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Effects of parental absence on child labor and school attendance in the Philippines

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Abstract This paper uses longitudinal data from the Philippines to analyze determinants of children's time allocation. The estimation method takes into account both the simultaneity of time use decisions, by allowing for correlation of residuals across time uses, and unobservable family heterogeneity, through the inclusion of household fixed effects. Importantly, this improved estimation method leads to different results than when applying the methods previously used in the literature. Girls suffer significantly from the absence of their mother with a reduction in time spent in school that is equivalent to dropping out completely. This effect is substantially larger when controlling for household unobservables than when not. Boys increase time spent working on market related activities in response to an absent father, although this time appears to come out of leisure rather than school or doing household chores. Land ownership substantially increase the time boys spend on school activities, whereas renting land reduces the time girls spend on school. Finally, there does not appear to be a substantial trade-off between time spent on school and work, either in the market or at home.

Keywords Schooling · Child labor · Philippines · Household heterogeneity · Joint estimation

JEL Classification I2 · J16 · J22 · O15

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1 Introduction

A child's time may be spent on any number of activities, and the distribution across different activities has implications both for the child's current well-being and for its future prospects. Parents' decisions about how much time a child spends on schooling, working, doing domestic work, or on leisure activities directly impact the child's current utility. This may also have large impacts on the child's human capital accumulation, with a resulting indirect impact on the development of the society.[1] This paper aims to answer two questions. First, how are different time uses traded off against each other? Second, to what extent are these trade-offs the result of observable conditions, that may potentially be changed, or the result of unobservable individual or household characteristics that are more difficult to impact? Focus is especially on how parental absence affect the allocation of children's time across different time uses.

The determinants of children's time allocation have attracted significant public interest. In response, since the early 1990s, there has been a substantial increase in the amount of research on the time allocation of children in developing countries (Edmonds 2008). One of the main difficulties in understanding the trade-off between different uses of children's time is that the uses are jointly determined. The initial research on the trade-off between work and schooling ignored this issue and found that working caused substantial negative effects on school attendance, grade progression, human capital accumulation, and educational attainment (Patrinos and Psacharopoulos 1995; Akabayashi and Psacharopoulos 1999; Heady 2003).

The later literature has predominantly employed one of two methods to address the issues of joint determination of time use: instrumental variables (IV) or some type of exogenous variation in conditions. The main problem with the instrumental variables method is that it requires one or more variables that affect, say, work but do not affect schooling, or vice versa. In addition, the results hold only for the subset of children who change behavior because of the instrument. This may explain why the IV results have been mixed, with some finding a stronger association between work and schooling and others finding a much weaker association as compared to the prior literature (Boozer and Suri 2001; Rosati and Rossi 2003; Ray and Lancaster 2004; Gunnarsson et al. 2006). The other approach exploits changes in local conditions when examining the relationship between schooling and work, such as changes in laws or programs that affect the relative cost of going to school. Using this approach, the general finding is that there has been a substantially larger increase in schooling than there has been a decrease in market work (Ravallion and Wodon 2000; Arends–Kuenning and Amin 2004; Cardoso and Souza 2004; Kazianga et al. 2009; de Hoop and Rosati 2012).[2]

Another strand of the literature has tried to understand the medium- and long-term impact of working on human capital and future earnings. The earlier literature

[1] An example is hard or hazardous work that may have damaging effects on children's health that are only seen later in life. The improper use of pesticides may, for example, have serious adverse health effects that only emerge following a long time lag. Another example is the human capital accumulation of the child, which is a strong predictor of lifetime income.

[2] A similar result holds for increased proximity to schools (Kondylis and Manacorda 2012; de Hoop and Rosati 2012).

found that individuals who began work at a younger age tended to have lower earnings as adults, except for those with no education, perhaps because of the accumulation of experience (Ilahi et al. 2005; Emerson and Souza 2011). More recent studies with a stronger focus on controlling for unobservable characteristics that might influence both later wages and the time use decision when young, have found negligible or even positive effects on outcomes such as test scores and earnings (Beegle et al. 2009; Dumas 2012).

With focus primarily on child labor and schooling, domestic work has received relatively little attention (Edmonds 2008). Domestic work is, however, an important time use and should not be ignored, especially with respect to girls (Assaad et al. 2010). It has been argued that whether or not there is a trade-off between school and work depends on whether or not domestic work is included, especially for girls (Levison and Moe 1998; Levison et al. 2001). This result is, however, not uniformly supported (de Hoop and Rosati 2012). In the same vein, the prior research has paid little attention to leisure, despite the potential importance of leisure on a child's development and his or her ability to perform satisfactorily in school (Edmonds 2008).

Most of the prior research has mainly examined the participation decision, rather the number of hours spent on each (Edmonds 2008). To the extent that researchers have examined work and schooling jointly, the commonly-used method has been bivariate probit. This approach, however, has a number of potential issues, both in terms of evaluating the effects of explanatory variables and in attempting to control for unobserved characteristics (Edmonds 2008). In addition, incorporating the decision on domestic work would require the implementation of a trivariate probit, which is not straightforward.

This paper makes three main contributions to the literature. First, it incorporates all possible time uses for a child—schooling, market work, domestic work, and leisure—using a data set with detailed information on children's time use over the week prior to the survey, measured over two survey rounds.

Second, it takes into account family heterogeneity and potentially endogenous variables through the use of household fixed effects. The two survey rounds provide enough variation within households and across time to estimate household fixed effects. Most of the literature have relied on cross-sectional data and have therefore either ignored the role of unobserved family heterogeneity or used an IV approach to deal with endogenous variables. This is especially important when estimating the effects of factors such as parental absence that are likely to be correlated with unobservable household characteristics and therefore biased in standard OLS estimates.

Third, it takes seriously the joint nature of time allocation decisions. It models all four time uses jointly and makes use of the available time data instead of just focusing on the participation decision (Edmonds 2008, p. 3649). This is important because estimating determinants of all time uses jointly provides a new way to understand how unobservable characteristics impact time use decisions. The correlation between individual residuals across time uses and estimated household fixed effects directly shows the extent to which two time uses substitute for each other for individual and household unobservable characteristics.

The results show substantial differences between boys and girls in their responses to changes in circumstances and household characteristics. Furthermore, a major

advantage of using household fixed effects over what the previous literature has done is that it is possible to estimate the effects of potentially important variables, such as parental absence and land availability, on children's time use. One place where this is important is when examining the effect of the absence of the mother. Using household fixed effects, girls are found to experience a very significant reduction in their time spent on school activities in response to their mother not being in the household, and this effect is substantially larger than what is found using standard OLS. This effect is large enough to be equivalent to dropping out completely for these girls. Boys, on the other hand, see an increase in time spent working on market related activities in response to an absent father, although this time appears to come out of leisure rather than school or doing household chores. Land ownership is found to substantially increase the time boys spend on school activities, whereas renting land reduces the time girls spend on school.

Hence, the use of an estimation method that takes into account heterogeneity and correlation across time uses together with longitudinal data lead to results that are substantially different from those found when using the method employed by the prior literature. Most of this change come from controlling for household heterogeneity, but many coefficients only become statistically significant after also allowing for correlation in the residuals across time uses. Jointly estimating time use also provides an indication of how households trade off one time use against another. Interestingly, these results indicate that different time uses, such as school against work/household chores, are very far from being traded off one-to-one. In other words, an increase in time spent on work does not come directly out time spent on school but rather a combination of school, household chores, and leisure.

2 Data

The data come from the Laguna Multipurpose Household Surveys.[3] The first survey took place in 1975 with resurveys in 1977, 1982, 1985, 1990, 1992 and 1998 on a progressively smaller number of households using almost the same questionnaire.[4] Of the available survey rounds, the 1982 and 1985 data sets have the most detailed time allocation information and the most children of relevant ages. Hence, all analyses below use these two survey rounds. Even though the data are not the most recent available on children's time use, there are two major advantages of this data over others. First, it includes very detailed information on time use of all children compared to other surveys, which often either only ask about participation or have relatively simple categories for time use (see, for example, discussion in Kis-Katos 2012). Second, the two years of data makes it possible to control for household heterogeneity through the use of household fixed effects. Most other data sets cover only one year, in which case it is not possible to both include household fixed effects

[3] The background for the original survey is described in Evenson (1978, Appendix) and Evenson et al. (1980). The survey is also known as the Laguna Household Studies Project or the Laguna Household Economics Survey.

[4] Unfortunately, the 1975 survey round is unavailable and time allocation data were not collected for the 1998 resurvey.

and estimate the effects of the main variables of interest, which are generally measured at household level.[5]

The Laguna Province is located south of Manila, covers a 1,759 square kilometer large area and had, in 1975, a population of 803,750 with a growth rate of 2.8 % (see Ho 1979). Laguna is bounded on the north by the province of Rizal, on the east by Quezon, on the west by Cavite, and on the south by Batangas. Although Laguna is an inland province, it does have a big freshwater lake (Laguna de Bay) that constitutes most of the province's northern border. The province consists mainly of plains but includes some elevated areas in the northeast. About 80 % of the province's area is used for agriculture, and water supplies are reliable and abundant in most parts.

In 1975, the shortest distance between the province and the capital, Manila, was about 30 kilometers. During the survey period, Manila's urban area expanded so that some areas in the northern part of the province are now urban zones. This proximity to Manila, together with the fact that it has fertile land and is home to the country's largest agricultural college and the International Rice Research Institute (IRRI) explains why Laguna is one of the more developed provinces in the Philippines. The surveyed households are located in 20 different villages or communities, also known as barangays.

Demographic, consumption, and time allocation data were collected from the mother, while the father was asked about production, income and land. Time allocation data are based on seven days' recall. King and Evenson (1983, Appendix B) attempt to estimate the bias introduced by using recall data. In both the 1975 and the 1977 surveys, time budgets were collected by both the "recall" and "direct observations" methods. For the 1975 survey, the recall method resulted in the reporting of a substantially higher level of market production time for both fathers and mothers. "The major discrepancy between the two methods, however, is the drastic understatement of the market production time of children. The observation method measured more than three times as much market production time for all children as reported under the recall method" (King and Evenson 1983, p. 59). Evenson, Popkin, and Quizon (1980, p. 297–301) also note that there appears to be a "...large understatement of both market and home time of children in recall." The recall questions were revised for the 1977 survey, resulting in little difference between recall and observation data for the home production time of both husband and wife, although the market production time are understated by the recall method for both. Unfortunately, observation data were not reported for children, making it difficult to assess whether the redesign had any effect on the under-reporting of children's productive activities. It appears likely, however, that these activities are still significantly under-reported.[6]

[5] Another important longitudinal data set from the Philippines is the Cebu survey. The focus of the Cebu survey is, however, on the index child and there is therefore only limited information about siblings. The 1994 follow-up survey did ask about the index child and a younger siblings' time allocation, but those questions were not longitudinal. Furthermore, they did not ask for a specific recall of time, but a statement of hours spent on a set of specific activities during a "regular" day.

[6] This under-reporting of productive activities of children also seemed to be an issue in the related surveys conducted in the Bicol area of the Philippines (personal correspondence with John Maluccio).

The educational system in the Philippines consists of an elementary school with six grades; a high school with four grades; a college, with either four or five years of education; and finally, post graduate study. There is mandatory schooling from the first academic year after reaching age seven until the completion of elementary education, or until the child is approximately thirteen years old. Most of the elementary schools are public and tuition-free, but to a large degree, secondary schools and colleges are private. One of the interesting characteristics of the educational system in the Philippines is a very equal distribution of students by sex, compared to most other developing countries.

2.1 The time use of children

For each individual in the household, time is allocated between four non-overlapping activities: domestic work, work, school, and leisure. "Domestic work" includes the various activities related to the maintenance and reproduction of the household; "work" refers to market-related activities; and "school" measures all activities related to education. Leisure is the residual of the 168 h in a week. Table 1 shows more detailed definitions of each variable.

Table 2 shows the average number of hours spent in the four activities for those who participate, the associated standard deviation, and the participation rates in percent for boys and girls. To examine differences in the time use of children by age, the children are divided into three age groups: 8–9, 10–13 and 14–16 years.

Almost all of the youngest children, aged 8 and 9, went to school in the week prior to the interviews, although both the participation rate and the average number of hours spent on school activities were slightly lower for girls than for boys. Schooling is mandatory until approximately 13 years of age, but a significant number of boys and girls do not continue in school in accordance with the law. The participation rate is only around 90 % for children aged 10–13. For the oldest children in the sample, those aged 14–16, the number of children in school drops substantially, although the number of students who continue on to secondary school is still high relative to many other developing countries. Interestingly, girls are more likely than boys to go to secondary school.

For both work and domestic work, there are marked differences in participation rate and time spent by sex. Boys are more likely to do market-related activities, whereas girls are more likely to do domestic work. The participation rate for market-related activities is more than twice as high for boys than for girls. Close to 10 % of the youngest boys spend some time working. This increases to almost 30 % for the 10- to 13- year-olds and to more than 50 % for boys aged 14–16. The participation rate of girls is, however, not negligible—almost a quarter of all girls aged 14–16 years do some market-related work.

There is also a corresponding increase in the mean hours of work for the boys who work. Boys aged 8–13 who work do so for a little more than 10 h a week, while 14- to 16- year-olds work an average of 25 h a week. The girls experience a similar change in the hours worked for those working, but the increase is even more pronounced. The average number of hours worked for girls is higher than for boys in all but the youngest age group.

Table 1 Variable definitions

Variable name	Activity
Domestic work	Washing the dishes
	Cleaning backyard/house
	Cooking and preparing food
	Washing and ironing clothes
	Getting water and firewood
	Mending, sewing, repairing
	Care of children and disabled family members (includes feeding)
	Food preservation
	Handicraft making/Household repairs
	Marketing food[a]
Market work	Work on crop production (own farm)
	Work on livestock production (own farm)
	Working for wages
	Other work
School	Attending school
	Studying
Leisure	Residual

[a] It would be more appropriate to include marketing food under work. Unfortunately, it is not possible to extract the necessary information for 1985, where marketing food are included in food preparation

Table 2 Time use in hours and participation in activities by age

	Boys				Girls			
Age	School	Market	Domestic	Leisure	School	Market	Domestic	Leisure
8–9	38.62	12.19	7.75	126.04	32.90	5.50	8.39	132.44
	(11.29)	(20.38)	(9.47)	(14.34)	(11.80)	(7.07)	(12.01)	(15.33)
	[98.73]	[8.86]	[35.44]		[95.59]	[2.94]	[47.06]	
10–13	39.23	11.89	8.16	124.18	41.08	17.85	11.80	120.11
	(11.18)	(17.12)	(11.59)	(17.87)	(12.33)	(17.45)	(12.51)	(19.21)
	[90.43]	[29.26]	[59.57]		[88.11]	[10.81]	[82.70]	
14–16	38.08	25.36	7.64	124.72	40.58	27.53	18.89	115.12
	(11.46)	(23.53)	(10.70)	(21.70)	(15.04)	(28.57)	(16.06)	(24.47)
	[64.90]	[51.66]	[71.52]		[72.87]	[24.03]	[88.37]	

Mean and standard deviation based on those participating. Standard deviations in parentheses and participation rates in brackets. Samples consist of 370 boys, living in 114 households, and 325 girls, living in 99 households, and are drawn from the 1982 and 1985 survey rounds

Domestic work is mainly the domain of girls. Save for the youngest group, the participation rate for girls is above 80 %, whereas the maximum participation rate for boys is 72 % for the 14- to 16- year-olds. Hence, at first glance it appears that boys do a fair amount of work in the home, even if the percentage participation rate

is not as high as for girls. The number of hours for those children who work at home reveal, however, that girls work substantially longer hours than boys. From age 14 on, girls spend an average of twice as much time on domestic work as boys. Boys who do work at home spend approximately one hour a day doing domestic work—no matter their age—while the corresponding figure for girls older than 14 is almost 3 h a day. The difference between boys and girls is also significant with respect to leisure time. Except for the youngest children, the girls have significantly less leisure time than the boys. For the oldest age groups the difference is more than one hour a day.

Table 3 shows the distribution across combinations of different activities by sex and age groups. The left section shows which activities children who were not in school over the week prior to the interview engaged in, and the right section shows the activities for those children who were in school. For the youngest children, the largest group has school as their only activity—61 % for boys and 53 % for girls. The second-largest group consists of those who combine schooling with housework. This is the case for 29 % of the boys and 40 % of the girls.

The number of children whose only activity is school declines substantially with age, falling to 29 % of the boys and 16 % of the girls for the 10- to 13- year-olds. For the oldest group, this number falls to 13 % of the boys and 7 % of the girls. In other words, of those in this middle age group who are still in school, 32 % of boys and 18 % of girls do only school activities. In the oldest age group, 20 % of the boys and 10 % of the girls do only school activities. Of the remainder of those boys still in school, most only do domestic work in addition to school, followed by those who combine house and market activities in addition to school, and finally by those who only do school and market activities. For the girls still in school and performing other activities at the same time, the majority of them do domestic work, with the remainder doing both domestic work and market activities.

2.2 Descriptive statistics

Table 4 presents the descriptive statistics for the explanatory variables. Most of the households consist of one or two parents and a number of children. Only households with two or more observations are included here. Except in cases where a child was either too young to be asked about time allocation, as in the 1982 survey, or too old, as in the 1985 survey, the children were surveyed in both periods. The final sample includes 370 boys from 114 households and 325 girls from 99 households.

A set of dummies captures the age of the child, with 8 years of age the excluded category. The age groups are approximately the same size, which indicates that the children are typically not leaving the parental household until after age 16. As they become older, children are expected to spend more time on market work and domestic work and less time in school.

Parental education is divided into three dummies, with 0–2 years of education the excluded category. The categories are: having 3–5 years of education; having finished primary school, which is equivalent to 6 years of education; and having more than a primary education. Consistent with the school participation rates for the children, more mothers than fathers have a primary school education or above.

Table 3 Combination of activities by sex and age

Age group	Not in school			In school			
	Participates in			Participates in			
	Market but not domestic	Domestic but not market	Both market and domestic	Neither market nor domestic	Market but not domestic	Domestic but not market	Moth market and domestic
Boys							
8–9	0	1	0	48	3	23	4
	[0]	[1]	[0]	[61]	[4]	[29]	[5]
10–13	4	9	5	55	17	69	29
	[2]	[5]	[3]	[29]	[9]	[37]	[15]
14–16	14	17	22	19	10	37	32
	[9]	[11]	[15]	[13]	[7]	[25]	[21]
Girls							
8–9	0	3	0	36	0	27	2
	[0]	[4]	[0]	[53]	[0]	[40]	[3]
10–13	0	15	7	30	2	120	11
	[0]	[8]	[4]	[16]	[1]	[65]	[6]
14–16	6	21	8	9	0	68	17
	[5]	[16]	[6]	[7]	[0]	[53]	[13]

First number in each cell is the number of children. The second number, in square brackets, is the percent of children of that age and sex who engages in the particular combination of activities. Each row adds to 100 %. There are no children who spend their entire time on leisure. Samples consist of 370 boys, living in 114 households, and 325 girls, living in 99 households, and are drawn from the 1982 and 1985 survey rounds

Slightly more than 54 % of the mothers have finished primary education or above, but only 41 % of the fathers have.

The survey contains separate information on land that is owned and used by the household, land that is owned but not operated, and land that is rented. The amount of land owned but not operated is very small and is categories with owner-operated land. Less than 10 % of the children in the sample live in a household that owns land.

Renting land is much more common than owning land. More than half of the children have access to land. Although more land means a higher profit from the agricultural business of the family, it is also possible that a household decides to rent more land because it can employ its own family members on the land. This points to a possible endogeneity problem with using rented land. If a household has children who are better suited for working on the family farm than for going to school, then it may decide to increase both the amount of land that it cultivates and the time their children spend working on it. Hence, both the amount of land rented and the time spent on the different activities are jointly determined by unobservable characteristics of the family and its children. Because rent still has to be paid by the household the a priori expectation is that renting land will increase the time spent in market activities, which includes agricultural production.

The final two variables are dummies for whether the father and the mother are present in the household at the time of the survey. A parent is assumed not to be present if no time use information is collected for that parent. Hence, this definition includes both parents who are deceased and parents who have temporarily or permanently left the household. There is, of course, a potential for a parent being present but refusing to provide time use information, but this does not appear to be a problem, based on other information in the survey. For slightly less than 10 % of the children in the sample, there is no father present, while for around 3 %, no mother is present.

3 Estimation strategy

It follows from the discussion in Rosenzweig and Evenson (1977) that a simple econometric model describing the time allocation of a child can be expressed as

$$H_i^j = \alpha^j + \beta^j I_i + \gamma^j Z_i + \varepsilon_i^j, \tag{1}$$

where H_i^j is the hours spent in an activity j by individual i and α^j, β^j, and γ^j are the coefficients to be estimated, with I_i a vector of individual characteristics, Z_i a vector of household characteristics, and ε_i^j are residuals that are independently and normally distributed, with mean zero and a common variance. The I_i vector includes individual specific characteristics of the child, here only the age dummies because the regressions will be done separately by sex. Household characteristics, included in the Z_i vector, are the education dummies for the father and the mother, the two dummy variables capturing whether or not the parents are present in the household at the time of the survey, and the land holdings of the household.

Table 4 Descriptive statistics

Variable name	Boys	Girls
Child 9 years old	0.097	0.098
	(0.297)	(0.298)
Child 10 years old	0.111	0.098
	(0.314)	(0.298)
Child 11 years old	0.116	0.129
	(0.321)	(0.336)
Child 12 years old	0.097	0.145
	(0.297)	(0.352)
Child 13 years old	0.135	0.135
	(0.342)	(0.343)
Child 14 years old	0.116	0.095
	(0.321)	(0.294)
Child 15 years old	0.108	0.105
	(0.311)	(0.307)
Child 16 years old	0.124	0.102
	(0.330)	(0.303)
Father has 3–5 years of education	0.451	0.351
	(0.498)	(0.478)
Father has finished primary school	0.281	0.320
	(0.450)	(0.467)
Father has more than primary school	0.130	0.194
	(0.336)	(0.396)
Mother has 3–5 years of education	0.349	0.412
	(0.477)	(0.493)
Mother has finished primary school	0.373	0.249
	(0.484)	(0.433)
Mother has more than primary school	0.168	0.222
	(0.374)	(0.416)
Land owned (1=yes, 0=no)	0.073	0.095
	(0.260)	(0.294)
Land rented/leased (1=yes, 0=no)	0.514	0.520
	(0.500)	(0.500)
Father not present (1=yes, 0=no)	0.086	0.095
	(0.281)	(0.294)
Mother not present (1=yes, 0=no)	0.049	0.034
	(0.215)	(0.181)
Number of observations	370	325
Number of households	114	99

Standard deviation in parentheses. For both boys and girls, only children where there are at least two observations are included to allow comparison across OLS and fixed effects estimations. If all children were included there would be 418 boys and 382 girls. Descriptive statistics for all boys and all girls are qualitatively the same and are available upon request. The data are from the 1982 and 1985 survey rounds

Although (1) serves as a convenient starting point, there are at least two issues that should be addressed when estimating the determinants of children's time use. First, the potential bias from unobservable heterogeneity. Second, that all time uses are jointly determined.

The first issue is possible bias from unobservable heterogeneity that is correlated across time uses and individuals. Fixed effects are used to control for unobservable heterogeneity. Ideally, the estimations should control for individual (in this case, child) level heterogeneity.[7] Because each child is observed a maximum of two times and the number of multiple observations of individual children is relatively small, it is not possible to identify individual level heterogeneity. Instead, a specification with household level heterogeneity is used. Two potentially important unobservable characteristics of households that might affect the decisions on children's time allocation are the preferences of the parents and the level and distribution of household members' abilities.

Secondly, even though it is possible to estimate the individual time uses independently, this ignores the correlation between the different time uses and thereby also the correlation in the error terms. Although this will not bias the results, it is, in theory, possible to improve the efficiency of the estimation by taking account of the correlation in the error terms. The sum of the four time uses must, by definition, equal 168 h. This implies that the sum of the constant terms must be 168, because the expected value of the individual error terms, and therefore the sum of the error terms, must be zero. Furthermore, the parameter estimates associated with each independent variable must sum to zero over the four time uses. Estimating a system of three time uses will impose the restrictions, and the parameter for the fourth time use can be recovered using these restrictions.

More importantly, estimating the determinants of time uses jointly provides direct information on aspects of the time use decisions that are of substantial interest, such as the relationship between unobservable characteristics that affect both schooling and working, either at home or in the market. Two correlations are of special interest. The first is the correlation of residuals for an individual. This tells us the extent to which individual unobserved characteristics affect the trade-off between different time uses. The second is the correlation of the unobservable household characteristics. We can answer two questions observing these correlations. First, what is the trade-off in terms of time between the main activities that children engage in? For example, to what extent does working—either in the market or at home—interfere with schooling? Second, to what extent are these trade-offs the result of individual characteristics or household unobservables such as preferences? In other words, how does the introduction of household fixed effect change the estimated parameters and the individual correlation across time uses?

Bringing together the issues discussed above leads to the following estimation strategy. Each time use is first estimated individually using (1) above. The models

[7] An example of child level heterogeneity is the learning ability of a child. A child better suited for receiving schooling might spend more time in school than a child with the same (observable) characteristics but lower ability.

are estimated separately for boys and girls, because it is likely that the variables and correlations between time uses are different for boys and girls. The next step is to introduce the correlation between the error terms of each individual child/year combination. Let the time uses be w, s, c for work, school and domestic work. Thus the jointly estimated set of equations is:

$$H_i^w = \alpha^w + \beta^w I_i + \gamma^w Z_i + \varepsilon_i^w \tag{2}$$

$$H_i^s = \alpha^s + \beta^s I_i + \gamma^s Z_i + \varepsilon_i^s \tag{3}$$

$$H_i^c = \alpha^c + \beta^c I_i + \gamma^c Z_i + \varepsilon_i^c \tag{4}$$

The error terms are distributed jointly normally, $\varepsilon \sim N_3(\mathbf{0}, \Sigma_\varepsilon)$, where Σ_ε is the variance-covariance matrix. The standard deviation and correlation matrix is

$$\begin{bmatrix} \sigma_w & \rho_{w,s} & \rho_{w,c} \\ \rho_{s,w} & \sigma_s & \rho_{s,c} \\ \rho_{c,w} & \rho_{c,s} & \sigma_c \end{bmatrix} \tag{5}$$

where σ_j is the standard deviation of the error term for time use j and $\rho_{j,k}$ is the correlation in the error terms of time uses j and k.

Although this imposes the restrictions on time available, it ignores the issue of unobserved heterogeneity. Equation (1) can be rewritten to include unobserved household heterogeneity, c_k, which leads to

$$H_{ik}^j = \alpha^j + \beta^j I_{ik} + \gamma^j Z_k + c_k^j + \varepsilon_{ik}^j, \tag{6}$$

for individual i in household k. This is estimated using a fixed effects model.

Finally, the two models are combined to allow for correlation in error terms and unobserved household heterogeneity simultaneously.

$$H_{ik}^w = \alpha^w + \beta^w I_{ik} + \gamma^w Z_k + c_k^w + \varepsilon_{ik}^w \tag{7}$$

$$H_{ik}^s = \alpha^s + \beta^s I_{ik} + \gamma^s Z_k + c_k^s + \varepsilon_{ik}^s \tag{8}$$

$$H_{ik}^c = \alpha^c + \beta^c I_{ik} + \gamma^c Z_k + c_k^c + \varepsilon_{ik}^c \tag{9}$$

The individual error terms are still distributed normally, $\varepsilon \sim N_3(\mathbf{0}, \Sigma_\varepsilon)$, with Σ the variance-covariance matrices. For both the individual error term and the household component, what is presented is the standard deviation and correlation matrix as

shown above for the individual error term in (5). Estimations are done using aML, which is freely available on-line.[8]

4 Determinants of time use

Tables 5, 6, 7, 8, 9, 10 present the determinants of time spent on work, school, and domestic work for boys and girls, respectively. For each time use, the first column shows standard OLS estimated for each separate time use. The second column shows OLS results allowing for correlation in the error term across the three time uses. The third column shows household fixed effects results for each time use estimated separately. Finally, the fourth column presents the full model, with correlation across the individual error terms and household fixed effects.

The results are discussed by type of explanatory variable, focusing on those that are most policy relevant based on the household fixed effects results. The introduction of household fixed effects and joint estimation can impact both the estimated coefficients and their precision. For some of the variables, there are substantial differences in the estimated effects between OLS and fixed effects results indicating that unobserved heterogeneity is, indeed, important. These differences are also discussed.

Land owned is often considered a measure of household wealth in development economics. Relative few children in the sample live in households that own land, but there is enough variation between the two survey rounds to estimate the effect using household fixed effects. The main effect of owning land is a statistically significant increase in the amount of time boys spend on school activities, and this effect is substantial, with an increase of more than 10 h per week. Contrary to boys, there is no statistically significant change in the time spent in school for girls. Owning land is not associated with any substantial changes in the time spent on market activities or domestic work for boys or girls. This effect is consistent with households that own land being wealthier than households that do not, although it does not explain the difference in effect between boys and girls.[9]

Renting land is associated with a statistically significant reduction in boys' time spent on household chores of about 4.5 h per week. The result for girls' time spent on school activities is puzzling with a large and statistically significant reduction of almost 10 h per week. None of the other effects are statistically significant for either boys or girls. It is unclear what is behind the large effect for girls' schooling, especially since there does not appear to be a corresponding increase in the other two estimated time uses. The OLS results show that having more rented land appears to lead to an increase in the amount of work for boys whereas the fixed effect results show the opposite, that there is, in fact, no effect of rented land on boys' market activities. As discussed above the decision to rent land is potentially endogenous to the time allocation decision for children. The results here show that the large increase in boys' time working according to the OLS results is most likely

[8] The program can be downloaded at http://www.applied-ml.com/.

[9] A similar results is seen in India (Kis-Katos 2012).

Table 5 Determinants of boys' time spent on work

	OLS		Fixed Effects	
	Single equations	Jointly estimated	Single equations	Jointly estimated
Child 9 years old	0.771	0.769	2.221	2.217
	(1.981)	(1.928)	(2.817)	(2.174)
Child 10 years old	−1.570	−1.572	−4.279	−4.290*
	(1.900)	(1.850)	(3.148)	(2.321)
Child 11 years old	0.056	0.058	−0.799	−0.809
	(2.020)	(1.966)	(2.959)	(2.210)
Child 12 years old	4.526	4.512	6.822*	6.837**
	(3.148)	(3.065)	(3.633)	(2.841)
Child 13 years old	4.180*	4.184*	1.954	1.963
	(2.288)	(2.228)	(3.239)	(2.403)
Child 14 years old	7.947**	7.940**	9.783***	9.779***
	(3.482)	(3.392)	(3.570)	(2.474)
Child 15 years old	12.010***	12.010***	13.507***	13.498***
	(3.277)	(3.191)	(3.376)	(2.548)
Child 16 years old	14.781***	14.772***	16.326***	16.363***
	(3.938)	(3.835)	(3.948)	(2.915)
Father has 3–5 years of education	−4.400	−4.394		
	(3.488)	(3.397)		
Father has finished primary school	−6.567*	−6.564*		
	(3.453)	(3.362)		
Father has more than primary school	−8.092**	−8.070**		
	(3.371)	(3.282)		
Mother has 3–5 years of education	6.767**	6.756**		
	(3.095)	(3.014)		
Mother has finished primary school	1.000	0.998		
	(2.707)	(2.636)		
Mother has more than primary school	3.344	3.343		
	(2.968)	(2.891)		
Land owned	−0.947	−0.944	−0.313	−0.317
	(2.512)	(2.446)	(5.093)	(4.496)
Land rented/leased	6.609***	6.606***	0.423	0.431
	(1.711)	(1.666)	(4.761)	(3.423)
Father not present	2.339	2.340	9.774	9.772**
	(2.694)	(2.623)	(6.194)	(4.339)
Mother not present	5.089	5.094	6.115	6.138
	(4.815)	(4.691)	(10.342)	(8.164)
Constant	−0.485	−0.483		
	(3.679)	(3.582)		

Asymptotic Huber-corrected standard errors in parentheses; * sign. at 10%; ** sign. at 5%; *** sign. at 1%. Sample consists of 370 boys, living in 114 households

related to unobservable household or child characteristics, such as sons in households that rent land being more suited for work than school. The end result is that we should worry less about the boys in households that rent land, and examine if the negative effect on girls' schooling is supported in other data using fixed effects.

Another important set of variables is the presence of parents in the household. For boys there there is a sizable and statistically significant increase in the time spent on market activities when the father is absent; boys with an absent father work almost 10 h a week longer than boys without an absent father. The number of hours in domestic work and school activities also increases but these effects are not statistically significant. In other words, boys end up with substantially less leisure time when their fathers are absent. The extent to which this has an overall negative or positive effect on later outcomes depends on whether any negative effects of increased time spent working on the ability to do well in school outweigh the positive effect of the increased experience in the labor market.[10] Girls experience no statistically significant changes in the time spent on the three activities, although having a father absent does lead to a more than one hour a day decrease in time spent on school activities.

The most important effect here is, however, what happens to girls' time use due to the absence of the mother. The fixed effect results show a very large decrease—around 26 h a week—in the time girls spent on schooling. A decrease of this size is essentially equivalent to the girls dropping out of school. Interestingly, there does not appear to be a corresponding increase in the number of hours spent on domestic work or market activities. A possible reason is that these girls might already be working more in response to future absence of their mother as would happen if the mother is sick, for example. The increased work load is, however, only possible as a temporary response and once the mother is absent the effect on schooling kicks in. This would also explain the difference between the OLS and fixed effects results, with the fixed effects results much larger than the OLS results, since the sickness of the mother would be an unobserved household characteristics. That is, the OLS results mask how bad the absence of the mother really is for girls when it comes to schooling. This is in line with Ainsworth et al. (2005), who, in Tanzania, find significantly lower hours in school in the months preceding the loss of a parent, and a sharp reduction in hours in school immediately after the that loss.

There is unfortunately no information in the survey on the reasons why a parent may be absent. There are two main possibilities: the parent has either migrated in search of work or has died.[11] If the parent has migrated and is able to transfer money back to the household, we would expect an income effect from these remittances. This might be what we see for boys with respect to school, but clearly the boys also end up working more, presumably on the family farm. The very large reduction in

[10] See, for example, Beegle et al. (2009) for an example from Vietnam, where the increased experience in the labor market outweighs the reduced time in school.

[11] Fostering is less prevalent in the Philippines than other places, so we are not picking up children from other households where we know that their parents have died. For a discussion of the effect of parental death in circumstances where fostering is prevalent see, for example, Ainsworth (1996), Zimmerman (2003), Akresh (2007), and Coneus et al. (2012).

Table 6 Determinants of boys' time spent on schooling

	OLS		Fixed Effects	
	Single equations	Jointly estimated	Single equations	Jointly estimated
Child 9 years old	4.363	4.359	6.229	6.231**
	(2.818)	(2.744)	(4.125)	(2.690)
Child 10 years old	0.743	0.756	3.870	3.886
	(3.237)	(3.152)	(4.038)	(2.685)
Child 11 years old	3.351	3.349	5.258	5.263**
	(3.131)	(3.048)	(3.607)	(2.484)
Child 12 years old	1.534	1.542	3.656	3.660
	(3.650)	(3.554)	(4.651)	(2.890)
Child 13 years old	−4.913	−4.904	−4.575	−4.569
	(3.732)	(3.634)	(4.220)	(2.811)
Child 14 years old	−8.018**	−7.996**	−6.907	−6.899**
	(3.866)	(3.765)	(4.473)	(2.807)
Child 15 years old	−11.090***	−11.091***	−10.315**	−10.313***
	(4.197)	(4.087)	(4.549)	(3.360)
Child 16 years old	−15.175***	−15.168***	−14.701***	−14.694***
	(3.762)	(3.664)	(4.515)	(2.766)
Father has 3–5 years of education	7.655**	7.651***		
	(3.027)	(2.948)		
Father has finished primary school	11.949***	11.942***		
	(3.219)	(3.135)		
Father has more than primary school	8.355**	8.342**		
	(3.916)	(3.813)		
Mother has 3–5 years of education	0.458	0.453		
	(3.040)	(2.961)		
Mother has finished primary school	3.030	3.030		
	(3.327)	(3.240)		
Mother has more than primary school	5.142	5.131		
	(3.610)	(3.516)		
Land owned	−1.049	−1.059	10.115	10.115**
	(3.301)	(3.215)	(6.497)	(4.096)
Land rented/leased	−0.352	−0.366	0.392	0.387
	(1.972)	(1.920)	(5.703)	(2.246)
Father not present	2.044	2.036	2.448	2.440
	(2.562)	(2.495)	(6.089)	(3.086)
Mother not present	−1.337	−1.342	9.139	9.137**
	(4.240)	(4.130)	(8.672)	(4.039)
Constant	25.807***	25.825***		
	(4.194)	(4.085)		

Asymptotic Huber-corrected standard errors in parentheses; * sign. at 10 %; ** sign. at 5 %; *** sign. at 1 %. Sample consists of 370 boys, living in 114 households

Table 7 Determinants of boys' time spent on domestic work

	OLS		Fixed Effects	
	Single equations	Jointly estimated	Single equations	Jointly estimated
Child 9 years old	0.441	0.453	−2.342	−2.324
	(1.757)	(1.710)	(2.492)	(1.889)
Child 10 years old	0.702	0.692	1.144	1.130
	(1.975)	(1.922)	(2.078)	(1.544)
Child 11 years old	0.696	0.699	−1.211	−1.200
	(1.611)	(1.568)	(2.349)	(1.755)
Child 12 years old	4.405*	4.374*	2.823	2.820
	(2.573)	(2.505)	(2.560)	(1.767)
Child 13 years old	4.327*	4.308**	5.247*	5.203**
	(2.202)	(2.144)	(2.946)	(2.103)
Child 14 years old	5.328**	5.293**	5.674**	5.663***
	(2.577)	(2.508)	(2.741)	(2.005)
Child 15 years old	3.149*	3.151*	3.619	3.614**
	(1.843)	(1.795)	(2.362)	(1.648)
Child 16 years old	2.119	2.123	3.815	3.798**
	(1.910)	(1.860)	(2.571)	(1.658)
Father has 3–5 years of education	1.385	1.370		
	(1.614)	(1.571)		
Father has finished primary school	0.199	0.211		
	(1.760)	(1.713)		
Father has more than primary school	−2.126	−2.136		
	(1.518)	(1.477)		
Mother has 3–5 years of education	−0.085	−0.041		
	(2.389)	(2.325)		
Mother has finished primary school	1.665	1.678		
	(2.469)	(2.406)		
Mother has more than primary school	−1.078	−1.037		
	(2.242)	(2.180)		
Land owned	−0.983	−0.969	−4.877	−4.853
	(1.690)	(1.645)	(5.168)	(4.167)
Land rented/leased	−1.587	−1.557	−4.422	−4.422*
	(1.231)	(1.195)	(5.079)	(2.489)
Father not present	−2.744**	−2.719**	2.233	2.236
	(1.230)	(1.193)	(2.390)	(1.415)
Mother not present	1.528	1.532	1.908	1.868
	(3.051)	(2.970)	(5.626)	(4.784)
Constant	2.673	2.619		
	(2.538)	(2.4660)		

Asymptotic Huber-corrected standard errors in parentheses; * sign. at 10 %; ** sign. at 5 %; *** sign. at 1 %. Sample consists of 370 boys, living in 114 households

Table 8 Determinants of girls' time spent on work

	OLS		Fixed Effects	
	Single equations	Jointly estimated	Single equations	Jointly estimated
Child 9 years old	0.591	0.602	−0.002	−0.028
	(0.934)	(0.900)	(3.120)	(2.450)
Child 10 years old	2.904	2.857	3.799	3.783*
	(1.936)	(1.873)	(2.751)	(2.170)
Child 11 years old	1.754	1.754	2.062	2.053
	(1.260)	(1.218)	(2.184)	(1.721)
Child 12 years old	0.362	0.347	0.295	0.290
	(0.824)	(0.791)	(2.783)	(2.196)
Child 13 years old	4.844***	4.810***	5.605**	5.618**
	(1.635)	(1.580)	(2.810)	(2.284)
Child 14 years old	5.797*	5.711*	8.145**	8.111***
	(3.070)	(2.969)	(3.506)	(2.810)
Child 15 years old	11.855***	11.613***	13.286**	13.327***
	(4.273)	(4.119)	(5.130)	(4.048)
Child 16 years old	7.373**	7.287**	12.505***	12.522***
	(3.281)	(3.177)	(4.147)	(3.333)
Father has 3–5 years of education	3.501*	3.432*		
	(1.985)	(1.916)		
Father has finished primary school	−0.773	−0.747		
	(1.684)	(1.628)		
Father has more than primary school	0.178	0.185		
	(2.815)	(2.727)		
Mother has 3–5 years of education	2.627	2.571		
	(2.197)	(2.125)		
Mother has finished primary school	−0.870	−0.931		
	(2.212)	(2.139)		
Mother has more than primary school	−1.783	−1.787		
	(2.427)	(2.350)		
Land owned	−1.532	−1.492	1.854	1.843
	(1.615)	(1.563)	(2.492)	(1.977)
Land rented/leased	−1.507	−1.486	−0.521	−0.512
	(1.616)	(1.567)	(4.552)	(3.302)
Father not present	1.274	1.273	−3.827	−3.779
	(2.181)	(2.117)	(7.557)	(5.946)
Mother not present	−1.602	−1.519	−3.052	−3.064
	(3.914)	(3.784)	(2.407)	(2.170)
Constant	−0.742	−0.696		
	(2.399)	(2.321)		

Asymptotic Huber-corrected standard errors in parentheses; * sign. at 10 %; ** sign. at 5 %; *** sign. at 1 %. Sample consists of 325 girls, living in 99 households

Table 9 Determinants of girls' time spent on schooling

	OLS		Fixed Effects	
	Single equations	Jointly estimated	Single equations	Jointly estimated
Child 9 years old	10.446***	10.442***	5.706	5.750*
	(3.863)	(3.748)	(4.533)	(3.320)
Child 10 years old	7.677**	7.694**	9.069*	9.072***
	(3.717)	(3.606)	(4.701)	(3.490)
Child 11 years old	16.142***	16.146***	13.285***	13.274***
	(3.526)	(3.421)	(3.739)	(2.572)
Child 12 years old	14.535***	14.540***	11.223***	11.219***
	(3.725)	(3.614)	(3.788)	(2.594)
Child 13 years old	6.520	6.539	5.948	5.953*
	(4.452)	(4.319)	(4.437)	(3.162)
Child 14 years old	5.143	5.183	4.343	4.335
	(4.366)	(4.235)	(4.776)	(3.357)
Child 15 years old	5.641	5.728	2.628	2.613
	(5.008)	(4.859)	(5.213)	(3.607)
Child 16 years old	8.686*	8.732*	6.309	6.272
	(5.044)	(4.893)	(5.546)	(3.823)
Father has 3–5 years of education	−0.204	−0.182		
	(3.129)	(3.036)		
Father has finished primary school	8.329**	8.316***		
	(3.280)	(3.182)		
Father has more than primary school	−0.865	−0.873		
	(4.354)	(4.223)		
Mother has 3–5 years of education	−5.263	−5.255		
	(3.426)	(3.323)		
Mother has finished primary school	3.609	3.624		
	(3.913)	(3.795)		
Mother has more than primary school	4.026	4.020		
	(4.242)	(4.112)		
Land owned	4.424	4.411	−0.149	−0.139
	(3.639)	(3.531)	(6.152)	(4.101)
Land rented/leased	1.124	1.106	−9.274	−9.254**
	(2.404)	(2.332)	(7.417)	(3.659)
Father not present	−0.957	−0.942	−6.019	−6.081
	(3.796)	(3.684)	(6.722)	(4.507)
Mother not present	−8.236	−8.265	−25.169***	−25.201***
	(5.908)	(5.733)	(8.898)	(7.132)
Constant	22.185***	22.181***		
	(4.776)	(4.633)		

Asymptotic Huber-corrected standard errors in parentheses; * sign. at 10 %; ** sign. at 5 %; *** sign. at 1 %. Sample consists of 325 girls, living in 99 households

Table 10 Determinants of girls' time spent on domestic work

	OLS		Fixed Effects	
	Single equations	Jointly estimated	Single equations	Jointly estimated
Child 9 years old	0.201	0.196	2.140	2.150
	(2.692)	(2.612)	(2.926)	(2.321)
Child 10 years old	1.191	1.188	4.861	4.863*
	(2.493)	(2.418)	(3.232)	(2.544)
Child 11 years old	4.932**	4.927**	8.059***	8.061***
	(2.428)	(2.356)	(2.573)	(1.990)
Child 12 years old	4.862*	4.862**	7.898***	7.897***
	(2.530)	(2.455)	(2.945)	(2.341)
Child 13 years old	12.622***	12.626***	14.098***	14.081***
	(3.423)	(3.321)	(3.417)	(2.739)
Child 14 years old	11.299**	11.315***	15.600***	15.606***
	(3.116)	(3.022)	(3.107)	(2.474)
Child 15 years old	16.107***	16.146***	18.796***	18.763***
	(3.728)	(3.620)	(4.525)	(3.535)
Child 16 years old	8.474***	8.493***	11.481***	11.472***
	(2.848)	(2.763)	(3.486)	(2.768)
Father has 3–5 years of education	−1.904	−1.899		
	(2.699)	(2.617)		
Father has finished primary school	−0.384	−0.389		
	(2.724)	(2.642)		
Father has more than primary school	1.021	1.018		
	(3.135)	(3.041)		
Mother has 3–5 years of education	3.995	4.012		
	(2.588)	(2.512)		
Mother has finished primary school	2.463	2.473		
	(2.759)	(2.678)		
Mother has more than primary school	−2.967	−2.965		
	(2.829)	(2.745)		
Land owned	−1.326	−1.332	−2.645	−2.628
	(1.829)	(1.775)	(4.422)	(3.383)
Land rented/leased	−0.176	−0.182	−5.115	−5.122
	(1.551)	(1.505)	(5.877)	(4.222)
Father not present	−4.756***	−4.755***	−2.681	−2.692
	(1.743)	(1.691)	(3.964)	(2.878)
Mother not present	7.339*	7.312*	−2.061	−2.078
	(4.411)	(4.279)	(3.506)	(2.819)
Constant	3.687	3.682		
	(3.490)	(3.386)		

Asymptotic Huber-corrected standard errors in parentheses; * sign. at 10 %; ** sign. at 5 %; *** sign. at 1 %. Sample consists of 325 girls, living in 99 households

Table 11 Correlation of residuals and fixed effects between time uses

	OLS Jointly estimated	Fixed effects Jointly estimated
	Boys	
	Correlation of individual residuals	
ρ(Work, school)	−0.319***	−0.304***
	(0.049)	(0.053)
ρ(Work, domesticwork)	−0.085*	−0.221***
	(0.044)	(0.063)
ρ(School, domesticwork)	−0.119**	−0.106*
	(0.060)	(0.056)
	Correlation of household fixed effects	
ρ(Work, school)		−0.279**
		(0.003)
ρ(Work, domesticwork)		0.149
		(0.114)
ρ(School, domesticwork)		−0.117
		(0.215)
	Girls	
	Correlation of individual residuals	
ρ(Work, school)	−0.310***	−0.177***
	(0.051)	(0.057)
ρ(Work, domesticwork)	−0.091	−0.180***
	(0.057)	(0.064)
ρ(School, domesticwork)	−0.166***	−0.219***
	(0.060)	(0.055)
	Correlation of household fixed effects	
ρ(Work, school)		−0.420***
		(0.000)
ρ(Work, domesticwork)		0.116
		(0.254)
ρ(School, domesticwork)		−0.021
		(0.839)

Asymptotic Huber-corrected standard errors in parentheses; * sign. at 10 %; ** sign. at 5 %; *** sign. at 1 %. Samples consist of 370 boys, living in 114 households, and 325 girls, living in 99 households

girls' time in school when the mother is not present suggests that it is more likely that the mother has died, although it is unclear in that scenario why boys would not also be more negatively affected by the mother's absence. Boys, in fact, seem to experience an increase in time spent on school activities when their mother is absent. One possible explanation is that, with the mother absent, there are no or fewer checks on the father's preference for sons' schooling (see, for example, Thomas 1994).

The effect of parents' education on children's time use can only be estimated for the two OLS models, because parental education does not vary between children or survey rounds. The discussion of the effects of parental education focuses on the jointly estimated OLS models. For boys, increasing fathers' education leads to less time spent working and more time in school. This effect has strong statistical significance. Most of the extra time spent in school comes from time spent not working. There is an almost a one-to-one trade-off between the two time uses for fathers' education. The time boys spent on domestic work is not statistically significantly affected by their fathers' education. These results are consistent with a strong income effect from an increase in fathers' education. The more education the father has, the less time boys need to work in market activities and the more money the family has to spend on schooling and school supplies.

Mothers' education does not have a statistically significant effect on sons' time use, except for mothers with 3–5 years of education, whose sons show an increase in the time worked, compared to sons of mothers with no education. This increase comes almost entirely from a reduction in leisure.

The effect of parental education on girls' time use is more variable. Compared with the no education group, girls of fathers with 3–5 years of education spend significantly more hours in work activities and significantly less on domestic work, but there is no effect on the number of hours spent in school. Having a father who has finished primary school leads to a statistically significant increase in hours spent in school. This extra time appears to come primarily from a reduction in domestic work, although this reduction is not statistically significant. There is no statistically significant effect of having a father who has more than a primary education on any of the time uses, relative to a father with no education.

There are no statistically significant effects of mothers' education on girls' time use. There is, however, some evidence that as a mother's education increases, her daughters initially spend more time on domestic work and less on school, but eventually this trend is reversed, and as the mother's education increases even further, the daughters spend less time on domestic work and more time in school. This is consistent with the two competing effects resulting from an increase in the mother's education: more education results in higher income, but also makes the mother's time more valuable. For lower education levels, the higher opportunity cost of the mother's time leads to a reduction in time spent in school and an increase in time spent on domestic work, whereas for higher education levels, the income effect comes to dominate, leading to more schooling and less housework.

Finally, age is captured by year dummies, where the excluded category is 8 years of age. For boys, growing up is associated with substantial and statistically significant increases in time spent on market activities and a corresponding substantial and statistically significant reduction in time spent on schooling activities. There is also a statistically significant increase in time spent on domestic work, but that effect is smaller. The trade-off between work and school is essentially one-to-one for boys older than 13 years of age. As girls grow older, they experience statistically significant and substantial increases in time spent on market activities and domestic work. Schooling increases initially, but after age 12, time spent on schooling drops. The overall effect for girls is a substantial decrease in leisure time

as they grow up. A 16-year-old girl has about 30 fewer hours of leisure time than a 8-year-old girl, whereas for boys there is only a 4-hour difference in leisure time between a 16-year-old and a 8-year-old.

4.1 Unobserved characteristics and joint estimation

One of the advantages of jointly estimating the determinants of children's time use is that it allows us to examine the extent to which households see school and other activities as substitutes. Table 11 shows the correlation coefficients for individual residuals across time uses and the correlation coefficients of estimated household fixed effects across time uses. If there is a very high correlation this would be indicative of substantial direct trade-offs between the two time uses, whereas a correlation coefficient closer to 0 would show that the two time uses can co-exist and that increasing, say time spent working, does not in itself decrease, say schooling.[12]

For the individual residuals, what stand out are the very low levels of correlations between school and market activities and between school and domestic work—although they are all statistically significantly different from 0. For boys, the individual level correlation between school and work is about -0.3 and the correlation between school and domestic work is even lower at around -0.1. For girls, the correlations are around -0.3 for school versus work and -0.17 for school versus domestic work. An interesting facet of this analysis is that once household fixed effects are controlled for the estimated correlation between school and domestic work, residuals increase by about one-third for girls. One interpretation of this is that there is some degree of specialization going on in the households, meaning that some girls focus more on domestic work and others on school.

Even with a potential downward bias in the correlations, the size of the correlations strongly suggests that the individual unobserved characteristics do not lead to a one-to-one trade-off between school and working, either at home or in the marketplace. These results reinforced the conclusion from above that most of the changes in time use come from changes in the amount of leisure time that a child has. It also indicates that the trade-off between work (both market and domestic) and schooling may not be as direct as has often been believed.[13]

The household fixed effects estimates show a strong and statistically significant correlation only between school and work, which holds for both boys and girls. For boys, the correlation in household fixed effects between time in school and time spent on market activities is close to -0.28, whereas for girls it is -0.42. This indicates that, at least for girls, there is a relatively stronger trade-off between time spent on school and time spent working at the household level that is not captured

[12] One caveat is that the estimated correlations are potentially biased downward if one or more time uses are at 0. If, say, time spent in school is already at 0, then increasing time spent working obviously cannot decrease time in school any further. As shown in Tables 2, 3, this is mainly an issue for very young children where few participate in market activities.

[13] One of the few papers to examine this questions is Ravallion and Wodon (2000), who for Bangladesh show that child labor does not displace schooling completely. The results here indicate that this result holds even when controlling for unobserved household characteristics.

by the included variables. That said, there are relatively few girls who spend a substantial amount of time working, but this may be particularly driven by unobservable household characteristics. The other correlations are all statistically insignificant.

Another potential advantage of jointly estimating the determinants of time use is that it may improve the precision of the estimates. There are some changes in the parameter estimates themselves, but most are small. The main differences in the estimated parameters are instead between the OLS and fixed effects models as detailed above. The results do, however, show that the parameters in jointly estimated models have higher levels of significance in many cases. Without joint estimations, the effect of parental absence on boys' work and time in school appears to be statistically insignificant. The same is the case for the effects of land owned on girls' time in school and the effects of the absence of a girl's father on domestic work. Hence, it is clearly important to take seriously not just the unobserved heterogeneity of households, but also that time use decisions are interrelated.

5 Conclusion

The allocation of children's time, especially the amount of work they perform, has long attracted attention, partly because of the possible direct negative consequences of child labor but especially because working, either at home or in the market, may interfere with schooling and a child's future prospects. This paper contributes to the literature by highlighting the importance of controlling for unobservable household characteristics and allowing for joint estimation of all time uses, thereby providing a much more complete picture of how distribution of time in different activities is affected by changes in variables.

The incorporation of household fixed effects allows unbiased estimation of the effect of variables that would otherwise be endogenous under standard OLS. Two such important set of variables are parental absence and land access for the household. The household fixed effects results show a strong negative effect of mother's absence on girls' schooling; the effect is essentially equivalent to spending no time on schooling at all. Father's absence only significantly affects boys, mainly through an increase in the time they spend on market activities, although this time appears to come out of leisure rather than school or doing household chores. Renting land reduced the time girls spend on school, whereas owning land works similarly to a wealth effect and increase the time boys spend on school.

There is a large prior literature on children's time use in developing countries, but most of this research has used relatively simple estimation methods and cross-sectional data. An important methodological result of this paper is the importance of controlling both for household unobservable characteristics and the joint nature of the time use decisions. Taking account of household fixed effects leads to substantial changes in some of the estimated effects of important factors such land access and parental absence. These household characteristics are potentially endogenous to the household's decision on the allocation of children's time use, underscoring the importance of addressing the potential for bias. Furthermore, a

number of estimated effects only become statistically significant when allowing for correlation of residuals across the different time uses.

One of the advantages of jointly estimating determinants of time use is that it provides a direct way to examine the trade-off between different time uses. The results presented here show that few of the explanatory variables and none of correlations of unobservable characteristics suggest a one-to-one trade-off between the activities examined. The correlation of individual residuals across time uses are all only in the range from -0.1 to -0.3 and therefore far from a one-to-one trade-off. In other words, unobserved individual characteristics, such as innate ability, do not, on average, lead children to give up one activity exclusively in order to increase participation in another. Rather, the extra time spent in an activity tends to come from a combination of other activities, often leisure. The inclusion of household fixed effects also allows us to examine the correlation across time uses in unobserved household characteristics. Here only the correlation between school and work is statistically significant, and, although larger than the correlation of individual residuals, still far from -1. The largest correlation is for girls at -0.42, whereas boys' correlation of household fixed effects is less than -0.3. Hence, controlling for unobserved household heterogeneity, child labor does not completely displace schooling.

The results presented here have important policy implications that are often different from those suggested by less sophisticated methods. Ignoring household heterogeneity and correlation across time uses there does not appear to be a strong effect of having an absent mother on girls, but as shown here this effect is, in fact, very important and in line with what the small literature on parental death indicates. Potential policies here is increased support, either financial or otherwise, to households where the mother is absent. The opposite is the case for the effect of renting land on boys' time spent working, which the OLS results suggests is a large increase. The results here show, however, that this effect disappear when controlling for household fixed effects, meaning that instead of directly affecting a household's renting of land there are other avenues that are better pursued. The results on trade-offs between work, both at home and in the market, and schooling suggests that if the goal is increasing school attainment of children, we should focus directly on policies to that effect, rather than on reducing time spent working. For example, banning child labor or implementing boycotts is likely much less effective in increasing schooling than policies that directly help children go to school, such as conditional cash transfers. That being said, it is possible that those children who still spent time working might do less well in school and that this needs to be addressed to achieve the desired outcomes.

A better understanding of the trade-offs between working and school achievement is one important area for future research. An addition area of future research that should be of special interest is whether incorporating household heterogeneity leads to substantial changes in the effect of household variables on long-term outcomes such as education and health. This question requires a more thorough examination of how decisions on time use, human capital, and fertility decisions interplay. In addition, a more detailed analysis that explicitly models the changes

over time for households could provide a clearer idea of how exactly fertility and time use are connected, and how they respond to changing conditions.

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