Understanding Children's Work Project Working Paper Series, October 2001

Understanding Children's Work
An Inter-Agency Research Cooperation Project

Children's working hours, school enrolment and human capital accumulation: evidence from Pakistan and Nicaragua

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As part of broader efforts toward durable solutions to child labor, the International Labour Organization (ILO), the United Nations Children's Fund (UNICEF), and the World Bank initiated the interagency Understanding Children's Work (UCW) project in December 2000. The project is guided by the Oslo Agenda for Action, which laid out the priorities for the international community in the fight against child labor. Through a variety of data collection, research, and assessment activities, the UCW project is broadly directed toward improving understanding of child labor, its causes and effects, how it can be measured, and effective policies for addressing it. For further information, see the project website at www.ucw-project.org.

This paper is part of the research carried out within UCW (Understanding Children's Work), a joint ILO, World Bank and UNICEF project. The views expressed here are those of the authors' and should not be attributed to the ILO, the World Bank, UNICEF or any of these agencies' member countries.

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ABSTRACT

We analyse the determinants of school attendance and hours worked by children in Pakistan and Nicaragua. On the basis of a theoretical model of children's labour supply, we simultaneously estimate the school attendance decision and the hours worked by Full Model Maximum Likelihood. We analyse the marginal effects of explanatory variables conditioning on the "latent" status of children in terms of schooling and work. We show that these effects are rather different, and discuss the policy implication of this finding. Finally, we use our predicted hours of work to analyse the effects of work on children's school achievements.

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1. INTRODUCTION

Child labour is thought to be harmful in many ways to children's welfare. It interferes with human capital accumulation and may affect the present and future health of the child. The determinants of child labour supply have been recently analysed in the literature (see Basu (1999), Rosati- Tzannatos (2000), Cigno – Rosati (2001) and the literature therein cited for the discussion of theoretical models and empirical results). The attention of the literature has been mainly focused on the determinants of the categorical decision of the household on the activity of the child: whether to send a child to school, to work or allow him to perform both activities[1]. Almost no attention has been paid to the amount of time that children devote to work (either when this is their only activity or when they combine it with school attendance).

The number of hours spent working is not only important in itself as a measure of child welfare (this is a measure of forgone leisure, etc.), but is also an essential ingredient to evaluate the cost of work in terms of health and human capital accumulation. In this paper we analyse the hours of work supplied by children and try to identify their effects on school achievement. Schooling is obviously one of the most important inputs in human capital accumulation, but education is also important for health. Many studies, starting from the seminal paper of Grossmann (1972, 1982), have shown that education has an important positive effect on health status. Hence, lower school achievement due to work may not only influence the human capital of the child, but also its future health.

The literature on child labour has mainly focused on the participation decision of the children. Almost no attention has been given to the hours supplied. An exception is Ray (2000), which, however, treats labour supply separately from the household decision of sending a child to school.

This paper innovates on the existing literature by focusing on the simultaneous decision relative to school attendance and to the amount of work supplied. On the basis of a simple theoretical model, we estimate a simultaneous two equations system. This model not only allows us to take into proper consideration the joint decisions about work and schooling, but also allows us to calculate marginal effects conditioning on the "latent" propensity of the child to attend school and/or to work. These marginal effects are in some cases rather different across the "latent" state of the child and this has interesting analytical and policy implication.

[1] For the quantitatively non negligible cases in which children appears to neither work nor go to school se the literature cited.

The final section of the paper is devoted to an exploration of the link between child work and school achievements. Unfortunately, as it is also true for the rest of the small literature on the subject, the available data sets offer proxies of school achievements that are not fully satisfactory. However, as discussed in more details below, we innovate on the existing literature by taking into account the endogeneity of the hours worked and by disaggregating the effects of work on school achievements by sector of activity.

A few attempts have been made to evaluate the impact of child labour on school achievement (Patrinos and Psacharopulos (1994), Psacharopulos (1997), Heady (2000), but their estimates do not take into account the simultaneity of the decision on whether to send a child to school and/or to work. Moreover, they discuss mainly the effects of work on school achievement by considering whether the child is working or not, without devoting much attention to the number of hours actually worked. While these studies offer some evidence on the matter, it is important to assess not only the effect on school outcome of the fact that a child is working, but also the effect of the amount of work performed.

From a policy perspective it is important to evaluate whether it is the fact that a child works or if it is the amount of time that she works that affects human capital accumulation. If working hours had only a negligible effect on school achievement, then school attendance rather than work would be the correct policy target (at least in terms of human capital accumulation). On the other hand, if working hours strongly affect human capital accumulation, then child labour also needs to be monitored. Moreover, establishing whether a few hours of work have a negligible effect on human capital accumulation will help to define the target of policy intervention and also offer some supporting or contradictory evidence to the claim often made that children working less than two or three hours a day should not be considered as "working" children.

2. A THEORETICAL OUTLINE

To outline our theoretical model we consider an altruistic set up, where parents care about the present and future consumption and current leisure of their children [2]. The number of children is taken as given and for simplicity of exposition is normalized to 1[3]. We also assume that human capital accumulation is the only way to transfer resources for children's future consumption[4]. Human capital is accumulated by sending children to school[5]. The time a child has to spend at school is fixed at h_S. Normally school hours are not flexible and school attendance requires a minimum fixed amount of time devoted to school. Some of the children that work and attend school might miss classes and thus make their school hours more "flexible". However, the degree of "flexibility" that can be achieved in this way is rather limited, as skipping school often results in dropping out and is normally not tolerated by school authorities[6]. Hence we treat school hours as fixed. School attendance does not rule out child labour. However, we assume that working hours have a negative influence on human capital accumulation. Hours spent at work reduce time available for study, tire the child and reduce her learning productivity, etc. Given the nature of the work that children perform, mainly unskilled and mostly at their family farm or business, we can safely consider the hours spent at work, $h_{L,}$ as flexible and treat them as a continuous choice variable.

The human capital production function takes the form:

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[2] As discussed in Cigno-Rosati (2000), similar results will be obtained if a non-altruistic model were used.

[3] Endogenous fertility does make a difference to child labour analysis (See Rosati-Tzannatos 2000), but for the present analysis nothing of substance is changed by treating fertility as exogenous.

[4] If capital market were present the efficient level of human capital investment will equalize returns to human capital investment to the market interest rate. Allowing for the presence of capital markets will complicate the exposition without bringing additional insights. For a discussion of the role of capital markets in determining child labour supply see Rosati-Tzannatos (2000).

[5] Child labour could also contribute to human capital accumulation by, for example, on the job training. We do not consider this case in our discussion for two reasons. Firstly, there is no evidence to substantiate the statement on the role of child labor as a means to accumulate human capital. Secondly, formal education plays an empowermet role that goes beyond that of increasing the productivity of working time. This effect is captured in our model by introducing human capital as such as an argument of the utility function.

[6] There are programs that try to make school hours more flexible to accommodate child labour activities, but their coverage is marginal and, in any case, such programs are not present in Pakistan.

$$H=h(h_L; h_S) \quad (1)$$

Where $\partial H / \partial h_L < 0$.

Parents maximize a utility function defined over the current consumption of the household members, the current leisure and the future consumption of the children. Current household consumption C_1 is given by:

$$C_{1S}=y+w\,h_L - q \quad (2)$$

if parents send their children to school.

Where y is the (exogenous) income of the parents, w is the wage rate (marginal product) of child labour, h_L are the hours of work supplied by children and q is the direct cost of education.

Future children's consumption, C_{2S}, is given by K+H where K is the exogenous endowment of human capital and H is defined in (1). Parents also attach value to the (current) leisure enjoyed by the children, $L= 1 - h_S - h_L$ (having normalised total available time to 1).

If parents do not send their children to school, present consumption is given by $C_{1L}= y + w\,h_L$, future consumption by $C_{2L} = K$ and current leisure by $L= 1- h_L$.

In both cases the choice variable is h_L (the time spent at work), but the money and time budget constraints are different according to whether the child is sent to school or not.

As the amount of time required by school attendance is fixed, the parent's choice of h_L is given by

$$\text{Max } [U_S^*(h_L), U_L^*(h_L)]$$

where

$$U_S^* = \max_{h_L} U(y+w\,h_L - q, K+H(h_L; h_S), 1-h_S - h_L; M) \quad (3)$$

and

$$U_L^* = \max_{h_L} U(y+w\,h_L, K, 1-h_L; M) \quad (4)$$

and M represents a vector of household characteristics like education of the parents, locality of residence, etc.

In other words, parents compare the maximized utility under the two regimes and select the one that yields the highest welfare. Children's hours of work are hence chosen conditional on the decision whether to send children to school or not. The comparative statics properties of the model show that an increase in parent's income increases the probability that a child attends school and reduces the numbers of hours worked. An increase in the cost of schooling reduces human capital accumulation. These results, however, depend on the simplifying assumption of exogenous fertility and absence of capital markets. Relaxing such assumptions would not change the results relevant to the focus of the present paper, but it will make a difference for the discussion of child labour policies. A detailed analysis of these issues can be found in Rosati- Tzannatos (2000). Note that child labour supply is expected, other things being equal, to be lower when children are attending school, because of the cost work has in term of human capital accumulation and the higher marginal value of leisure. Also observe that corner solutions are possible in both regimes for h_L.

3. THE ECONOMETRIC MODEL

As illustrated in the Section 2, the decision of schooling and working are simultaneous. In particular we observe that a child is enrolled in school if Us* - U_L*>0 $\Rightarrow s^* > 0$ and that the hours of work supplied by the children depend also on their enrolment status.

We model hours worked and enrolment status starting from the following structure:

$$s^* = Z'g + u \tag{5}$$

$$h^* = X'b + \gamma s^* + \varepsilon = X'b + \gamma\left(Z'g + u\right) + \varepsilon \tag{6}$$

By using the following useful definitions: X*'b*=X'b+γZ'g and $\eta = \gamma u + e$, we can rewrite equation (6) as follows:

$$h^* = \mathrm{X}^* \beta^* + \eta$$

(6)

h* are the hours worked, s* is the enrolment status of the child, ε and u are the disturbance terms following a bivariate normal distribution with zero means and variance co-variance matrix (Σ) as follows:

$$= \begin{bmatrix} \sigma_\varepsilon^2 & \sigma_{\varepsilon u} \\ \sigma_{\varepsilon u} & 1 \end{bmatrix}.$$

We allow the two equations to be correlated via their error terms. One possible source of correlation is the unobservable (by the researcher) ability of the child. If children with higher abilities are more likely to go to school and work fewer hours, we expect a negative correlation between the two error components.

Both the enrolment rate and the hours worked are latent variables. Enrolment is observed as a dichotomous variable according to the following structure:

s=1 if s*>0
s=0 if s*<=0

As it is not possible to buy time, the hours worked are censored at zero. We assume that observed hours worked are described by the following Tobit model:

h=h* if h*>0
h=0 if h*<=0

The joint decision of working and studying is described by a simultaneous equation model that combines a Tobit and a probit model with correlated disturbances.

More specifically, each observation belongs to one of the four possible regimes:

Working hours>0, enrolled
Working hours=0, enrolled
Working hours>0,not enrolled
Working hours =0, not enrolled

The probability associated to each of the regimes can be written as follows:

Pr (1)=P(s=1)*P (h*>0|s=1)

$$= \phi(h^* - X^{*\prime} b^*, \sigma)\Theta\left(\frac{\left(Z'g + \rho\sigma^{-1}(h^* - X^{*\prime} b^*)\right)}{\sqrt{1-\rho^2}}\right)$$

Pr (2)=P(s=1)*P (h*<=0|s=1)= $\Theta 2\left(-X^{*\prime} b^*/\sigma, Z'g, -\rho\right)$

Pr (3)=P(s=0)*P (h*>0|s=0)=

$$\phi(h^* - X^{*\prime} b^*, \sigma)\left(1 - \Theta\left(\frac{\left(Z'g + \rho\sigma^{-1}(h^* - X^{*\prime} b^*)\right)}{\sqrt{1-\rho^2}}\right)\right)$$

Pr (4)=P(s=0)*P (h*<=0|s=0)= $\Theta 2\left(-X^{*\prime}b^{*}/\sigma, -Z'g, \rho\right)$

where $\phi, \Theta, \Theta 2$ are respectively the univariate density function, univariate cumulative function, and the bivariate cumulative function.

We estimate this model by maximum likelihood. The log likelihood function (L) for estimation of the parameters b, γ, ρ and σ is given by:

$$L=\sum_{i\in 1}\ln p(s=1,h^{*}>0)+\sum_{i\in 2}\ln p(s=1,h^{*}\leq 0)+\sum_{i\in 3}\ln p(s=0,h^{*}>0)+\sum_{i\in 4}\ln p(s=0,h^{*}\leq 0)$$

Note that the coefficient on enrolment rate enters the equation of hours worked and it is determined simultaneously with them.

Human capital accumulation is modelled using a production function approach, assuming that it depends on a set of individual and household characteristics and on hours worked. As measures of school achievements are not available as such, we used information on whether the child is enrolled in the expected grade or has failed one or more times. The probability of failing is modelled as a function of a set of household and individual characteristics, of the hours worked and of the sector of employment. As the number of hours worked is an endogenous variable, we use the fitted value from the model of school enrolment and labour supply described above to obtain unbiased estimates.

4. THE DATA SETS

We have employed two different data sets in the estimates: one survey conducted in Pakistan and the other survey in Nicaragua. The reason for this is twofold. Firstly, it is interesting to test the effects of hours of works on school achievements with data relative to largely different economies and social structures. This allows us to be more confident on the generality of the results obtained. Secondly, the data sets have different characteristics that complement each other. In the Pakistani data set working children are oversampled allowing for disaggregation among sectors of activity. The data for Nicaragua, on the other hand, contains more precise information on school achievement.

4.1 Pakistan

The survey was carried out in 1996 and contains information on working children by age, sex, location, occupation and industry; on the working conditions of the children, i.e. hours worked, wages received and terms of employment as well as on the safety and health aspects of their workplace; and socio-economic characteristics of the children and their families. The Pakistan survey is part of the SIMPOC (Statistical Information and Monitoring Programme on Child Labour) survey led by ILO within the program on the elimination of Child Labour. It contains 10,453 households with an average household size of 8 individuals, for a total of 77,684 individuals. As the goal of the survey is to investigate working children's conditions, only households that reported child labour within the age group 5-14 years were interviewed. The sample, therefore, is representative of the subset of population of Pakistan households that have at least one child working. Because of the "oversampling" of working children, the SIMPOC data set contains also enough observations to significantly disaggregate children's work by sector of activity and to estimate a child wage equation.

On the basis of the estimate of the number of households with at least one working child (with respect to the total number of households), ILO-IPEC estimated that among the 40 million Pakistani children aged 5-14 years, 3.3 million, i.e. 8.3 per cent, were economically active during the reference week. During the 12-month reference period almost 8.1 per cent of the 40 million children reported that their principal activity was either working or being available for economic activity during most of the past 12 months[7].

[7] For details refer to the technical documentation that can be found in the ILO web site at www.ilo.org

In describing the data set utilized for the estimates, however, we refer to the statistics derived from the sample. The figures discussed, therefore, refer to the sample of households with at least a working child and not to the whole Pakistani population. Children aged between 5 and 14 amount to 30,772 in the sample. Table 1, 2 and 3 show the fraction of children who work and are enrolled in school programmes and also the fraction of full-time students and part-time workers among total children. The overall enrolment rate is about 40%, and there is a very large gender differential in enrolment rate at any age group. A large fraction of children cannot be classified in any of the three activities: "working only", "studying only", "working and studying". We define them as children with "no activity". Girls are more likely than boys to belong to the latter group: this is likely due to the fact that household chores are not classified, according to the questionnaire, as working activity. The highest proportion of working children is involved in family related businesses (Table 4).

Table 1. Children enrolled in school
(as % of total number of children in each age group)

Age	Male	Female	Total
5	41.64	16.29	29.91
6	51.83	22.64	38.14
7	65.03	29.17	49.28
8	61.23	27.23	45.41
9	64.41	28.18	48.77
10	59.16	23.8	43.68
11	57.85	27.24	45.85
12	46.64	22.67	37.89
13	38.9	15.74	32.1
14	27.31	10.28	22.26
Total	49.41	22.69	38.79

Table 2. Children working only and Children working and studying
(as % of total number of children in each age group)

Age	Male	Female	Total
5	2.04	1.81	1.93
6	6.82	12.04	9.27
7	13.9	10.39	12.36
8	27.15	24.87	26.09
9	41.8	30.97	37.13
10	56.59	37.71	48.32
11	67.91	38.07	56.21
12	77.49	39.01	63.44
13	87.89	46.96	75.88
14	92.23	47.13	78.85
	55.91	29.81	45.54

Table 3. Children's activities by sex
(*as % of total number of children)*

Activity	Male	Female	Total
Work only	36.35	27.49	32.83
Study only	29.85	20.36	26.08
Work and Study	19.56	2.32	12.71
No Activities	14.24	49.82	28.38
Total	100	100	100

Table 4. Children working in wage employment, self-employment and family employment
(as % of all working children)

Sector	Male	Female	Total
Wage Employ	25.42	16.88	23.16
Self employ	7.04	5.54	6.64
Family	67.54	77.58	70.2
Total	100	100	100

Table 5. Children working in agriculture, manufacturing, construction, transport and community activities, by sex (as % of all working children)

Activity	Male	Female	Average
Agriculture	63.61	76.69	66.97
Manufacturing	10.26	11.99	10.71
Construction	2.36	0.32	1.83
Transport	16.79	0.89	12.71
Community	6.97	10.1	7.78
Total	100	100	100

4.2 Nicaragua

The Nicaragua survey refers to year 1998 and is part of the LSMS (Living Standards Measurement Study) survey[8]. There are 6,084 children aged 5 to 14 in the sample, representing the 28.8% of the total Nicaraguan sample.

The majority of children, about 73 per cent, attend school. The school attendance rate is higher for females than males at all ages. Most of the children study only (67 per cent of boys and 76 per cent of girls). Girls are less likely than boys to belong to the work. About 20 per cent of the children are apparently involved in no activity. Among them girls are the majority, this is perhaps due to the fact they are involved in household chores more than boys.

The tables 1(a) 2(a) 3(a) summarise the main statistical findings for children aged 6 to 14 in Nicaragua.

Table 1 (a). Children enrolled in school

(as % of total number of children in each age group)

Age	Male	Female	Total
6	60.68	74.29	67.52
7	74.41	77.05	75.70
8	79.18	85.64	82.54
9	81.59	83.13	82.34
10	81.08	84.35	82.66
11	77.88	81.36	79.52
12	77.46	85.88	81.67
13	68.61	73.25	70.95
14	59.03	65.25	62.11
Total	73.49	79.06	76.25

[8] The Living Standards Measurement Study was established by the World Bank in 1980 to explore ways of improving the type and quality of household data collected by government statistical offices in developing countries.

Table 2 (a). Children working only and working and studying
(as % of total number of children in each age group)

Age	Male	Female	Total
6	0.57	0.56	0.57
7	4.96	0.55	2.80
8	4.40	1.90	3.10
9	8.78	2.11	5.55
10	15.02	3.19	9.29
11	17.88	3.73	11.20
12	21.68	5.76	13.71
13	31.39	7.32	19.26
14	39.68	10.82	25.37
Total	15.41	3.84	9.68

Table 3 (a). Children's activities by sex
(as % of total number of children)

Activity	Male	Female	Total
Work only	8.61	1.07	4.88
Study only	66.69	76.29	71.44
Work and Study	6.81	2.77	4.81
No Activities	17.90	19.87	18.87
Total	100	100	100

5. ESTIMATES OF CHILDREN'S LABOUR SUPPLY.

The results of our Maximum Likelihood estimates for Pakistan and Nicaragua are presented in table 7 and 8, respectively.

The set of regressors used in the enrolment equation include the following variables for the Pakistani data: age, age squared, a dummy variable taking value of one if female, 0 otherwise (*Female*), household income net of child earnings[9] (*HH Income*), household size (*hhsize*), number of children aged 6-14 (*Children*), number of children aged 0-5 (*Babies*), number of children aged 0-5 interacted with the female dummy variable (*Babiesf*), a dummy variable taking value of one if the household resides in a rural area, 0 otherwise (*Rural*), and dummies variables taking value of one if the father (*Eduf*) or the mother (*Edum*) have at least completed primary education. A similar set of regressors has been used for Nicaragua. However, for Nicaragua, given the different characteristics of the sample, the education of the parents is represented by two dummies. The first dummy takes the value of one if the father/mother has completed the primary school (*Eduf/Edum primary*), the second takes the value of one if the father/mother has completed the secondary school (*Eduf/Edum secondary*).

As we control for income, the education of the father and of the mother should reflect the household preferences for education, the role of the mother as complement to schooling for human capital accumulation, etc. On the other hand, the education of the parents should not directly influence the decision about the length of the working time. We have hence used parent's education to identify our model together with the functional form.

Let us now briefly comment on the coefficient's estimates. School enrolment is a non-linear function of age. Net (of children's contribution) household income has a positive effect on enrolment in Pakistan. The same effect has been found with in Nicaragua. However, in this case we were not able to disentangle household income in its different components (adults and children contributions), we then used total expenditures as a proxy of total household available resources. The household composition effects are well determined. As we control for income these effects should mainly reflect the marginal productivity of children's time in the various activities. An increase in the numbers of adults[10] increases the probability of enrolment. This is probably due to the fact that the higher the potential labour supply of the household the lower the value of the marginal

[9] In order to obtain the total adults income, we first estimated children's wage using a two steps Heckman procedure, we then predicted the earnings for those children who do not work for a wage or for whom wage data are not available. We obtained the total adult income by netting out the predicted child earnings from the household income.

[10] I.e. an increase in *Hhsize* holding the remaining variables constant.

contribution of children time to current household income. An additional child aged 6-14 in the household positively affects the enrolment rate in the Pakistan, while it has a negative one in the Nicaraguan case. The presence of small children reduces, in both countries, the probability of attending school as it increases the value of time spent at home. This effect is more pronounced for the girls, even though in Nicaragua this effect is only significant at 10% level. Children living in rural areas work shorter hours in Pakistan, but are also less likely to be enrolled in school. The presence of a significant gender differential in enrolment is confirmed by the estimates in both countries, albeit in opposite directions. Girls are less likely to be at school in Pakistan and the probability of being enrolled decreases further if there are very young children in the household, as shown by the negative coefficient of *Babiesf* (the interaction between the number of young children present in the household *Babies* and the dummy for being a girl, *Female*). In contrast, girls have higher chances than boys to be enrolled in school in Nicaragua. However, the chances are reduced if there are young children in the household.

Enrolment is very significant in the hours equations with a negative sign: children enrolled in school work shorter hours and are also less likely to work. Taking the effect of enrolment as given, we observe the following relationship among hours worked and the explanatory variables (we will discuss and comment below on the full marginal effects). The number of small children has a positive effect on the hours worked for both countries, while the number of children aged 6-14 has a positive impact for Nicaragua only. An additional adult in the household raises the children working hours in Pakistan while it has the opposite impact in Nicaragua. Income does not significantly influence the hours worked. Girls work fewer hours than boys.

Given the structure of the estimated model we can compute the marginal effects conditioning on the latent status of children: enrolled or not, working or not. This will give us information on the effects of exogenous variables differentiated by "latent" group of children. As we shall see, not negligible differences emerge among the various groups, indicating that policy effects of interventions might be differentiated according to the target selected. This is a fact that has been hardly discussed in the literature, and shows the potential interest of using semi-structural simultaneous model to analyse the determinants of child labour supply.

Columns (c) and (d) of Table 7 show the marginal effects on working hours computed taking into account also the indirect effects through the changes in the decision to attend school, and conditioning on the enrolment status of

the child[11]. As it is easy to see, once the endogeneity of the enrolment status and the covariance in the errors are taken into account, the marginal effects are quite different from the estimated coefficients. Moreover, these "total" marginal effects are quite different from those that are obtained by estimating a single equation Tobit model of children's labour supply.

An increase in income has no direct effect on the hours worked. However it increases the probability that a child is enrolled in school and children attending school tend to work fewer hours. This explains why the "total" marginal effect of income on hours worked is negative. Similarly, household size has a negative effect on hours worked mainly because it increases the probability of attending school. In fact, the direct effect on hours is positive indicating that, if they work, children belonging to larger households do work longer hours. The presence of an additional small child increases of more than an hour the child labour supply. Being a female does reduce the average numbers of hours worked. Girls are less likely to attend school, but if they work they work shorter hours than the boys: this is probably due to the fact that household chores are not recorded as working activities in the survey. The presence of a small child in the household does reduce the probability that a girl attend school (as it raises the value of her time at home), but once a girl is working the presence of a small child increases the hours worked. This is most likely an income effect. Children working in rural areas are less likely to attend school, but they work shorter hours with respect to children working in urban areas.

Similar results are obtained also for Nicaragua as shown in columns (c) and (d) of table 8. The main differences with respect to Pakistan are given by the effects of the number of school age children and of the area of residence. Children belonging to household with larger numbers of school age children tend to work longer hours, while we observe a small negative effect of this variable in Pakistan. Living in rural area increases the numbers of hours worked, contrary to what we observe for Pakistan. This is likely to be due to the differences in the sampling design of the two surveys.

Columns (a) and (b) of table 7 and 8 report the marginal effects (respectively for Pakistan and Nicaragua) conditioned on the "latent" index of working hours being positive or not. In other words, the marginal effects

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[11] The total marginal effects in column (c) were obtained by differentiating with respect to each regressor the expected value of the hours worked conditional on the enrolment and working status of the child (Maddala, 1993): E(h|h*>0,s*>0) = $\beta^{*\prime}X^{*}+\frac{\sigma}{\Phi_2\left(X^{*\prime}\beta^{*},Z^{\prime}g,\rho\right)}\left(\phi(-X^{*\prime}\beta^{*}/\sigma)\Phi\left(\left(1-\rho^2\right)^{-1/2}\left(Z^{\prime}g-\rho X^{*\prime}\beta^{*}/\sigma\right)\right)+\rho(-Z^{\prime}g)\Phi\left(\left(1-\rho^2\right)^{-1/2}\left(X^{*\prime}\beta^{*}/\sigma-\rho Z^{\prime}g\right)\right)\right)$

. Total marginal effects of the enrolment probability conditional on the working status of the child in column (a) are derived by partially differentiating the enrolment probability with respect to each regressor: E(s*>0||h*>0)= $\Phi_2\left(X^{*\prime}\beta^{*},Z^{\prime}g,\rho\right)/\Phi\left(X^{*\prime}\beta^{*}\right)$

presented should be interpreted as relating respectively to children with "low propensity" to work and with "high propensity" to work. Some of the explanatory variables have quite different effects on the two groups. Consider for example income. Children with a high propensity to work show an enrolment sensitivity with respect to income far smaller than that of the children that have a lower "propensity" to work. Analogously, household size has a negative and small effect on the probability of attending school for the potentially working children, while it has a strong and significant positive effect on the other group. As we control for income, this is likely to be a marginal productivity effect. In households that are not likely to send their children to work, substitutability between adult and child work appears to be stronger than in the other group. The presence of younger children reduces the enrolment probability for those children who do not work, while it increases it for those children who are working.

These results indicate that policies aiming at reducing child labour by introducing incentive schemes (like income transfers) that only marginally modify the opportunity set of the household are likely to produce significant effects only on those households that are at the margin between sending their children to work or to school, i.e. that have a low propensity to child labour. Such schemes are hence likely, if not properly targeted, to be ineffective toward those households, most likely the poorest and most uneducated, that hence have a high propensity to send their children to work.

6. IMPACT OF HOURS WORKED ON SCHOOL PERFORMANCE

6.1 Pakistan

To what extent is child labour affecting school performance? The ILO-IPEC survey does not have a direct measure of school achievements. We have hence constructed an indicator of falling back in the course of study. In particular, we have utilized a dummy variable taking value of 1 if a child aged 10 or more is still enrolled in the primary school or if aged 13 or more and still enrolled in the middle school, zero otherwise. Obviously this variable is only an approximation to the measure of school achievement, because it does not measure the extent to which a child fell back in his/her course of study nor other dimensions of school achievements.

The probability of falling back in the course of study was regressed on the hours worked predicted by the model described above and on a set of household characteristics like income, household composition, area of residence and education of the parents. We have also used different specifications in order to highlight the role played by the sector of work of the child and possible non-linearity in the effects of hours on school achievements. The results are shown in Table 9. Before discussing the effect of the hours of work, let us describe the role played by the other explanatory variables. The education of both the father and the mother reduces the probability of falling back in the course of study, even if the education of the mother is only marginally significant. This confirms the role played by maternal education as an input in the production of human capital (see Behrman et al. 1999). Father education might proxy an income effect, but also might reflect the role of father time as an input in the human capital accumulation. Income has also a negative effect, pointing to the importance of inputs other than time in the human capital production function. Being female increases the chances of falling back in the course of study. As we have no information on the time spent on household chores, the female dummy might be capturing the effect that girls are more likely than boys to spend time in that activity.

The increase in the hours worked significantly affects human capital accumulation. The results in column 1 show that an additional hour of work a day increases the probability of falling behind by just over 1.6 percentage point at the mean. As Fig. 1 shows the increment is rather steady at all the levels of hours, even if it tends to become smaller the higher the number of hours worked. We have disaggregated the hours worked by sector of activity of the child. After some preliminary testing on the equality of

coefficients, we selected the specification presented in column 2 and Fig 2. The cost in terms of human capital accumulation is higher if the child is employed in trade or manufacturing, smaller if employed in the other sectors (largely dominated by agricultural employment). In the former an extra hour of work increase the probability of falling back in the course of study by just over 2 points (at the mean), in the latter of about 1.5 points. Again the equation shows that increases are higher, even if marginally, for the initial hours of work rather than for the subsequent ones.

Overall the estimates show that the effects on human capital accumulation are not linked to the mere fact that a child is working but also depends heavily on the number of hours that s/he is working. As Figures 1 and 2 show, for a child working 3 hours the probability of falling behind in the course of study is 5 points higher than for a child working one hour. The estimates also indicate that the marginal cost in terms of human capital accumulation does not increase with the numbers of hours worked. In fact, if anything the estimates show the opposite: (marginally) decreasing marginal costs. As this result is important in terms of policy (it indicates that also a few hours of work can non trivially influence school outcomes) we have tried to further test for non-linearity in the effects of working hours on school achievements. We have employed various specifications of the hours in the estimates: quadratic, cubic, etc. all the estimates suggest that non linearities are present and that the marginal impact of hours is higher at low levels of hours worked. They also suggest that marginal effects increase when the number of hours worked becomes high. Unfortunately the estimates, even is suggestive of the result just described, are not very precise, mainly because of the difficulty in estimating coefficients with highly correlated variables. An example is reported in column 3 of table 9 where the regressors have been included, beside total hours, as two separate variables the hours worked respectively between 2.4 and 4 hours and above 4 hours[12]. The estimates show that up to 2.5 hours, one additional hour of work increases of about 3.8 points the probability of failing at school. From 2 to 4 hours the increase in the probability is negligible, and above for hours the increase is about 2.7 point for each additional hour. This is illustrated (after correcting the intercept) in Figure 3.

The results obtained show that the marginal cost in terms of human capital accumulation of the hours of work is not substantially different whether a child works just a few or many hours a day. In fact, there is some evidence that these costs are higher for "initial" hours of work. This indicates that not considering as child workers those children that work just a few hours a day

[12] The cut off points have been selected through a grid search procedure by looking at the log likelihood.

might be misleading, as the cost of these few hours of work is not negligible.

6.2 Nicaragua

The survey for Nicaragua contains more information than that on Pakistan on the education of the child. In particular, there is information also on the grade attended the previous year by a child currently at school. On this basis, it has been possible to build an indicator of school performance defined as the difference between the grade the child should be attending (according to his/her age) and the one s/he is actually enrolled in. We have used as dependent variables in the estimates a dummy variable taking the value of one if the child has lost at least one year of school and zero otherwise[13]. This indicator was then regressed on a set of explanatory variables similar to those used for Pakistan. Since the hours worked are endogenous, we used the predicted values to consistently estimate the impact of hours worked on school performance.

Table 10 contains the results of the estimates. An additional hour worked significantly increases the probability of having repeated at least one grade. The higher the quintile of income the child belongs to, the lower is the probability of failing at school. Children with more siblings and children living in rural areas have a higher chance of repeating at least one year. Girls appear to have better school performance than boys.

Parents' education has the expected negative effect on the probability of failing at school. The more the parents are educated the higher is the probability that the child is enrolled in the right grade. Mother's education affects more markedly than father's education the child's performance at school.

Figure 4 illustrates the relationship between the probability of failing at school and the hours worked, holding constant the other continuos variables at their means and the dummies variables at their mode. As for Pakistan, even a small number of hours worked affects significantly school performance. One hour of work a day has a strong impact on the school performance of the child increasing by almost 3.6 percentage points the chance of failing at school. The probability of having failed at least one grade increase by 10 points if the child works 3 hours and by more than 20 if s/he works 8 hours.

Information on the sector of activity is not available in this data set, therefore we were unable to compare the effects of hours worked in

[13] Similar results are obtained using the numbers of years that a child has lost or other indicators based on a transformation of this variable.

different sectors as we did for Pakistan. Other specifications were also used to test the non–linear effect of hours worked on school performance by using exponential and quadratic form functions of hours. The related estimates confirm the non linear relation between hours worked and school performance and highlight the larger impact of working hours at low levels of hours worked.

7. CONCLUSIONS

The literature on child labour has to some extent neglected to analyse the determinants of the hours worked by the children. The attention has been mainly devoted to the household decision to send the children to school and/or to work. The duration of the working day is, however, important to assess the impact of work on the human capital accumulation and on the child's health. Starting from a simple theoretical framework, we have derived and estimated a simultaneous equation system for estimating the household's decision relative to the school enrolment and to the hours worked by their children. The results show the importance of taking into account the simultaneity of the decision about schooling and hours worked in order to assess the importance and the role played by different explanatory variables. We have seen that the number of hours worked also depends on the (endogenous) decision whether or not to let the child attend school. The effects of the variables on the hours worked then depend also on the change they induce in the probability that a child is sent to school. In fact we have seen, that this latter "indirect" effects often dominates the direct one.

Moreover, the structure of the model we have estimated allow us to compute not only the "full" marginal effects described above, but also the marginal effects conditional on the latent variable indicating the "propensity" of the household to send the child to work or not. These marginal effects are very different among the two "groups" and show that policy action can have a different impact depending on whether the child is likely to be sent to work or not.

Finally, we have obtained consistent estimate of the effects of hours of work on human capital accumulation by regressing our indicator on school achievement on the hours of work predicted by our model and on other variables. The results of the estimates, based on an indicator of whether the child has fallen back during her course of study, indicates that the amount of hours worked are an important determinant of school achievements beyond the fact that the child participates in economic activities. These effects are far from negligible, as a few hours of work per day increases the probability of falling back in the course of study of about 10 per cent. Hours of work have an effect that is not increasing; if anything the first hours of work have a larger impact on school achievements than the successive ones. This indicates that the assumption often made that a few hours of work only have negligible effects on human capital accumulation is not supported by the evidence, at least in the case of Pakistan and Nicaragua. A different issue is whether the changes induced in school achievements are "large". This has implications in terms of policy interventions. If the loss due to child work is not large in terms of human capital accumulation, then school

enrolment rather than child work itself should be targeted (at least as far as the effect of child labour on human capital accumulation is concerned). More evidence and the use of a larger set of indicators are necessary to deal with such an issue.

Table 6. Descriptive statistics

Variables	Pakistan		Nicaragua	
	Mean	Standard deviation	Mean	Standard deviation
	(1)	(2)	(1)	(2)
Weekly hours worked	*15.72*	*20.74*		
Daily hours worked			0.68	2.11
Weekly hours worked if working	35.29	16.59		
Dailly hours worked if working			5.94	2.77
Age	10.14	2.780	9.82	2.58
Hh size	8.46	3.54	7.74	2.99
Babies	1.38	1.30	3.13	1.45
Children	3.55	1.48	1.04	1.07
HH (net) income	2968.34	2588.09		
HH income			4779.45	5894.62
Female	0.389	0.487	0.49	0.50
Rural	0.435	0.496	0.55	0.50
Father education: primary	0.267	0.442	0.42	0.49
Father education: secondary or more			0.19	0.40
Mother education: primary	0.053	0.225	0.44	0.50
Mother education: secondary or more			0.16	0.37
Fail rate	0.706	0.455	0.79	0.40
Fail rate for enrolled children aged 10 or more	0.667	0.471	0.73	0.44
Number of observations	27512		4278	

Note: children aged 5-14 and aged 6-14 are the sample considered for Pakistan and Nicaragua, respectively

Table 7. ML estimates of enrolment and hours worked. Pakistan

	Enrolment		Hours*					
			(a)	(b)			(c)	(d)
	Parameter	p value	Marginal effect| working	Marginal effect| not working	Parameter	p value	Total marginal effect| enrolled	Total marginal effect| not enrolled
Age	0.592	0.000	0.335	0.207	23.634	0.000	-1.273	-3.454
age2	-0.033	0.000	-0.008	-0.018	-0.770	0.000	0.269	0.365
Hhsize	0.038	0.000	-0.090	2.631	0.344	0.002	-0.488	-0.572
Children	0.023	0.011	-0.071	0.058	-3.495	0.000	-0.016	-0.015
Babies	-0.051	0.000	0.034	-0.055	1.268	0.000	1.259	1.292
Babyf	-0.127	0.000	0.061	-0.122	1.882	0.000	2.694	2.837
HH income /1000	0.032	0.000	-0.005	0.025	0.091	0.250	-0.484	-0.547
Female	-0.375	0.000	-0.121	-0.226	-31.829	0.000	-7.888	-12.383
rural	-0.048	0.004	-0.016	-0.025	-1.701	0.000	-0.611	-0.957
Eduf	0.620	0.000	0.240	0.229			1.179	0.499
Edum	0.460	0.000	0.171	0.180			0.895	0.258
Enrolment ( )					-8.2341	0.000		
Constant	-2.899	0.000			-140.342	0.000		

Total observations: 27512, sigma error: 0.052 (p-value:0.000); covariance errors:-0.091 (p-value 0.00).

Dependent variable: weekly hours worked/100.

First column indicates the parameter corresponding to each regressor, the second the p-value. The third and fourth column refers to the hours equation and show the marginal effect of each regressor conditioned to enrolment=1 and enrolment=0 respectively.

The standard errors of the marginal effects (col a, b, c, d) are not reported as all the marginal effects were found significant at 5% level.

Table 8. ML estimates of enrolment and hours worked. Nicaragua

Nicaragua	enrolment		hours					
			(a)	(b)			(c)	(d)
Regressors	parameter	p value	Tot effect| working	tot effect| not working	parameter	p value	Tot effect| enrolled	Tot effect| not enrolled
Age	0.788	0.000	0.465	0.193	6.479	0.000	4.951	-2.328
age2	-0.041	0.000	-0.012	-0.010	-0.235	0.000	-0.108	0.157
Hhsize	0.025	0.061	-0.067	0.005	-0.462	0.001	-0.811	-0.300
Children	-0.049	0.035	0.071	-0.010	0.413	0.091	0.875	0.423
Babies	-0.136	0.000	0.146	-0.030	0.734	0.031	1.835	1.036
Babyf	-0.068	0.096	-0.041	-0.017	-0.568	0.185	-0.439	0.198
HH income /1000000	17.980	0.001	0.329	4.242	63.700	0.140	-9.138	-81.890
Female	0.222	0.001	0.013	0.051	-5.218	0.000	-0.819	-1.090
Rural	-0.443	0.000	-0.144	-0.146	1.300	0.075	0.437	0.617
Eduf primary	0.267	0.000	0.096	0.077			-0.111	-0.145
Eduf secondary	0.486	0.000	0.169	0.130			-0.202	-0.254
Edum primary	0.346	0.000	0.123	0.097			-0.144	-0.185
Edum secondary	0.578	0.000	0.199	0.148			-0.241	-0.297
Constant	-2.914	0.000			-44.786	0.000		
Enrolment ( )					-4.120	0.000		

Total observations: 4278 sigma error: 66.703 (p-value:0.000); covariance errors: 1.773 (p-value 0.00). Dependent variable: daily hours worked.

First column indicates the parameter corresponding to each regressor, the second the p-value. The third and fourth column refers to the hours equation and show the marginal effect of each regressor conditioned to enrolment=1 and enrolment=0 respectively.

The standard errors of the marginal effects (col a, b, c, d) are not reported as all the marginal effects were found significant at 5% level with the exception of expenditure and babyf in the hours equation for those who go to school and expenditure, babyf and female in the enrolment equation for those who work.

Table 9. Probit Estimates of failing rate at school. Pakistan

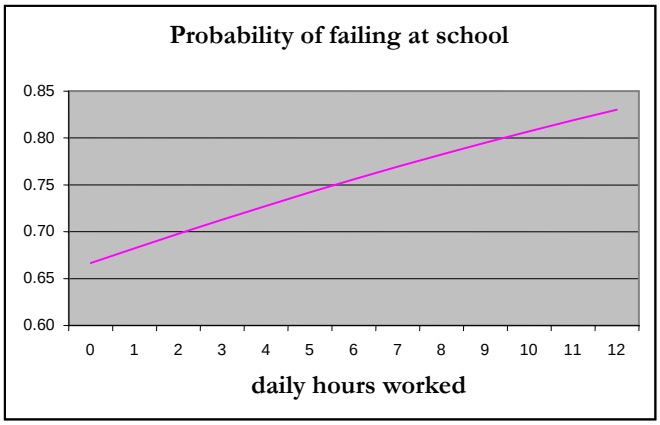
	probability of failing at school		
Hours predicted	0.044		0.105
	(3.58)**		(1.83)*
Hours>2.5 &<4			-0.102
			(-1.73)*
Hours>4			-0.031
			(-0.53)
Hours* trade & manifact		0.059	
		(3.72)**	
Hours*agricolture constr & community		0.042	
		(3.12)**	
Incnet	-0.026	-0.027	-0.029
	(-2.73)**	(-2.73)**	(-2.95)**
Hhsize	0.031	0.031	0.022
	(3.25)**	(3.20)**	(2.20)*
Children	-0.017	-0.016	0.02
	(-0.78)	(-0.71)	(0.85)
Female	0.141	0.154	0.105
	(2.61)**	(2.85)**	(1.79)*
Rural	-0.079	-0.09	-0.06
	(-1.85)*	(-2.01)*	(-1.4)
Educ father	-0.176	-0.182	-0.218
	(-4.02)**	(-4.14)**	(-4.86)**
Educ mother	-0.13	-0.129	-0.145
	(-1.83)*	(-1.83)*	(-2.04)*
Constant	0.313	0.309	0.292
	(4.36)**	(4.28)**	(4.03)**
Observations	4195	4195	4195

Absolute value of z-statistics in parentheses

* significant at 5% level; ** significant at 1% level

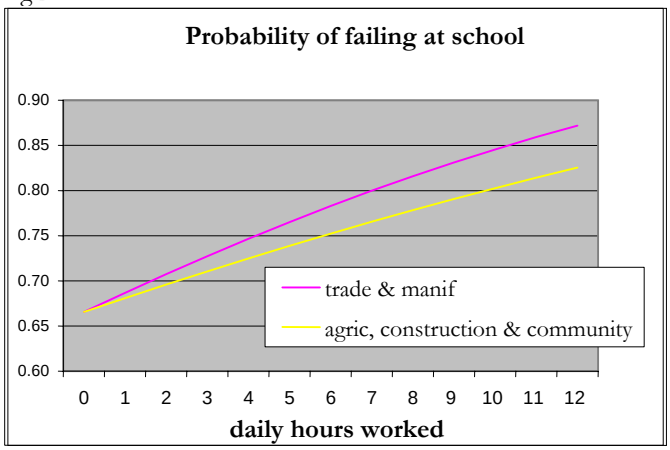
daily hours worked	Prob of failing
0	0.667
1	0.682
2	0.698
3	0.713
4	0.728
5	0.742
6	0.756
7	0.769
8	0.782
9	0.795
10	0.807
11	0.819
12	0.830

Fig 1



daily hours worked	trade & manif	agric, construction & community
0	0.666	0.666
1	0.687	0.681
2	0.707	0.696
3	0.727	0.710
4	0.747	0.725
5	0.765	0.739
6	0.783	0.752
7	0.800	0.766
8	0.816	0.778
9	0.831	0.791
10	0.846	0.803
11	0.859	0.814
12	0.872	0.825

Fig 2



daily hours worked	Prob of failing
0	0.675
1	0.711
2	0.746
3	0.763
4	0.764
5	0.785
6	0.806
7	0.825
8	0.843
9	0.859
10	0.874
11	0.888
12	0.901

Fig 3

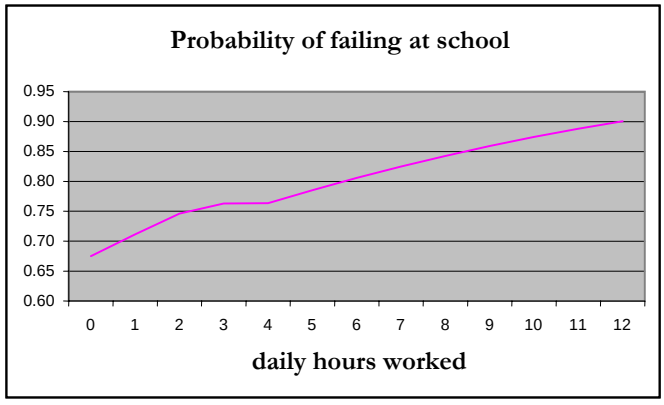


Table 10. Probit estimates of failing rate at school. Nicaragua

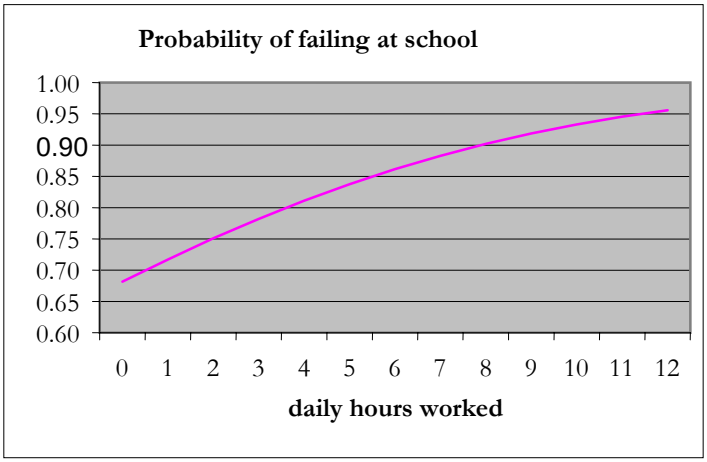
	probability of failing at school.
hours predicted	0.029
	(3.26)**
quintile 2	0.001
	(0.05)
quintile 3	-0.055
	(-2.03)*
quintile 4	-0.08
	(-2.67)**
quintile 5	-0.123
	(-3.41)**
Hhsize	0.004
	(-0.97)
Children	0.044
	(5.42)**
Female	-0.063
	(-3.94)**
rural	0.049
	(2.80)**
edu father: primary	-0.069
	(-3.23)**
edu father: more than primary	-0.173
	(-5.90)**
edu mother: primary	-0.085
	(-4.12)**
edu mother: more than primary	-0.181
Observations	

Absolute value of z statistics in parentheses

* significant at 5%; ** significant at 1%

hours worked	probability of failing
0	0.681
1	0.717
2	0.751
3	0.782
4	0.811
5	0.838
6	0.861
7	0.883
8	0.902
9	0.918
10	0.933
11	0.945
12	0.956

Fig 4



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