Land, Child Labor, and Schooling: Longitudinal evidence from Colombia and Mexico

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Abstract

Several studies find that child labor incidence is higher in households with larger land holdings. The existence of this "wealth paradox" has been explained as the consequence of simultaneous imperfections in the land and labor markets. This work shows that although rural households in Colombia and Mexico seem to exhibit this same positive relationship between land and child labor, the wealth paradox disappears when individuals are evaluated using longitudinal data. A possible explanation for this is that the omission of idiosyncratic household preferences regarding schooling, child labor and land holdings in cross-sectional data analysis leads to an overestimation of the effect land has on these outcomes.

Resumen

Varios estudios encuentran que la incidencia del trabajo infantil es mayor en los hogares con mayor tenencia de tierras. La existencia de esta "paradoja de la riqueza" se ha explicado como consecuencia de imperfecciones simultáneas en los mercados de tierra y trabajo. Este trabajo muestra que aunque los hogares en Colombia y México parecen presentar esta misma relación positiva entre la tierra y el trabajo infantil, la "paradoja de la riqueza" desaparece cuando los individuos son evaluados usando datos longitudinales. La principal hipótesis del autor sobre la posible explicación para esto es que las preferencias idiosincráticas de los hogares con respecto al trade-off entre la escolarización y el trabajo infantil no son observables en el análisis de datos transversales conduce a una sobreestimación del efecto que la tierra tiene en estos resultados.

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Tierras, trabajo infantil y escolaridad: evidencia longitudinal de Colombia y México

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I. Introduction

The main decision-making model about child labor (Basu & Van, 1998) formalizes an intuitive idea: The central driver of child labor is poverty inside the household. Parents do not make their children work if they can avoid it, and only when income is below a minimum threshold are children in the household forced to work. Evidence that supports this assumption is abundant (Ray, 2000; Basu & Tzannatos, 2003; Edmonds, 2005; Edmonds & Pavcnik, 2005).

However, several studies in various developing countries (Bhalotra & Heady, 2003; Dumas, 2007; Boutin, 2012; Gáfaro, Ibáñez & Zarruk, 2012) find that land-rich households are both more likely to have their children working and less likely to send them to school, and that average time spent in labor is increasing with land size. These findings challenge the presumption that child labor occurs almost exclusively in the poorest households, since land is strongly correlated to household income (Winters *et. al.*, 2009).

This "wealth paradox" has been explained as the consequence of simultaneous imperfections in the land and labor markets: On the demand side, households who face a less than fully functioning labor market and thus have high transaction or monitoring costs when trying to hire external workers have an incentive to use the labor of their children. This incentive is stronger as land holdings increase in size because the marginal productivity of labor is itself larger. If households cannot compensate this failure in the labor market by adjusting the land size they operate through sale or rent of land, the positive land-child labor relationship may arise (Bhalotra & Heady, 2003).

Regarding the supply of child labor, Basu, Das & Dutta (2010) argue that those households who would find it optimal to have their children working a positive amount of time may be demand-constrained if sending their children to work somewhere else is not possible.[1] In this scenario, these households can only employ their children's labor if they have land, and the amount of labor they use can only be high if land holdings are relatively large. In both the demand and supply driven cases, the observed result is that households with more land are more likely to make their children work, and to do so for longer hours.

This work studies the relationship of land wealth with child labor and schooling using data from two separate longitudinal surveys for Colombia and Mexico. In contrast to other studies (Boutin, 2012; Dumas, 2007; Nkamleu & Kielland, 2005; Bhalotra & Heady, 2003), which observe only cross-sectional data, it develops a fixed effect panel

[1] Due, for example, to laws banning child labour.

estimation of the relationship between these variables in rural households. Results show that even though the wealth paradox is observed as well in these countries when data is analyzed cross-sectionally, the strong positive correlation between land size and the amount of child labor is no longer present when changes through time are observed for the same group of individuals. Furthermore, the negative relationship between land size and school attendance observed in cross-sectional estimates for Colombian households becomes positive when longitudinal data is used.

These results suggest that market failures alone may not be the only factor responsible for the existence of the positive relationship between land and child labor observed in several developing countries. They are consistent with an alternative hypothesis, which argues that idiosyncratic parental preferences over land, agricultural labor, and schooling -which simultaneously influence the land holding and child labor levels- are as well relevant in explaining the presence of this phenomenon in the data.

Although the type of empirical strategy carried out in this work cannot account for all potential sources of endogeneity in land distribution across households, and it thus cannot be claimed that the causal effect of land on the outcomes of interest is estimated, the inclusion of household fixed effects does correct the confounding effect that specific unobservable characteristics at the household level have. The fact that results show that controlling for these characteristics is indeed relevant, provides evidence that questions the causal nature of cross-sectional estimates.

Following this introduction, section II. illustrates the conceptual framework under which both types of hypothesis are set. Section III. describes the Colombian and Mexican datasets from which information on rural households is obtained. Section IV. presents the econometric specification used in the estimations. Section V. shows and discusses the results obtained and section VI. concludes.

II. Conceptual Framework

Numerous studies show that the agricultural sector tends to have imperfect labor and land markets. For example, Shaban, (1987), or Foster & Rosenzweig, (1994) show that external labor tends to be inefficient relative to household labor due to the high monitoring costs related to agricultural activities. Arguing that these two types of labor are not perfect substitutes, Jacoby, (1993) presents data on how marginal productivity of household labor in the Peruvian Sierra is significantly higher than market wages. Discussion on the many causes and evidences found for less than fully flexible land markets can be found in Binswanger, Deininger & Feder, (1995).

If these two markets are simultaneously incomplete, the total effect on child labor of an increase in the household land holdings is theoretically unclear

(Dumas, 2013). An increase in land would have two opposite forces affecting the decision to put a child to work: There is an income effect linked to the increase in the net asset position of the household, which tends to reduce child labor (because the household is effectively richer, it can afford to offer less of it). There is as well a substitution effect, based on the fact that because now the land / labor ratio is higher, the marginal productivity of labor increases; since labor markets are not well functioning, employing family members is preferable to hiring external workers, and therefore the opportunity cost of not employing children from the household rises.[2]

The fact that data from various developing countries around the world shows that the relationship between land size and child labor is positive would imply that, for the majority of households in each country, the substitution effect tends to be stronger. Why this effect would be consistently stronger is unclear. One possibility, described by Dwibedi & Marjit, (2015) argues that relative, rather than absolute, income disparities within communities could be the main driver of the decision to put a child to work. The authors hypothesize that if a household's income increases but does so at the same or at a slower rate than that of its peers, the income effect is reduced and thus child labor in the household may not decrease.

Basu, Das & Dutta, (2010) argue that when landholdings are sufficiently large, households should be rich enough not to need the use of child labor at all. They explicitly model an imperfect labor market and show that an increase in the land holdings of a household should have a positive effect on the amount of child labor only until a turning point after which the effect starts becoming negative. The relationship of child labor with land should thus be increasing for relatively small landholdings but decreasing after land size reaches a threshold. To validate their formulation they use data from a cross-sectional survey for households in northern India, with information on the number of hours worked, and find that the relationship is indeed that of an inverted-U. They estimate that, on average, the turning point after which these households are sufficiently land rich for the income effect to start dominating is around 4 acres of land per household. The fact that this turning point is significantly higher than the average landholdings in the sample is consistent with the overall negative relationship

[2] This kind of trade-off –where the households' income increases simultaneously with the marginal productivity of child labor– has also been studied for a broader set of economic activities: Nardinelli, (1990) finds no relationship in child labor participation rates for nineteenth century Britain even when regional variations in wages were large. Santos, (2013) and Kruger, (2007) study this trade-off with variations in gold and coffee prices respectively. Edmonds & Turk, (2004) find that households in Vietnam who open a non-farm business are more likely to have their children working. On the macroeconomic level, Kambhapati & Rajan (2005) show that child labor participation rates are positively associated with increases in state-level economic growth in India.

observed: Most households are in a point of the inverted-U where the substitution effect is still larger.

This and other models rely on the assumption that land markets in developing countries are nearly non-existent and therefore landholding variations between households can be taken as exogenous initial endowments. If, however, land variations depend at least partially on active decisions by the household, additional factors may be influencing the observed relationship between land and child labor. The decisions to send a child to work and to acquire and operate land could be both at least partly determined by preferences associated to the value each household assigns to agricultural work relative to other activities such as schooling. If this is so, the positive correlation between land size and child labor would be -at least partially- caused by selection bias: Households that have a higher preference for land will more actively engage in increasing their land holdings while, simultaneously, those preferences will cause that children from these households have a higher probability of working and of doing so for longer hours. The observation that land-rich households tend to have more children working would not be then a consequence of the effect land has on child labor, but of the effect preferences have on both outcomes separately. A simple decision model that more rigorously presents the trade-offs faced by the household is laid out in the appendix.

Taking into consideration differences in parents' intrinsic preferences respective to child leisure, schooling and labor time use, Fan (2011) formally models the idea of how variations in preferences can place otherwise identical households on different child labor levels. Empirically, using the same data from Bhalotra & Heady, (2003), Lima, Mesquita & Wanamaker (2015) find that the positive correlation observed between land and child labor is only present in the upper quantiles of the average hours of work distribution. They argue that these results are consistent with the hypothesis that parental preferences are the main cause of the land wealth paradox phenomenon: Children from households where aversion to child labor is lower will work more when land holdings increase, whereas those from households with high aversion, faced with the same increase in land, will tend to work less. Although the authors frame the problem as that of differences in parent altruism towards their children, it could be that these differences in aversion levels towards child labor are ultimately motivated by variations in the perceived expected returns of farm labor relative to schooling. Households who prefer land (over other assets) may also prefer that their children learn from work experience rather than in a classroom.

There is a testable implication of this proposition. If preferences do matter -and the assumption that they remain constant over long periods of time is correct-, the results obtained with a fixed effects panel estimation at the individual level would wipe out their influence and thus show significantly different magnitudes for estimated parameters of land

on child labor. If, instead, they do not, estimates of this kind of regression should remain fairly similar to the cross-sectional ones.[3]

This work shows that, both for Colombian and Mexican rural households, these two types of estimates are significantly different from each other. A possible explanation for this divergence in results may lie in the inability cross-sectional estimates have in separating the true effect of land variations on child labor from the effect that unobserved preferences have both on child labor and land holding decisions. This implies that the net effect land has on child labor will be overestimated when analyzed in only one period of time and that the wealth paradox may not be truly caused by the household's land levels. The estimates presented in this work suggest instead that an increase in land is related, on average, with no significant increase in child labor. Furthermore, estimations on the school attendance rate suggest that -at least for Colombian households- increases in land size are related to higher school attendance rates.

III. Data

This work draws information from two separate and relatively recent longitudinal surveys carried out in Colombia and Mexico respectively. Longitudinal surveys have become an important tool to study various dynamics in developing countries and few studies of child labor determinants have been done using this kind of data. Additionally, studies related to the land-child labor relationship for Latin America are scarce and thus a comparative exploration of the similarities and differences between these two countries could be useful for policy debates in this specific region.

A. ELCA

ELCA is a longitudinal survey for Colombian households carried out by Universidad de los Andes. The rural sample is representative of four regions within the country and collects information on a broad set of dimensions. At baseline, rural households in the sample are located in 17 different municipalities, which are themselves divided into 224 smaller communities. Data for two different time periods are available for 1,943 children, from 1,483 different households. Children's age at baseline in 2010 varies between 5 and 9. Information on schooling attendance, workforce participation and average weekly hours spent working is available. Information on these variables for each child in the household is reported either by the household head

[3] There is no reason to believe that the market failure and the preference hypotheses are mutually exclusive. It is possible that, while each household's particular beliefs or perceptions on the expected future returns of land relative to human capital play a role in its decision towards schooling and child labor decisions, high transaction costs in the labor and land market are also distorting its otherwise optimal decision.

or its spouse, and a child is classified as working if he has been "working or helping anyone in work for at least an hour" (not considering household chores) in the past week.

Although data on domestic chores both outside and inside the house -such as taking care of younger siblings, washing, cooking, tending to the family orchard, collection of firewood or water- is available both on the intensive and extensive margins in the survey; and even though these type of duties are an important component of child labor (Cigno and Rosati, 2005) and should be included in calculations, differences in the questionnaire for both periods make comparisons impossible and are thus not considered in the child labor definition used for estimations. Real child labor prevalence may be therefore underreported in the sample.

ELCA's rural component was intended to target small agricultural landowners specifically. Thus, the survey contains detailed information on land use and type of tenure. Following previous studies on the subject, households' land holdings are defined as total land used over any form of tenancy is claimed minus any area of land belonging to the household that has been rented to someone else.[4]

B. MxFLS

The Mexican Family Life Survey (MxFLS) is a nationally representative longitudinal survey started in 2002, developed by the Iberoamerican University (UIA) and Center for the Economic Research and Teaching (CIDE) in collaboration with researchers from Duke University. Data for 1,838 children from rural areas with ages 6 to 12 at baseline and 8 to 14 at the first follow-up in 2005-2006 is available. As in ELCA, information on schooling attendance, workforce participation and average weekly hours spent working is available. A child is also classified as working if he has been "working or helping anyone in work for at least an hour" in the past week or if he has spent more than an hour helping in agricultural related jobs in the household's farm. Since MxFLS was not specifically designed to survey landowners, different land tenancy arrangements are not asked for in detail. Land holdings are thus defined as the sum of total land declared as owned and other land declared as being used.

Additionally, given that the main objective of this work is to study the relationship between land holdings and child farm labor, estimations are done on agricultural work only, and children engaged only in other types of work -such as non-

[4] The survey makes a distinction between several types of tenancy (formal and informal ownership, possession, occupation, sharecropping, usufruct, etc.). Estimates using alternative definitions of land holdings -such as using only plots with self-reported ownership, or adding plots rented out to other households- are qualitatively the same.

agricultural wage labor, or self-employment in other businesses- are not considered as 'working'.[5]

For both surveys, the sample used corresponds to those children in rural households who were surveyed both at base line and at follow up. Two sources of selection between waves are therefore present: first, attrition may be non-random and households who could not be resurveyed at follow up may be systematically different in one or more characteristics to those who were. Second, households who migrated from rural areas to urban ones between surveys are not considered in estimations and may be themselves systematically different to those who did not migrate. Table A1 in the appendix shows statistics for differences between both groups and the final sample for both surveys.

The table shows that both for ELCA and MxFLS, the attrition and the migrant groups are indeed significantly different from the sample in several observable characteristics, and therefore the external validity of the results shown is disputable. Estimations should therefore be considered only valid for the specific group of households who did not make the decision to migrate to an urban area, and whom interviewers where able to recontact and resurvey at follow-up.

Table 1 shows summary statistics on schooling, labor and land for each wave of both surveys. School attendance rates are in all cases very high, the lowest of which (94% for MxFLS-II) is related to the higher average age -and thus higher dropout rate- of children surveyed. Workforce participation rates are also increasing with age, and -particularly for ELCA- consist almost entirely of agricultural labor. The fact that practically all children engaged in work are also attending school is consistent with the observation (see, for example, Ravaillon & Wodon, (2002)) that these two activities are not full substitutes and rarely displace each other. This also underlies the importance of estimating the potential effects land may have on child labor in the intensive margin.

Two important differences between both surveys are shown in Table 1: first, as mentioned earlier, ELCA was specifically designed for small landholders and therefore land access rates are significantly higher to those observed in the nationally representative MxFLS[6]. Although this work focuses on agricultural households, the fact that ELCA has few rural households who do not have -or choose not to have- access to land makes it difficult to analyze the effect of land holdings on the extensive margin. The more even distribution in MxFLS of

[5] Estimations done including these types of workers do not, however, produce significantly different results.

[6] There is substantial variation in the plot land size for both waves of the MxFLS database. 24 land plots in 2002 and 22 land plots in 2005 with sizes equal or above 1000 hectares were not considered in the sample.

Table 1
SUMMARY STATISTICS FOR EACH SURVEY

	ELCA - I	ELCA - II	MxFLS - I	MxFLS - II
Observations	1,943	1,943	1,838	1,838
Age	7.09	10.09	8.55	11.63
	(1.41)	(1.44)	(1.68)	(1.67)
Percentage Female	49.46	49.46	50.27	50.27
Percentage School Attendance	96.71	98.56	97.44	93.73
Percentage Work (Any)	3.96	7.72	8.16	13.82
Percentage Agricultural Work	3.55	7.26	7.48	10.66
Percentage Work and School	3.86	7.41	8.05	12.08
Percentage Household has land	86.10	86.88	38.68	32.23
Land Size (ha)	1.92	2.29	8.70	7.71
	(3.30)	(6.32)	(27.52)	(25.87)

Standard deviations in parentheses. Data for rural areas only. Data for ELCA survey cover 5 to 9-year-olds in the first survey and 8 to 12-year-olds in the second. Data for MxFLS cover 6 to 12-year-olds in the first survey and 9 to 14-year-olds in the second. Figures for average land holdings are only over households who have land.
Source: Own calculations based on ELCA and MxFLS.

households with and without land makes it possible to analyze the relationship between having or not having land -rather than the amount of land held- and child labor and schooling outcomes.

The second difference is that the age range in MxFLS surveys is broader than the one in ELCA. While kids in the Colombian survey are between 5 and 9 years old at baseline, MxFLS children are between 6 and 12. This broader range makes it possible to make estimations on older kids (up to 14) and to divide the cohort into a younger and older subsample and look for any heterogeneous effects dependent on age group.

Because this work estimates a fixed effect model where the main independent variable is the difference in land size within the household, it is important that there is enough variation in this variable between both waves of each survey. Table 2 shows that a considerable proportion of households change their level of landholdings, and that, even though average land size variations are centered around zero, the variance of this changes is large.

Differences in work and schooling outcomes by land tenancy and household size range are shown in Table 3. With the exception of ELCA-I, all surveys show significantly higher rates of child labor participation in households who have land, suggesting the presence of the wealth paradox in both countries. Schooling attendance rates are only significantly lower in households who have land

Table 2

LAND SIZE VARIATIONS BETWEEN WAVES

	ELCA	MxFLS
Percentage Households who change landholding area	85.02	38.68
Average land area variation between baseline and follow-up	0.23	-0.89
	(5.50)	(18.60)

Standard deviations in parentheses. Land variation figures in hectares.
Source: Own calculations based on ELCA and MxFLS.

Table 3

SCHOOL AND LABOR PARTICIPATION RATES BY LAND SIZE

	Land Tenure		Land Size		
Colombia	**Has Land = 0**	**Has Land = 1**	**Under 1ha**	**Between 1 and 3 ha**	**Over 3ha**
ELCA - I					
Number of Individuals	270	1,673	962	420	291
Percentage School Attendance	97.4	96.6	96.1	96.7	98.3
Percentage Work	4.4	3.9	4.1	3.6	3.8
Weekly Work Hours	2.58	5.34 *	4.92	6.33	5.45
	(1.98)	(5.39)	(5.37)	(6.69)	(3.39)
ELCA - II					
Number of Individuals	255	1,688	985	390	313
Percentage School Attendance	98	98.6	99.5	97.4	97.4
Percentage Work	4.3	8.2 ***	6.5	9.7	11.8
Weekly Work Hours	5.55	7.09	6.63	6.08	8.95
	(5.56)	(6.36)	(6.05)	(5.02)	(7.77)
Mexico					
MxFLS - I					
Number of Individuals	1,127	711	279	164	268
Percentage School Attendance	98.0	96.6 *	96.4	98.8	95.5
Percentage Work	4.6	11.8 ***	12.55	10.37	11.94
Weekly Work Hours	20.28	15.54	12.57	19.38	16.88
	(24.35)	(22.15)	(20.2)	(28.38)	(21.02)
MxFLS - II					
Number of Individuals	1,243	591	234	174	183
Percentage School Attendance	93.6	93.9	93.6	92.5	95.6
Percentage Work	7.2	17.8 ***	18.1	19.2	16.6
Weekly Work Hours	24.84	17.48 **	16.22	19.32	17.10
	(24.09)	(21.21)	(21.9)	(21.70)	(20.26)

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard deviations in parentheses. Data for rural areas only. "Work" figures are restricted to agricultural labor. Weekly work hours are reported averages, conditional on the child's participation in farm labor.
Source: Own calculations based on ELCA and MxFLS.

in MxFLS-I, whereas average working hours are only significantly higher for households who have land in the first wave of the ELCA. A puzzling fact observed in the MxFLS survey is that, even though differences are not statistically significant, farm work hours for children in households who do not own or use land are on average higher than those who do. A tentative explanation for this fact could be that children who are engaged in farm labor and come from households who do not have land are probably agricultural wage-laborers on external farms and are therefore subject to longer hours compared to children who work on the family farm and where their work may be required more sporadically.

When disaggregated by land size ranges, data for the MxFLS survey and, to a lesser extent, ELCA-I, suggest that the kind of non-linearities in the number of hours worked hypothesized by Basu, Das & Dutta (2010) -increasing up to a point after which the household is rich enough to start decreasing the labor required from its children- do exist. Figures 1 and 2 in the appendix show a set of non-parametric regressions of land size on working hours, analogous to those presented by these authors, which indeed seem to show that this relationship has the shape of an inverted-U in cross-sectional data.

IV. Econometric Specification

To estimate the relationship between land, child labour supply and schooling attendance, two different sets of regressions are considered. First, three dependent variables -school attendance, labour participation and average weekly work hours- on a single time period are regressed against the independent variable of interest (land area (A)) and a set of individual and household level controls. Since the relationship between these variables is not expected to be lineal, the squared of land size is also included. The equation estimated is

$$y_{ihm} = \beta_0 + \beta_1 A_h + \beta_2 A_h^2 + X_i'\beta + C_h'\beta + \delta_m + \varepsilon_i \qquad (1)$$

Where y_{ihm} is the outcome of interest for child i in household h at municipality / community m; X_i is a set of individual level controls which include sex, age and biological relationship to the household head; C_h is the set of household level controls which include number of children in the household, age distribution of household members[7] and educational level of household head. Finally, δ_m is a geographic fixed effect, which serves the purpose of accounting for specific characteristics of local labor and land markets, and ε_i is the specific idiosyncratic error term. If, as hypothesized by Lima, Mesquita & Wanamaker (2015) the decision to send

[7] Considering male labor may be more appreciated in farm activities, additional estimations where carried out controlling specifically by the number of male individuals in each age group within the household. Results are identical in both cases.

the child to work is influenced by unobservable parental preferences over schooling importance relative to labour, estimation of equation *(1)* will produce biased estimators due to omitted variable bias. Specifically, if a higher preference towards schooling respective to child labor is simultaneously -and negatively- affecting the amount of land area used, the main parameters of interest (β_1 and β_2) in equation *(1)*, and thus the effect of land on the child labor outcomes is being overestimated.

Under the assumption that these preferences do not change over time, the use of panel data offers an opportunity to assess the omitted variable bias in equation *(1)*. By carrying out a fixed effects estimation of the different outcomes at two different periods, it is possible to remove the effect of any unobserved variable that remains constant through time.

The equation for this fixed effects specification is

$$\Delta y_{ihm} = \beta_0 + \beta_1(\Delta A_h) + \beta_2(\Delta A_h^2) + \beta_3 \Delta C_h + \delta_{m,t} + \varepsilon_i \quad (2)$$

Where, $\Delta y_{ihm} = (y_{ihm,t+1} - y_{ihm,t})$

$\Delta A_h = (A_{h,t+1} - A_{h,t})$

And *(t, t+1)* are respectively the baseline and follow-up values of each survey. The set of controls $\Delta C_h = (C_{h,t+1} - C_{h,t})$ includes changes in the number of household members distributed by different age ranges, changes in the kinship of the child to the household head, and a dummy for households who migrated to another community or municipality between both surveys. Additionally, $\delta_{m,t-1}$, a fixed effect for the state, municipality or community level at baseline is included, to account for any geographical specific time-dependent change.

Estimation of equation *(2)* thus shows how the differences -between baseline and follow-up- in the independent variables are associated with the differences in the outcomes of interest. If preferences were not relevant in the relationship between land and children's time allocation, equations *(1)* and *(2)* should be expected to produce fairly similar estimates.

V. Results

Table 4 presents the main results for the OLS[8] regressions of equations *(1)* and *(2)* for child labor participation. The table is divided into three parts, each showing the coefficients for the land size variables at baseline, follow-up, and the panel estimation respectively. Parameters calculated with an identical specification are those under the same column -(I) to (VI)- and are thus comparable to each other. Tables showing results for hours worked and school assistance (Tables 5 and 6) have the same format.

[8] Estimations using logit models where carried out and produce similar results.

Table 4

SCHOOL AND LABOR PARTICIPATION RATES BY LAND SIZE

	ELCA - I			MxFLS - I		
1.	**(I)**	**(II)**	**(III)**	**(IV)**	**(V)**	**(VI)**
Land Hectares	-0.0105	0.00009	-0.0162	0.000421	0.0399 ***	0.0284 **
	(0.00841)	(0.0211)	(0.0215)	(0.00347)	(0.0118)	(0.0116)
Land Hectares^2		-0.00554	0.00103		-0.000221 ***	-0.000154 **
		(0.00698)	(0.00700)		(0.00006)	(0.00006)
Observations	1,943	1,943	1,943	1,838	1,838	1,836
Household & Individual Controls	No	No	Yes	No	No	Yes
Geographic Fixed Effects	No	No	Yes	No	No	Yes
	ELCA - II			**MxFLS - II**		
2.	**(I)**	**(II)**	**(III)**	**(IV)**	**(V)**	**(VI)**
Land Hectares	0.0181	0.0827 ***	0.0892 ***	-0.000618	0.0445 ***	0.0271 *
	(0.0116)	(0.0274)	(0.0277)	(0.00477)	(0.0165)	(0.0165)
Land Hectares^2		-0.00884 ***	-0.00929 ***		-0.000251 ***	-0.000168 *
		(0.00274)	(0.00271)		(0.00009)	(0.00009)
Observations	1,943	1,943	1,943	1,838	1,838	1,836
Household & Individual Controls	No	No	Yes	No	No	Yes
Geographic Fixed Effects	No	No	Yes	No	No	Yes
	ELCA - Panel			**MxFLS - Panel**		
3.	**(I)**	**(II)**	**(III)**	**(IV)**	**(V)**	**(VI)**
Δ Land Hectares	-0.0125	-0.0435	-0.0376	-0.00149	0.0152	0.0154
	(0.00974)	(0.0286)	(0.0279)	(0.00463)	(0.0158)	(0.0158)
Δ Land Hectares^2		0.00408	0.00299		0.00009	0.00009
		(0.00267)	(0.00265)		(0.00009)	(0.00008)
Observations	3,886	3,886	3,886	3,650	3,650	3,650
Household & Individual Controls	No	No	Yes	No	No	Yes
Geographic Fixed Effects	No	No	Yes	No	No	Yes

*** p < 0.01, ** p < 0.05, * p < 0.1. Robust standard errors in parentheses. Household controls are household head education level, number of household members by age range, and a dummy for migration. Individual level controls are age, gender and relationship to the household head. Geographic fixed effects are at the municipality (17) and state (16) level for Colombia and Mexico respectively. Panel regressions also include a fixed effect for each household's geographical unit at baseline.
Source: Own calculations based on ELCA and MxFLS.

Excluding ELCA-I, which does not show a statistically significant relationship among these variables, when taken as separate cross-section surveys, both MxFLS waves and ELCA-II show the presence of the land wealth paradox for both countries in the form of a strongly significant positive relationship of land size to child labor prevalence. The negative sign of the land size squared term also shows that this relationship is non-linear and tends to have an inverted-U shape. These results are consistent with those observed in several other developing countries like Pakistan and Ghana (Bhalotra & Heady, 2003), Mali (Boutin, 2012), Côte d'Ivoire (Nkamleu & Kielland, 2006) or Burkina Faso (Dumas, 2007). However, part 3 of the table shows that when the same relationship is analyzed through a fixed effect panel of both waves, the parameters estimated are no longer significant, and in the Colombian case the sign becomes negative. This shows that changes in the level of land in the time period between both surveys were not followed by changes in the same direction in the child labor rate inside each household, casting doubts on whether the positive relationship observed in the cross section estimates is actually the causal effect land has on child labor.

These results suggest that there are unobserved intrinsic household characteristics that are indeed relevant in determining both land holdings and land-related labor, and thus accounting for their effect is important for the determination of the true effect land has on the household's decision of making their children work.

Results for average farm working hours are shown in Table 5. For both ELCA waves these results show that there is a strong significant relationship between land area and number of hours children spend working, when analyzed as separate cross-section surveys. Coefficients for the most stringent specification (column III) show that on average, one additional hectare of land holdings is associated to 0.59 and 1.01 additional hours of child labor per week for children in ELCA-I and in ELCA-II respectively. Once again these results seem to confirm the existence of a relationship analogous to that observed in other countries, where hours worked are increasing with land wealth. The significance of the squared term also shows that there is a turning point in land levels after which average working hours start to actually decrease, presumably because the household is rich enough no to need them any more. This turning points are around 1.93 and 4.88 hectares for ELCA-I and II respectively. Both values are, as expected, over the average land holdings for the sample, but well under the maximum values observed.

This relationship, however, disappears when the panel fixed effect estimation is carried out. Part 3 of Table 5 shows that coefficients of the same set of specifications, when estimated as panel data, are not statistically significant and have a negative sign. This result suggests that, due to the fact that panel fixed effects estimations cancel out any observed or unobserved individual characteristics that remain constant through time, the positive

Table 5
OLS ESTIMATES: WORK HOURS

	ELCA - I			MxFLS - I		
1.	**(I)**	**(II)**	**(III)**	**(IV)**	**(V)**	**(VI)**
Land Hectares	0.264 *	0.942 ***	0.592 **	0.0152	0.728 **	0.455
	(0.143)	(0.303)	(0.300)	(0.101)	(0.345)	(0.346)
Land Hectares^2		-0.354 ***	-0.199 *		-0.00398 **	-0.00253
		(0.119)	(0.113)		(0.00184)	(0.00184)
Observations	1,943	1,943	1,943	1,835	1,835	1,834
Household & Individual Controls	No	No	Yes	No	No	Yes
Geographic Fixed Effects	No	No	Yes	No	No	Yes
	ELCA - I			**MxFLS - I**		
2.	**(I)**	**(II)**	**(III)**	**(IV)**	**(V)**	**(VI)**
Land Hectares	0.228 *	0.971 ***	1.014 ***	-0.0821	0.271	0.0246
	(0.124)	(0.291)	(0.302)	(0.150)	(0.522)	(0.527)
Land Hectares^2		-0.102 ***	-0.104 ***		-0.00196	-0.00072
		(0.0297)	(0.0306)		(0.00278)	(0.00279)
Observations	1,943	1,943	1,943	1,834	1,834	1,832
Household & Individual Controls	No	No	Yes	No	No	Yes
Geographic Fixed Effects	No	No	Yes	No	No	Yes
	ELCA - Panel			**MxFLS - Panel**		
3.	**(I)**	**(II)**	**(III)**	**(IV)**	**(V)**	**(VI)**
Δ Land Hectares	-0.0715	-0.231	-0.194	0.0490	0.596	0.647
	(0.104)	(0.331)	(0.328)	(0.147)	(0.502)	(0.507)
Δ Land Hectares^2		0.0210	0.0177		-0.00309	-0.00328
		(0.0305)	(0.0304)		(0.00271)	(0.00273)
Observations	3,886	3,886	3,886	3,650	3,650	3,650
Household & Individual Controls	No	No	Yes	No	No	Yes
Geographic Fixed Effects	No	No	Yes	No	No	Yes

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Robust standard errors in parentheses. Household controls are household head education level, number of household members by age range, and a dummy for migration. Individual level controls are age, gender and relationship to the household head. Geographic fixed effects are at the municipality (17) and state (16) level for Colombia and Mexico respectively. Panel regressions also include a fixed effect for each household's geographical unit at baseline.
Source: Own calculations based on ELCA and MxFLS.

and significant cross-section estimates in the Colombian survey may be upwardly biased by unobserved idiosyncrasies impossible to account for in such a setting.

Coefficients for MxFLS are in general not significant and do not show a clear relationship between hours worked and land size. It is possible that the relatively low proportion of households who operate land in any way in the survey (as shown in Table 1) limits the explanatory power of the estimation since, as mentioned above, the dependent variable is number of hours worked in agricultural labor only. Additionally, the puzzling observation discussed above that shows that landless households have a higher average number of farm-work hours in this survey may be indicating that wage-labor in external farms may be more relevant in Mexican households than domestic farm work.

Finally, Table 6 shows estimation results for the schooling attendance outcome. Possibly due to the fact that school attendance rates are so high in both countries, coefficients for this outcome are not significant in most of the specifications considered. The exception is ELCA-II, where schooling assistance rates are negatively correlated with household landholdings. This same relationship is found for children in Pakistan by Bhalotra & Heady, (2003) and could indicate the existence of a displacement effect caused by higher labor rates and longer hours for children in land-rich households. However, the panel data estimation for ELCA shows that this relationship is reversed when individual fixed effects are included, and changes in land holdings in the household have a positive statistically significant effect on school attendance rates.

The difference in coefficients between cross-section and panel estimations suggest that there are omitted confounding factors whose effect is being added up to the land estimator on the cross-sectional analysis. This implies that the negative relationship between land and schooling, as well as the positive one between land and child labor outcomes observed in one period of time only, are being overestimated. The wealth paradox may thus actually really be an omitted variable paradox.

These results are consistent with the hypothesis of parental preferences as an important driver of child labor occurrence. Other explanations, however, are also plausible. One possibility could be that the unobservable household characteristic which causes the bias in cross-sectional results is not the relative preference of land over human capital, but a difference in intrinsic health endowments: households who are somewhat healthier and thus more fit to perform agricultural work could also have more incentives both to simultaneously acquire more land and put their children to work instead of investing time in formal education. These differences between households are also difficult to observe in cross-sectional estimates and thus its bias would be present in the estimations shown above.

Table 6
OLS ESTIMATES: SCHOOL ATTENDANCE

	ELCA - I			MxFLS - I		
1.	**(I)**	**(II)**	**(III)**	**(IV)**	**(V)**	**(VI)**
Land Hectares	0.0130	0.0246	0.0197	-0.00985 ***	-0.00152	-0.00130
	(0.0107)	(0.0183)	(0.0193)	(0.00208)	(0.00709)	(0.00722)
Land Hectares^2		-0.00608	-0.00291		0.00005	0.00004
		(0.00514)	(0.00551)		(0.00004)	(0.00004)
Observations	1,943	1,943	1,943	1,838	1,838	1,836
Household & Individual Controls	No	No	Yes	No	No	Yes
Geographic Fixed Effects	No	No	Yes	No	No	Yes
	ELCA - I			**MxFLS - I**		
2.	**(I)**	**(II)**	**(III)**	**(IV)**	**(V)**	**(VI)**
Land Hectares	-0.00393	-0.0191 *	-0.0200 *	0.00381	0.00879	0.0150
	(0.00340)	(0.0109)	(0.0115)	(0.00375)	(0.0130)	(0.0130)
Land Hectares^2		0.00208 *	0.00211 *		-0.00003	-0.00001
		(0.00110)	(0.00118)		(0.00007)	(0.00008)
Observations	1,943	1,943	1,943	1,835	1,835	1,833
Household & Individual Controls	No	No	Yes	No	No	Yes
Geographic Fixed Effects	No	No	es	No	No	Yes
	ELCA - Panel			**MxFLS - Panel**		
3.	**(I)**	**(II)**	**(III)**	**(IV)**	**(V)**	**(VI)**
Δ Land Hectares	0.0114	0.0358 *	0.0379 **	-0.00199	0.0102	0.00603
	(0.00722)	(0.0196)	(0.0185)	(0.00331)	(0.0113)	(0.0113)
Δ Land Hectares^2		-0.00322 *	-0.00345 **		-0.00007	-0.00005
		(0.00180)	(0.00162)		(0.00006)	(0.00006)
Observations	3,886	3,886	3,886	3,650	3,650	3,650
Household & Individual Controls	No	No	Yes	No	No	Yes
Geographic Fixed Effects	No	No	Yes	No	No	Yes

*** p < 0.01, ** p < 0.05, * p < 0.1. Robust standard errors in parentheses. Household controls are household head education level, number of household members by age range, and a dummy for migration. Individual level controls are age, gender and relationship to the household head. Geographic fixed effects are at the municipality (17) and state (16) level for Colombia and Mexico respectively. Panel regressions also include a fixed effect for each households' geographical unit at baseline.
Source: Own calculations based on ELCA and MxFLS.

To examine this possibility, a proxy for household health endowment, average weight at birth for kids in the household ages 0 to 5, is included in the same estimations shown in section V for ELCA I and II. Results are shown in the appendix Tables A2 to A4. Inclusion of this control variable does change cross-sectional estimates for schooling, work probability, and working hours, making the relationship between land and these outcomes not significant and causing the wealth paradox to be no longer observable. This would suggest that intrinsic health endowments could be an important unobservable characteristic which could be biasing cross-section estimates. Nonetheless, the considerable reduction in sample size the inclusion of this control variable entails makes it difficult to assess whether the loss of significance in the parameters estimated is actually caused by a correction in the omitted variable bias or simply because of a less precise estimation. Therefore, while this work cannot discern the specific impact of individual unobserved characteristics and whether there is any interplay between them, testing different channels through which bias in the cross-section estimates could be produced, and thus identifying the main unobservable factors affecting the land, labor and education relationship is an important next step to be taken in future research.

Results shown in Tables 4 and 5 also give support to the theoretical assumption that, other things equal, increases in household wealth should not be related to increases in child labor inside the household. When potential bias from unobserved characteristics is removed from estimations, increases in land seem to act as a normal increase in the net asset position of the household would. Nevertheless, an important issue to be considered is the potentially endogenous nature of land variations.

Whereas several papers on the subject assume the complete inexistence of land markets in the regions studied to argue the causal interpretation land disparities have on labor and schooling outcomes, land markets both in Colombia and Mexico are relatively flexible, and changes in the amount of this particular asset within a household are not necessarily exogenous. To address this issue, changes in land holdings only caused either by receiving an inheritance or because of loss due to climatic shocks were tried as a relatively more exogenous instrument for total land variations. Even though this constructed variable is strongly correlated to the main independent regressor, the F-statistic for the excluded instrument is below the threshold that indicates a potential weak instrument and thus this strategy couldn't be pursued[9].

[9] The main problem with this kind of estimation is the small number of households who inherited or lost land due to climate changes between both surveys relative to the total variation in land. The inclusion of information from a new follow-up survey in Colombia, scheduled to be carried out in 2016, and the second follow up of the MxFLS, carried out through years 2009-2012, could remove this obstacle.

The fact that even though markets are far from completely inexistent the wealth paradox is still observed in the data further suggests that the cause for these correlations to exist are not only market imperfections. Dumas (2013), shows that the magnitude of this phenomenon is increasing as market failures are more severe. The wealth paradox would be thus expected to be of little salience in comparatively more competitive Colombian markets; Gafaro, Ibañez & Zarruk, (2012) show this not to be the case. In this respect, a longitudinal study on a sample of households where land markets are inexistent and thus land variations through time could be considered completely exogenous could prove conclusive.

A. Heterogeneous Effects

Additional estimations splitting the sample by gender and age group were carried out to evaluate differential effects between these subsamples. Tables for these estimations are presented in the appendix. Analogous to the main results, heterogeneous effects are found between boys and girls for the ELCA survey both in school attendance and in average working hours. Regarding schooling, the positive relationship between land holdings and school attendance when household fixed effects are included is present mainly for boys, which is an interesting result since it is generally assumed that boys are preferred for agricultural labor over girls, and thus higher land levels should be related to higher rates of school absenteeism for this group. What these estimates show is that, after controlling for household characteristics, positive variations in land levels produce on average a stronger income effect and are thus related to an overall increase in boys' schooling attendance rates. Accordingly, average working hours seem to be positively associated with land on the cross-section estimates for boys only, yet this relationship is no longer observed when household fixed effects are included.

Because the age range in ELCA is relatively small (children at baseline are between 5 and 9), no differential effects are found by splitting the sample into age groups. However, heterogeneous effects for different age groups are found in the MxFLS survey, which has a broader age range (6 to 12 at baseline) and makes it possible to analyze the relationship between land and child labor prevalence in older individuals. After splitting the sample into two different age groups at baseline -6 to 8 and 9 to 12- estimations show that the positive relationship between work probability and land holdings is driven mainly by the younger cohort, even though when fixed effects are included no statistically significant relationship between these variables is observed. This result is consistent with the child labor market failure explanation presented in Basu, Das, & Dutta (2010), since it would be precisely the younger children who would find it harder to offer their labor outside the household, and thus only households with access to land can overcome this restriction by employ-

ing their children in the family farm. Although the interpretation of this result is more problematic due to the fact that –unlike gender– age does change between surveys and thus members of the younger cohort are not as young in the follow up survey, what these results show is that there effectively are age related differences in the relationship between land and schooling which can be only analyzed in surveys which include individuals in a relatively broad age range like those in MxFLS.

VI. Conclusion

This work finds that while cross-sectional estimations show that households' land holdings have a positive relationship with child labor participation rates and number of hours worked, these relationships are no longer observable when longitudinal data is used in a fixed-effects model for Colombian and Mexican rural households. Similar results are observable for school enrollment rates, which tend to be negatively related to land holdings in cross-sectional surveys but show no relationship -or are even positively related- when analyzed including individual fixed effects.

The difference in results between both types of estimation could lie in the omission of unobservable idiosyncratic characteristics relative to the labor/schooling trade-off, which cannot be accounted for in cross-sectional analysis. Although the specific unobservable factor cannot be identified, the results presented in this work are consistent with the idea that household preferences are an important determinant in the child labor decisions inside the household and support the theoretical assumption that, other things equal, increases in household wealth should not be related to increases in child labor inside the household.

In a more general sense, the results presented in this work challenge the claim that the -well-established- observation that children in land rich households are more likely to be working has a causal nature. Discussing the implications of the wealth paradox, Basu, Das & Dutta, (2010) state that "The channel through which poverty is reduced is important. If monetary transfers are given to every poor household to reduce poverty, and these transfers are in turn used to increase their levels of agrarian assets, child labor may in fact increase" (p. 14). What this work argues is that those households who choose to invest in land rather than in, for example, human capital, will be precisely those who are less averse to have their children working. Evidence does not seem to support the assertion that land itself is the cause neither of increases in child labor participation rates nor of decreases in schooling attendance rates.

Therefore, attempts to reform access to land and the distribution of land holdings between households may not have the negative externalities in educational dimensions cross-sectional estimates would suggest. Especially since land and human capital are not necessarily substitute inputs (Foster

& Rosenzweig, 1996). This work disputes the claim that if land and labor markets are not perfect, an exogenous increase in the amount of land held by poor households would tend in average to increase child labor prevalence and decrease school attendance rates. On the contrary, even in the presence of incomplete markets, increases in the amount of land seem to be related -at least for Colombian households- in increases in schooling levels.

However, if the preference hypothesis is correct, children from households who more actively seek increasing their land holdings are likely to be the most vulnerable to engage in child labor and to drop out of school. Since most programs with the objective of reforming land distribution rely on direct land requests by households, an important policy implication is that, alongside the improvement of agricultural land and labor market conditions in developing countries, an effort should be made to raise the perceived future returns and reduce the perceived opportunity cost formal education has in rural areas. While the most straightforward intervention may be to raise *actual* returns of schooling through increases in education quality, alternate policy actions, like the creation or expansion of more flexible educational models in rural areas which lower the opportunity cost of attending school may be particularly important in reducing grade repetition and dropout rates for this particular group of the population, especially in a context of structural land reform.

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Appendix

Table A1

DIFFERENCES BETWEEN SAMPLE, ATTRITION AND MIGRANT-TO-URBAN GROUPS

ELCA	**Final Sample (N = 1,943)**	**Migrants to Urban Areas (N = 139)**	**Attrition Group (N = 278)**
Household head age	42.8	43.8	42.42
	(11.16)	(12.58)	(12.55)
Percentage Household head Male	82.9	82.7	84.5
Household head education years	3.97	4.19	4.31*
	(3.04)	(2.79)	(3.26)
Percentage Household head employed	36.0	38.4	45.1 ***
Household members 0-5	0.93	0.71 **	0.76 ***
Household members 6-17	2.38	2.01 ***	2.28
Household members 18-65	2.50	2.42	2.53
Household members over 65	0.19	0.24	0.21
MxFLS	**Final Sample (N = 1,838)**	**Migrants to Urban Areas (N = 160)**	**Attrition Group (N = 1,523)**
Household head age	43.0	40.1 ***	45.0 ***
	(12.27)	(10.62)	(11.84)
Percentage Household head Male	83.9	86.9	82.8
Household head education years	2.97	3.79 ***	3.02
	(1.72)	(1.94)	(1.87)
Percentage Household head employed	83.1	88.7 *	82.9
Household members 0-5	0.78	0.60 ***	0.60 ***
Household members 6-17	3.02	2.56 ***	2.94 *
Household members 18-65	2.35	2.44	2.46 ***
Household members over 65	0.14	0.10	0.14

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard deviations in parentheses. All values are at baseline levels. Mean difference tests between the final sample and migrants, and between the final sample and the attrition group respectively.

Table A2

HEALTH ENDOWMENT PROXY: SCHOOL ATTENDANCE

School Attendance	**ELCA - I**		**ELCA - II**		**ELCA - Panel**	
Land Hectares	0.0197	0.0719 ***	-0.0200 *	-0.0453	0.0379 **	0.0896
	(0.0193)	(0.0278)	(0.0115)	(0.0275)	(0.0185)	(0.0602)
Land Hectares^2	-0.00291	-0.0226 **	0.00211 *	0.00499 *	-0.00345 **	-0.0154
	(0.00551)	(0.00969)	(0.00118)	(0.00299)	(0.00162)	(0.00974)
Average Household birthweight		-2.70e-06		-2.47e-06		-9.63e-06
		(3.36e-06)		(1.76e-05)		(8.51e-06)
Observations	1,943	759	1,943	574	3,886	794
R^2	0.065	0.135	0.027	0.068	0.041	0.068
Household & Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Household Fixed Effects	No	No	No	No	Yes	Yes

*** p < 0.01, ** p < 0.05, * p < 0.1. Robust standard errors in parentheses. Household controls are household head education level, number of household members by age range, and a dummy for migration. Average household birthweight is calculated over children up to 5 years old in the household who where weighted at birth. Individual level controls are age, gender and relationship to the household head. Geographic fixed effects are at the municipality level. Panel regressions also include a fixed effect for each household's geographical unit at baseline.

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Table A3

HEALTH ENDOWMENT PROXY: WORKING HOURS

Working Hours	**ELCA - I**		**ELCA - II**		**ELCA - Panel**	
Land Hectares	0.592 **	-0.231	1.014 ***	0.400	-0.194	-0.953
	(0.300)	(0.478)	(0.302)	(0.558)	(0.328)	(1.667)
Land Hectares^2	-0.199 *	0.112	-0.104 ***	-0.0422	0.0177	0.117
	(0.113)	(0.250)	(0.0306)	(0.0581)	(0.0304)	(0.255)
Average Household birthweight		9.77e-07		-0.000285		-0.000327 *
		(6.86e-05)		(0.000389)		(0.000174)
Observations	1,943	759	1,943	574	3,886	794
R^2	0.068	0.091	0.055	0.069	0.036	0.071
Household & Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Household Fixed Effects	No	No	No	No	Yes	Yes

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Robust standard errors in parentheses. Household controls are household head education level, number of household members by age range, and a dummy for migration. Average household birthweight is calculated over children up to 5 years old in the household who where weighted at birth. Individual level controls are age, gender and relationship to the household head. Geographic fixed effects are at the municipality level. Panel regressions also include a fixed effect for each household's geographical unit at baseline.

Table A4

HEALTH ENDOWMENT PROXY: WORK PROBABILITY

Work Probability	**ELCA - I**		**ELCA - II**		**ELCA - Panel**	
Land Hectares	-0.0162	-0.0260	0.0892 ***	0.0205	-0.0376	-0.0434
	(0.0215)	(0.0386)	(0.0277)	(0.0475)	(0.0279)	(0.108)
Land Hectares^2	0.00103	0.00198	-0.00929 ***	-0.00274	0.00299	0.00636
	(0.00700)	(0.0144)	(0.00271)	(0.00493)	(0.00265)	(0.0177)
Average Household birthweight		1.91e-06		1.51e-05		-1.46e-05
		(3.13e-06)		(2.20e-05)		(1.17e-05)
Observations	1,943	759	1,943	574	3,886	794
R^2	0.050	0.059	0.061	0.092	0.041	0.106
Household & Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Household Fixed Effects	No	No	No	No	Yes	Yes

*** p < 0.01, ** p < 0.05, * p < 0.1. Robust standard errors in parentheses. Household controls are household head education level, number of household members by age range, and a dummy for migration. Average household birthweight is calculated over children up to 5 years old in the household who where weighted at birth. Individual level controls are age, gender and relationship to the household head. Geographic fixed effects are at the municipality level. Panel regressions also include a fixed effect for each household's geographical unit at baseline.

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Table A5

HETEROGENEOUS EFFECTS BY GENDER: SCHOOL ATTENDANCE

	Boys			Girls		
School Attendance	**ELCA - I**	**ELCA - II**	**ELCA - Panel**	**ELCA - I**	**ELCA - II**	**ELCA - Panel**
Land Hectares	0.0222	-0.0239	0.0664 **	0.0145	-0.0164	0.00951
	(0.0222)	(0.0170)	(0.0268)	(0.0330)	(0.0152)	(0.0257)
Land Hectares^2	-0.00750	0.00306	-0.00625 **	0.00195	0.00180	-0.000941
	(0.00841)	(0.00187)	(0.00263)	(0.00966)	(0.00154)	(0.00209)
Observations	982	982	1,964	961	961	1,922
R^2	0.065	0.059	0.057	0.084	0.031	0.043
Household & Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Household Fixed Effects	No	No	Yes	No	No	Yes

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Robust standard errors in parentheses. Household controls are household head education level, number of household members by age range, and a dummy for migration. Individual level controls are age, gender and relationship to the household head. Geographic fixed effects are at the municipality level. Panel regressions also include a fixed effect for each household's geographical unit at baseline.

Table A6

HETEROGENEOUS EFFECTS BY GENDER: WORKING HOURS

	Boys			Girls		
Working Hours	**ELCA - I**	**ELCA - II**	**ELCA - Panel**	**ELCA - I**	**ELCA - II**	**ELCA - Panel**
Land Hectares	0.788 *	1.406 ***	-0.642	0.423	0.305	-0.361
	(0.478)	(0.415)	(0.613)	(0.392)	(0.507)	(0.305)
Land Hectares^2	-0.351	-0.152 ***	0.0606	-0.0788	-0.0314	0.0431
	(0.217)	(0.0428)	(0.0590)	(0.133)	(0.0490)	(0.0330)
Observations	982	982	1,964	961	961	1,922
R^2	0.080	0.058	0.042	0.060	0.207	0.209
Household & Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Household Fixed Effects	No	No	Yes	No	No	Yes

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Robust standard errors in parentheses. Household controls are household head education level, number of household members by age range, and a dummy for migration. Individual level controls are age, gender and relationship to the household head. Geographic fixed effects are at the municipality level. Panel regressions also include a fixed effect for each household's geographical unit at baseline.

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Table A7

HETEROGENEOUS EFFECTS BY AGE GROUP: WORK PROBABILITY

	Old (9-12 at baseline)			Young (6-8 at baseline)		
Work Probability	**MxFLS-I**	**MxFLS-II**	**MxFLS-Panel**	**MxFL -I**	**MxFLS-II**	**MxFLS-Panel**
Land Hectares	0.0143	-0.0129	0.00461	0.0504 ***	0.0758 ***	0.0311
	(0.0177)	(0.0250)	(0.0175)	(0.0141)	(0.0211)	(0.0210)
Land Hectares^2	-0.00008	0.00008	-0.00005	-0.000259 ***	-0.000394 ***	-0.000142
	(0.00009)	(0.000131)	(0.00009)	(0.00008)	(0.000114)	(0.000120)
Observations	950	950	1,888	886	886	1,762
R^2	0.107	0.098	0.114	0.076	0.084	0.154
Household & Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Household Fixed Effects	No	No	Yes	No	No	Yes

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Robust standard errors in parentheses. Household controls are household head education level, number of household members by age range, and a dummy for migration. Individual level controls are age, gender and relationship to the household head. Geographic fixed effects are at the state level. Panel regressions also include a fixed effect for each household's geographical unit at baseline.

Table A8
CHILD LABOUR DECISION MODEL

Following Santos, (2013), consider a rural household with one adult and one child with the following utility function.

$$UI = u\,(c) - \alpha v\,(e)$$

Where c is consumption, e is the fraction of the child's time spent working, and α is a parameter that measures the relative aversion each household gives to schooling. These functions satisfy that

$$\frac{\partial u(c)}{\partial c} > 0;\ \frac{\partial^2 u(c)}{\partial c^2} \leq 0;\ \frac{\partial v(e)}{\partial e} > 0;\ \frac{\partial^2 v(e)}{\partial e^2} \leq 0$$

It is assumed there is no labour market[1]. Consumption is thus determined by

$$c = f(T, e) + I$$

Where $f(T, e)$ is the child's production function, T is land used by the household and I is an exogenous income provided by the adult, who is always assumed to be working.

Function $f(T, e)$ is assumed to have the standard properties:

$$\frac{\partial f(t,e)}{\partial T} > 0;\ \frac{\partial^2 f(t, e)}{\partial T^2} \leq 0;\ \frac{\partial f(t, e)}{\partial e} > 0;\ \frac{\partial^2 f(t, e)}{\partial e^2} \leq 0$$

A central assumption in the model is a well established fact in agricultural economics (Mueller, 1984), which shows that an increase in land raises labors' marginal productivity

$$\frac{\partial^2 f(t, e)}{\partial e \partial T} > 0$$

It is assumed in this model that the relative degree of aversion towards child labor in the family farm simultaneously influences the level of land holdings chosen by the household. The interpretation of this assumption is that households where parents have an overall higher taste for agricultural labor in comparison to employment which requires formal education are both more likely to have a higher level of land holdings and to be less averse to child farm labor. Thus, the level of land chosen by the household is negatively affected by the aversion to child labor the household intrinsically has:

$$T = g(\alpha) \text{ Where, } \frac{\partial T}{\partial \alpha} < 0$$

Finally, the child has one unit of labor which must be divided between school (s) and work

$$s + e = 1$$

[1] The assumption of no market could be relaxed by the inclusion of a parameter that represents the transaction cost of hiring or selling labour (this cost being infinite for the no market case). Including this parameter does not generate any additional conceptual insights (Basu, Das & Dutta, 2010).

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Table A8
CHILD LABOUR DECISION MODEL

The maximization problem for the household is then to chose the optimal amount of time the child is to spend working:

$$\max_{(e)} U = u\{f(T,e) + I\} - \alpha v(e)$$

Assuming an interior solution to this problem, the first order condition is

$$-\alpha v'(e) = u'(c) \cdot f_e(T,e)$$

This condition states that, for any level of land (T), the household chooses a level of schooling that satisfies $\frac{-\alpha v'(e)}{f_e(T,e)} = u'(c)$. Not surprisingly, since the parameter for schooling preference (α) varies between households, in equilibrium, households with similar levels of land can choose different levels of child labour due to their prior differences in relative preferences for schooling and labour.

Furthermore, by differentiating implicitly the first order condition we get that

$$\frac{\partial e}{\partial T} = \frac{u''(c) \cdot f_T \cdot f_e + u'(c) \cdot f_{eT}}{\alpha u''(e) + u''(c) \cdot f^2 + u'(c) \cdot f_{ee}}$$

Since the denominator is always positive, the sign of the derivative will be the sign of $(u''(c) \cdot f_T \cdot f_e + u'(c) \cdot f_{eT})$, which will depend on the degree of concavity of both the utility and the production functions. The net effect on schooling of a change in land used by the household can then be either positive or negative depending on which effect (income or substitution) is stronger. Since $f(T, e) = f(g(\alpha),e)$, both the sign and magnitude of the net effect land has on labor will be partly influenced by the degree of aversion towards child labour.

Two things that this simplified model shows are, first, that the net effect a change in land has on the time distribution of the child is theoretically ambiguous and is thus an empirical matter and, second, that failing to assess the influence parental preferences have may lead to biased results regarding the true effect land has on labor and schooling outcomes.

Table A9
NON-PARAMETRIC REGRESSIONS OF LAND ON WORK HOURS

Figures 1 and 2 show the result of non-parametric, Gaussian kernel regressions of land size on working hours without additional control variables. They are presented, following those presented in Basu, Das & Dutta, (2010) as a way of illustrating the nonlinear relationship between land and schooling. MxFLS regressions show a rather irregular curve where the highest levels of working hours happen between 10 and 20 land hectares, somewhat above the mean for both waves. Regression curves for ELCA data are much more smooth and produce an unequivocal inverted-U shape both at baseline and follow-up. The turning points where land starts to correlate negatively with work hours happens around 5 hectares in ELCA-I and around 15 in ELCA-II, both considerably above the sample means - but well within the maximum land holdings observed.

Figure 1. Non-parametric regression: Land size & Working Hours

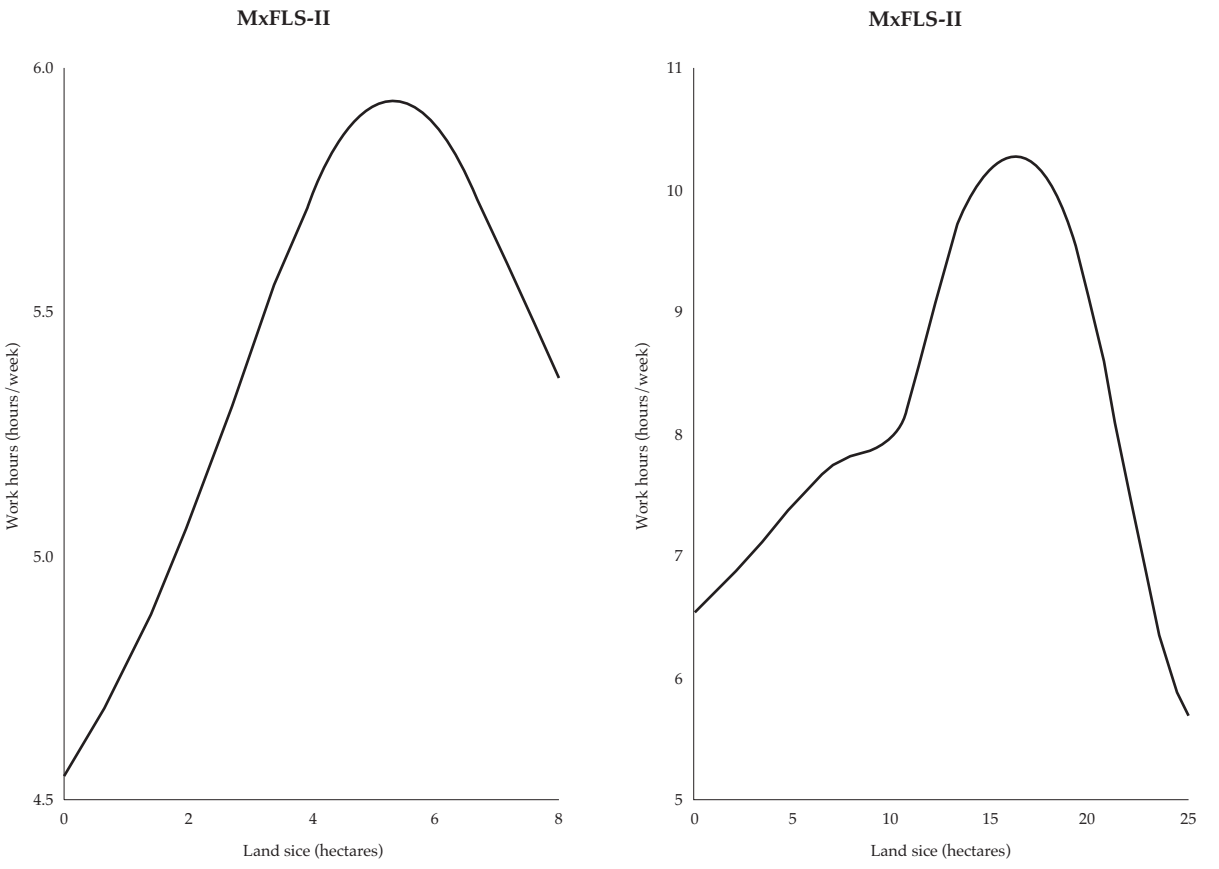

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Figure 2. Non-parametric regression: Land size & Working Hours