \quad (15)$$

To prove that LHS  $\geq 0$ , it is sufficient to show that RHS  $\geq 0$ . This amounts to showing that  $E_1[U'(c_2^p)(y_2^p - \xi)] \leq 0$

Since  $U''(c_2^p) < 0$ ,

$$U'(c_2^p) \leq \left( U'(c_2^p) \right)_\xi \quad \text{if } y_2^p \geq \xi$$

Also,

$$y_2^p - \xi \geq 0 \quad \text{if } y_2^p \geq \xi$$

$$\Rightarrow U'(c_2^p)(y_2^p - \xi) \leq (U'(c_2^p))_\xi (y_2^p - \xi)$$

Take expected values

$$\Rightarrow E_1[U'(c_2^p)(y_2^p - \xi)] \leq (U'(c_2^p))_\xi E_1(y_2^p - \xi) = 0$$

$$\Rightarrow E_1[U''(c_2^p)(y_2^p - \xi)] \geq 0 \quad \text{from (15)}$$

$$\Rightarrow (p^D + w_1^c)U''(c_1^{hh})E_1[U''(c_2^p)(y_2^p - \xi)] \leq 0$$

$$\boxed{y_2^p \leq \xi}$$

Because risk aversion is decreasing in  $c_2^p$ , it must be that

$$-\frac{U''(c_2^p)}{U'(c_2^p)} \geq \left( -\frac{U''(c_2^p)}{U'(c_2^p)} \right)_\xi \text{ if } y_2^p \leq \xi \quad (16)$$

Also

$$U'(c_2^p)(y_2^p - \xi) \leq 0 \text{ if } y_2^p \leq \xi \quad (17)$$

Multiply (16) by (17)

$$\begin{aligned} \Rightarrow U''(c_2^p)(y_2^p - \xi) &\geq \left( \frac{U''(c_2^p)}{U'(c_2^p)} \right)_\xi U'(c_2^p)(y_2^p - \xi) \quad (18) \\ \Rightarrow E_1[U''(c_2^p)(y_2^p - \xi)] &\geq \left( \frac{U''(c_2^p)}{U'(c_2^p)} \right)_\xi E_1[U'(c_2^p)(y_2^p - \xi)] \end{aligned}$$

To prove that LHS  $\geq 0$ , it is sufficient to show that RHS  $\geq 0$ . So it must be shown that  $E_1[U'(c_2^p)(y_2^p - \xi)] \leq 0$

$$U'(c_2^p) \geq \left( U'(c_2^p) \right)_\xi \text{ if } y_2^p \leq \xi$$

Also

$$\begin{aligned} y_2^p - \xi &\leq 0 \text{ if } y_2^p \leq \xi \\ \Rightarrow U'(c_2^p)(y_2^p - \xi) &\leq (U'(c_2^p))_\xi (y_2^p - \xi) \end{aligned}$$

Take expected values

$$\begin{aligned} \Rightarrow E_1[U'(c_2^p)(y_2^p - \xi)] &\leq (U'(c_2^p))_\xi E_1(y_2^p - \xi) = 0 \\ \Rightarrow E_1[U''(c_2^p)(y_2^p - \xi)] &\geq 0 \text{ from (18)} \\ \Rightarrow \beta(p^D + w_1^c)U''(c_1^{hh})E_1[U''(c_2^p)(y_2^p - \xi)] &\leq 0 \end{aligned}$$

$$\Rightarrow \partial D_1 / \partial \delta \leq 0 \text{ in (12)}$$

## References

- [1] ASRA, A. (1993), “Working Children in Bandung, Indonesia 1993”, Jakarta, Central Bureau of Statistics and the International Labour Office.
- [2] ASRA, A. (1996), “Working Children in Medan and Deli Serdang”, Jakarta, Central Bureau of Statistics and the International Labour Office.
- [3] BALAND, J. AND J. ROBINSON (2000), “Is Child Labor Inefficient?”, *Journal of Political Economy*, 108(4): 663-679.
- [4] BASU, K. (2001), “Gender and Say: A Model of Household Behavior with Endogenously-Determined Balance of Power”, mimeo: Cornell University.
- [5] BECKER, G. (1991), “A Treatise on the Family”, Enl. Ed. Cambridge, Mass.: Harvard University Press.
- [6] BEEGLE, K., R. DEHEJIA AND R. GATTI (2003), “Child Labor, Income Shocks and Access to Credit”, Development Research Group, The World Bank.
- [7] BESLEY, T. (1995a), “Nonmarket Institutions for Credit and Risk Sharing in Low-Income Countries”, *Journal of Economic Perspectives*, 9(3): 115-127.
- [8] BESLEY, T. (1995b), “Savings, Credit and Insurance”, Chapter 36 in Jere Behrman and T.N. Srinivasan, eds., *Handbook of Development Economics*, Volume 3A.
- [9] CAIN, M. (1982), “Perspectives on Family and Fertility in Developing Countries”, *Population Studies*, 36(2): 159-175.
- [10] CAMERON, L. AND D. COBB-CLARK (2001), “Old-Age Support in Developing Countries: Labour Supply, Intergenerational Transfers and Living Arrangements”, IZA Discussion Paper No.289.

- [11] EATON, J. AND H. ROSEN (1980), "Taxation, Human Capital and Uncertainty", *American Economic Review*, 70(4): 705-715.
- [12] GALASSO, E. (1999), "Intra-household Allocation and Child Labor in Indonesia", mimeo: Boston College.
- [13] GERTLER, P. AND J. GRUBER (2002), "Insuring Consumption against Illness", *American Economic Review*, 92(1): 51-70.
- [14] GROOTAERT, C. (1999), "Child labor in Cote d'Ivoire", in C. Grootaert and H. Patrinos, eds., *The Policy Analysis of Child Labor: A Comparative Study*: World Bank, Washington.
- [15] GROOTAERT, C. AND R. KANBUR (1995), "Child Labour: An Economic Perspective", *International Labour Review*, 135(2): 187-203.
- [16] JACOBY, H.G. AND E. SKOUFIAS (1997), "Risk, Financial Markets and Human Capital in a Developing Country", *Review of Economic Studies*, 64(3): 311-335.
- [17] KOCHAR, A. (1995), "Explaining Household Vulnerability to Idiosyncratic Income Shocks", *American Economic Review*, 85(2), Papers and Proceedings: 159-164.
- [18] KODDE, D. (1986), "Uncertainty and the Demand for Education", *Review of Economics and Statistics*, 68(3): 460-467.
- [19] LEVHARI, D. AND Y. WEISS (1974), "The Effect of Risk on the Investment in Human Capital", *American Economic Review*, 64(6): 950-963.
- [20] MANNING, C. (2000), "The Economic Crisis and Child Labour in Indonesia", mimeo: ILO.
- [21] MORDUCH, J. (1995), "Income Smoothing and Consumption Smoothing", *Journal of Economic Perspectives* 9(3): 103-114.
- [22] PAXSON, C. (1992), "Using Weather Variability to Estimate the Response of Savings to Transitory Income in Thailand", *American Economic Review*, 82(1): 15-33.

- [23] PÖRTNER, C. (2001), “Children as Insurance”, *Journal of Population Economics*, 14(1): 119-136.
- [24] QUISUMBING, A.R. (1994), “Intergenerational Transfers in Philippine Rice Villages: Gender Differences in Traditional Inheritance Customs”, *Journal of Development Economics*, 43(2): 167-196.
- [25] RANJAN, P. (2001), “Credit Constraints and the Phenomenon of Child Labor”, *Journal of Development Economics*, 64(1): 81-102.
- [26] RAUT, L. AND L. TRAN (1998), “Motives for Investment in Human Capital of Children: Evidence from Indonesian Family Life Survey Data”, mimeo: Economics Working Paper Archive at WUSTL.
- [27] ROSENZWEIG, M. (1988), “Risk, Implicit Contracts and the Family in Rural Areas of Low-Income Countries”, *Economic Journal*, 98: 1148-1170.
- [28] ROSENZWEIG, M. AND H. BINSWANGER (1993), “Wealth, Weather Risk and the Composition and Profitability of Agricultural Investments”, *Economic Journal* 103: 56-78.
- [29] ROSENZWEIG, M. AND O. STARK (1989), “Consumption Smoothing, Migration and Marriage: Evidence from Rural India”, *Journal of Political Economy*, 97(4): 905-926.
- [30] SANDMO, A. (1970), “The Effect of Uncertainty on Saving Decisions”, *Review of Economic Studies*, 37(3): 353-360.
- [31] SAWADA, Y. AND M. LOKSHIN (2001), “Household Schooling Decisions in Rural Pakistan”, mimeo, World Bank, Country Economics Department.
- [32] THOMAS, D., K. BEEGLE, E. FRANKENBERG, B. SIKOKI, J. STRAUSS AND G. TERUEL (2003), “Education in a Crisis”, mimeo, UCLA.
- [33] TOWNSEND, R. (1994), “Risk and Insurance in Village India”, *Econometrica*, 62(3): 539-591.

- [34] UDRY, C. (1994), "Risk and Insurance in a Rural Credit Market: An Empirical Investigation in Northern Nigeria", *Review of Economic Studies* 61(3): 495-526.