Household income dynamics and investment in children: Evidence from India

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Abstract:

Shocks to households in developing countries impact the investment in the education of children. In this paper, we explore the effects of various income and expenditure shocks on educational investment and cognitive outcomes in children. We use three rounds of household-level panel data from Young lives survey conducted in two southern states of India, Andhra Pradesh and Telangana. We use Dynamic Panel data model using system General Method of Moments (GMM) estimator for investigating the impact of various income and expenditure shocks on children's education and cognitive abilities. we find that idiosyncratic shocks like paternal health shocks and livestock loss translate into lower inputs of children's education which in turn reduce their cognitive ability captured through vocabulary and mathematics tests. We also find that these shocks mainly affect children's development through decreased time spent in school.

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1. Introduction

Investment in the education of children is important for the human capital formation and productivity during the later part of life. Child's family plays a very important role in the development of the human capital through a decision to enroll children in school, keep children in school, determining their time allocation between work and study, providing the physical resources, providing emotional care. Families' decisions regarding investment in the human capital of their children have important long-run consequences for their welfare (Ferreira and Schady, 2009). Due to the important role played by the family, shocks that affect the family affect the children. In this paper, we focus on the impact of shocks on education of children.

Households in developing countries are frequently exposed to a broad array of shocks. These shocks cause large disruptions in households along with large income fluctuations in the household (Murdoch, 1995). Shocks can be classified into two types - idiosyncratic shocks and covariate shocks. Idiosyncratic shocks are shocks that affect individual households like illness, injury or death of family members, job loss, farm or business loss, theft or destruction of property. Covariate shocks are aggregate shocks that affect groups of household, communities, regions or even entire countries like natural disasters, changes in food prices, economic crisis. The shocks can be both positive and negative. In this paper, we focus on negative shocks.

Developing countries are characterized by lower income levels, more shocks and lower opportunities for the diversification of such shocks, because of thin insurance markets and the comparatively more acute presence of borrowing constraints (Fitzsimons, 2007). These characteristics of developing countries create the need for households to develop alternative ways of coping with risk. If households can smooth income (by diversifying into production activities which entail low levels or risk) or consumption (through borrowing, saving and insurance mechanisms) then income fluctuations are not likely to translate into welfare loses for shock-exposed households (Ahmed, 2015). In less developed countries, where incomes are low and erratic, the impact of market incompleteness on human capital accumulation is potentially large (Jacoby and Skoufias, 1997).

Numerous studies have estimated the impact of various shocks on educational outcomes in developing countries: Weather shocks (Jensen, 2010; Thai and Falaris, 2014; Shah and Steinberg, 2013; Abiona, 2007; Zamanand, 2016; Baez and Santos, 2016; Deuchert and Felfe, 2013), macroeconomic shocks (Hou et. al., 2016; Grimm, 2008; Cogneau and Jedwab, 2012; Ferreira and Schady, 2009; Rucci, 2003; Beegle et al, 2004; Singh, 2013), farm yield or job loss (Duryea et. al., 2007; Guarcello et. al., 2010; Janvry et. al., 2006; Dasgupta and Ajwad, 2011; Dung, 2013; Beegle et al, 2003; Woldehanna and Hagos, 2012; Glick et. al., 2016; Kayser, 2013), health shocks (Woode, 2017; Dinku et. al., 2017; Sun and Yao, 2010; Woldehanna and Hagos, 2012; Evans and Miguel, 2007), and fertility shocks (Kpein et. al., 2012; Glick et. al., 2007).

These studies consider various outcome indicators to test the impact on education. Input variables such as expenditure on education (Dung,2013; Dasgupta and Ajwad, 2011; Beegle et al , 2004) and decision to enroll in school(Guarcello et al ,2010; Ferreira and Schady , 2009, output variables such as school enrolment (Jensen ,2000; Janvry et al,2006; Cogneau and Jedwab ,2012; Baez and Santos ,2007; Grimm,2008; Kayser , 2013; Deuchert and Felfe ,2013), school dropout (Glick et al ,2016; Duryea et al, 2007; Dung, 2013; Kpein et al, 2012), child labour(Beegle et al, 2003; Nandi and Maio, 2010; Baez and Santos ,2007; Singh, 2013), schooling, study time etc (Dung, 2013) and outcome variables such as Cloze Test, PPVT (Peabody Picture Vocabulary Test) and mathematics test Scores (Fink and Rockers, 2014; Singh and Sarkar, 2015; Crookston et al, 2014; Shah and Steinberg, 2013; Deuchert and Felfe, 2013; Zamand, 2016) are used to capture investment in education.

We use the Young lives data of three rounds to study the impact of shocks on these indicators. We focus on the younger cohort of the Young lives sample as this sample provides panel data for a longer period for mathematics test and The Peabody Picture Vocabulary Test (PPVT). We use system Generalized method of moments (GMM) to effectively capture the panel structure with a low number of time periods and large observations. We find that crop shocks and drought increase the time spent at school while a livestock shock decreases time spent at school and increases work time. Maternal and paternal health shocks have a different impact on children. Paternal health shock decreases time spent in school while a maternal health shock increases the time spent in school but decreases study time at home. Drought increases score in the cognitive ability test while a livestock and paternal heath shock decrease the score in the mathematics test.

In this paper, we expand on the existing literature in a number of ways. There has been a lot of studies that analyze the impact of various shocks on the investment in education. But such studies are rare in the Indian context, mostly due to unavailability of longitudinal data on shocks and investments in children. Among those studies that have analyzed the impact of shocks on children's human capital, they focus on specific indicators of human capital. Such an approach does not throw light on the mechanism through which shocks affect investments in human capital. Even though these numerous studies consider the impact of these shocks one education, these studies concentrate on one or two shocks in general. In this paper, we examine the impact of a wide variety of shocks, both covariate and idiosyncratic on child human capital. Such multi-shocks studies help to understand better which shocks predominate, and which have inter-generational effects in terms of translating to poorer outcomes for children's human capital. n the Indian context, the studies that analyzed investment in child human capital focused economic and household characteristics. Those limited number of studies that have assessed the impact of shocks on investment in child human capital mainly focused on health shocks and climatic shocks only. We study the impact of these shocks on input indicators (time spent in schools, studying at home and working) and outcome indicators that measure cognitive achievement of children through PPVT test and mathematics.

The rest of the paper is organized as follows: section two describes the data used, section three describes the methodology, section four presents the results, section five discusses the limitations and future directions.

2. Data

This study uses the longitudinal dataset of Young Lives project that follows the lives of approximately 12,000 children in four low and middle-income countries (Ethiopia, India, Peru, and Vietnam). In India, the survey is conducted in the state of Andhra Pradesh and four rounds have been completed (2002, 2006 and 2009 and 2013). The sample consists of two age-groups of children: the younger cohort of 2011 children who were aged between 6 and 18 months when Round 1 of the survey was carried out in 2002 and an older cohort of 1008 children then aged between 7.5 and 8.5 years. The survey has rich information on the health status, school enrolment,

and attainment, cognitive and non-cognitive abilities of Young lives children. In this paper, we use the data from younger cohort.

The young lives children were selected from 20 sites. The survey uses semi-purposive sampling method. The sampling method is as follows: Andhra Pradesh (now Andhra Pradesh and Telangana) has three distinct agro-climatic regions – Telangana, Rayalaseema and Coastal Andhra. One poor and one non-poor district were chosen from each region based on a set of development indicators. In addition to the six districts, Hyderabad district, capital of Andhra Pradesh was also included. From these districts, twenty *mandals* were selected as sentinel sites based on a set of socio-economic indicators. These *mandals* or sentinel sites are further divided into four contiguous geographical areas and one village is randomly selected from each area. From the sentinel sites, 100 households with a child born in 2001-02 and 50 households with a child born in 1994-95 were randomly selected (Young lives survey design and sampling in India, 2014).

Young lives study has low attrition rate when compared to other longitudinal studies. The attrition rate is 2.6% for the Younger Cohort and 4.3% for the Older Cohort since the beginning of the study. The main reasons for attrition are migration (both internal and abroad), marriage (non-participation due to the disapproval of in-laws), and the feeling that no tangible benefits have been brought by the study (Galab et al., 2011).

This study focuses on investment in education. Young lives survey provides rich information on child education. It provides information on the enrollment status of children, highest grade completed, time use of children, and scores of various tests administered to check the cognitive ability of the child. The time use of children provides information on how much time the children spend on sleeping, leisure, studying both in and out of school, and working (both paid and unpaid). For cognitive ability, The Peabody Picture Vocabulary Test (PPVT) was administered. PPVT uses stimulus words and accompanying pictures to test receptive vocabulary. In India, the test was adopted in the native tongue of children (predominantly Telugu). Maths test items consisted of questions related to addition, subtraction, multiplication, division, problem-solving, measurement, data interpretation, and basic geometry.

Table 1 presents summary statistics on child education for the rounds two, three and four of survey for younger cohort. It can be seen that for younger cohort there is almost universal enrolment into schools since around 99% of children were enrolled in primary education in Round 3; there was a

slight drop in enrolment rate in Round 4 as they moved to upper primary education. The average time spent in paid activities is negligible for younger cohort across all the rounds. Time spent in studies (both at home and school) increase from Round 2 to Round 4 for younger cohort.

Table 1: Indicators of Investments in children's education

Variable	Younger Cohort		
	R2	**R3**	**R4**
Enrolment	89.4%	99.0%	97.2%
Grade completed	0.2	1.7	5.4
Grade advanced		1.6	3.9
Time spent on unpaid work (in Hours)	0.2	0.6	1.1
Time spent on paid work (in Hours)	0.0	0.0	0.1
Time spent on leisure activities (in Hours)	14.0	13.9	13.0
Time spent on studies (in Hours)	6.1	9.5	9.9
PPVT score	90.3	130.8	43.1
CDA quantitative score	9.4	-	-
Maths test score	-	12.0	12.8

Source: Author's own compilation based on Young Lives survey

The primary variable of interest of this study is the income shocks faced by the households. The Young Lives survey includes a separate section for collecting information about the shocks and adverse events that affected households. In each survey round, households were asked if they had suffered from any shocks or adverse events that affected their income since the previous survey. A large number of shocks and negative events are specified in each round.[1] The shocks that are reported in the surveys can be broadly classified into different groups namely natural disaster, crop shock, livestock shock, paternal health shock, maternal health shock, job shock, divorce shock, fertility shock, education expenditure shock, crime shock, price shock, housing damage shock, regulatory and economic shocks and other shocks. The table below gives the percentage of households that were affected by different income shocks during the time between the four rounds of the survey. Crop loss or damage and natural disaster are the major shocks that caused reduction

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[1] Table B1 in Appendix B gives detailed information on the questions asked in all the four rounds.

in economic well-being of households. Health shock is the next major shock affecting the households.

Health shocks are seen to be consistently affecting a significant number of households across the four rounds of survey. Price fluctuations also affect a significant number of households in the Round 2, 3 and 4. Fertility shocks and livestock damage also affects a significant percentage of households. The smallest incidence among the income shocks under consideration is by the divorce shock. In round 1 and 2, most commonly experienced shocks were crop shock, health shocks and natural disaster. But in Round 3 and 4, price shocks were a major shock that negatively affected the households

Table 2 : Shocks faced by households (younger cohort)

Type of shocks	Between child birth and Round 1 (per cent)	Between Round 1 and Round 2 (per cent)	Between Round 2 and Round 3 (per cent)	Between Round 3 and Round 4 (per cent)
Crop loss / damage	28.2	18.2	21.5	24.6
Livestock loss/ disease	5.8	6.3	7.7	7.7
Health shock	18.5	28.7	18.4	32.9
Natural Disaster	22.3	30.6	9.7	14.6
Fertility shock	7.4	18.4	4.5	1.1
Divorce/ separation	1.4	3.5	1.2	0.7
Education expenditure	3.2	4.1	7.5	3.5
Crime	5.9	5.7	4.2	1.9
Price fluctuations	-	11.1	79.4	51.7
Job loss	5.1	1.5	1.4	1.8
Housing damages	-	1.6	1.2	0.2
Regulatory/economic shocks	-	6.4	3.0	1.3
Other Shocks	10.5	2.6	8.9	3.5
Observations	2011	1950	1931	1915

Source: Authors' own compilation based on Young Lives survey

3. Methodology

This study uses the dynamic panel data model to find the impact of various shocks on investment in the education of children. A brief explanation of the model is given below. The difference GMM estimator proposed by Arellano-Bond (1991) and system GMM estimator proposed by Arellano-Bover (1995) and Blundell-Bond (1998) are dynamic panel estimators devised for situations

where there are small time periods and large number of individuals, a functional relationship that is linear, a single dynamic dependent variable which depends on its own past realizations, independent variables that are not strictly exogenous i.e. correlated with past and possibly current realizations of the error; fixed individual effects; and heteroscedasticity and autocorrelation within individuals, but not across them (Roodman, 2009).

Arellano-Bond estimators are called difference GMM estimator because they start estimation by transforming all independent variables, usually by differencing, and uses the Generalized Method of Moments (Hansen 1982).

Sometimes, the forward orthogonal deviations transform, proposed by Arellano and Bover (1995), is performed instead of differencing. The system GMM estimator expands the difference GMM estimator by making an additional assumption, i.e., the first differences of instrumenting variables are not correlated with the fixed effects. This can lead to the introduction of more instruments, and can significantly improve efficiency. The system GMM builds a system of two equations, the original equation as well as the transformed one.

Consider the following equations

$$yit = X_{it}\beta_1 + W_{it}\beta_2 + v_{it}$$

$$v_{it} = u_i + \varepsilon_{it}$$

where X_{it} includes strictly exogenous covariates, W_{it} are predetermined covariates (which may include lags of y) and endogenous regressors, all of which may be correlated with u_i, the unobserved individual effect. β_1 and β_2 are vectors of parameters that have to be estimated. ε_{it} are the observation-specific errors (Roodman,2009).

First-differencing the equation removes the u_i and its associated omitted-variable bias. But, differencing predetermined variables that are not strictly exogenous makes them endogenous. Therefore, Arellano and Bond (1991) developed a GMM estimator that instruments the differenced variables that are not strictly exogenous (variables that are not correlated with either current or past errors) with all their available lags in levels. The difference GMM estimator faces a problem if the variables are close to a random walk. In those situations, lagged levels are poor instruments for first differences. The system GMM estimator solves this problem by using the levels equation to obtain a system of two equations, a differenced equation and the other one in levels. Additional

instruments can be obtained by adding the level equation. This leads to an increase in the efficiency. Variables in *levels* are instrumented with suitable lags of their own first differences. The assumption made is that these differences are uncorrelated with the unobserved individual effects (Mileva, 2007).

We run separate regressions for input indicators of education (time spent in school, time spent in study and time spent doing paid or unpaid work) and outcome indicators that assess the cognitive ability of the children like PPVT scores and math scores. Time spent at school includes travel to school time as well. Time spent on work includes hours spent by the children on paid as well as unpaid work. The paper mainly focuses on the impact of income shocks on investment in education. The shocks that are considered in the paper include drought, flood, crop shock, livestock shock paternal health shock, maternal health shock, job shock, divorce shock, fertility shock, education expenditure shock and housing damage shock. Crime shock, price shock, regulatory and economic shocks and other shocks are excluded from the model since they are not consistently captured in all the four rounds of the survey (Refer table B1 in Appendix).

Other explanatory variables like child's age, gender and birth order are included in the model. Household level characteristics like gender of the household head, head's and mother's education like years of schooling, wealth index, household size, rural residence, whether the household belongs to disadvantaged group like Scheduled caste (SC), Scheduled tribe (ST), other backward castes (OBC) and Muslims are also included. To account for the fact that some of these variables might itself change in response to shocks, we include lagged values of time varying factors. For instance, a household might adjust the number of members, break into more households, move to urban residence seeking for jobs, etc. in response to shocks. Hence, we use lagged values of these variables as explanatory factors. We also include dummy variables for rounds of the survey. Further, in the regressions we consider shocks as endogenous variables since there might be unobserved characteristics that make certain households more prone to some of the shocks. These unobserved factors might also influence children's educational outcomes through mechanisms other than shocks.

4. Results

4.1 Effect of shocks on input Indicators of children's education

We present our findings of dynamic panel analysis for input indicators of education (time spent in school, studying at home and working). Results show positive effect of drought on school time while floods increase time spent by children in domestic work. Shah and Steinberg (2013) who find similar results explain that parents invest more in education in times of drought, because the returns to child labour are lower in comparison with the seasons with high rainfall during which children are more likely to work.

Results obtained from regression finds that paternal health shocks have negative effects on time spent by children at school whereas maternal health shock reduces only time spent studying at home. Since father of the household is in most cases the breadwinner, the loss of income caused by the paternal health shock negatively affects the investments in children. Children will not be able to attend school regularly or spend time on studies outside school because they may be to work to generate additional income to compensate the loss of income caused by paternal health shock. However, maternal health shocks only reduce time spent in studying partly because children may be required to help in domestic chores or time spent by mothers who are ill in home-teaching might reduce.

Loss of livestock reduce the study time spent by children studying at home and school and also increase time spent working. We note that more than 40% of households in the southern states of Andhra Pradesh and Telangana own livestock and this is one of the main sources of income diversification for rural households. Thus, loss of livestock may cause direct income loss for the household and in order to meet the income fluctuations due to loss of livestock, children may have to reduce their study time and do some work either at home or outside. Increase in the education expenditure might have caused parents to induce their children to spend more time on studies and attend school regularly.

We also find that female and older children spend more time working and less time in schools. This in turn points to the gender bias in educational investments in children which literature has pointed out. Among the other household characteristics, households having a female head have children with higher study time at home and at school in comparison with the households with male heads. Time spent by children on studies increases with the increase in the years of schooling of the mother and wealth of the household for both the cohorts and this has negative effects on children's time spent in work. Belonging to low socioeconomic status groups like Scheduled Tribe, Scheduled castes and Backward Castes has a negative effect on the study time in comparison with

the belonging to upper caste groups for the younger children. ST and Muslim children are also more likely to spend time working than other children.

Table 3 : Effect of shocks on input indicators of education

VARIABLES	(1) At school coeff	(2) se	(3) Study at home coeff	(4) se	(5) Work time coeff	(6) se
Lagged dependent variable	-0.020	0.017	0.050	0.033	0.075**	0.038
Crop shock	0.135*	0.080	-0.053	0.066	0.030	0.071
Drought	0.213*	0.124	-0.148	0.103	0.007	0.111
Flood	-0.022	0.155	-0.167	0.129	0.529***	0.138
Livestock loss	-0.212*	0.116	-0.176*	0.096	0.273***	0.103
Father ill/died	-0.306***	0.098	0.022	0.081	0.089	0.087
Mother ill/died	0.249**	0.105	-0.203**	0.087	-0.021	0.094
Job shock	0.164	0.211	0.120	0.175	-0.250	0.188
Divorce	0.350	0.419	-0.395	0.349	0.612	0.374
Fertility shocks	0.025	0.193	-0.202	0.160	0.095	0.172
Education expenditure	0.572***	0.124	-0.161	0.103	-0.033	0.110
Housing damages	-0.059	0.324	-0.228	0.269	0.003	0.289
Age	0.002	0.006	-0.012**	0.005	0.012**	0.005
Female	-0.122***	0.044	0.081**	0.037	0.328***	0.040
Eldest child	0.045	0.045	0.100***	0.038	0.075*	0.040
L.Head female	-0.052	0.133	0.340***	0.111	-0.347***	0.119
L.head education	0.024***	0.007	0.012**	0.005	-0.023***	0.006
Mother education	0.025***	0.007	0.017***	0.006	-0.011*	0.006
L.household size	-0.006	0.012	0.017*	0.010	-0.003	0.010
L.wealth index	0.530***	0.195	0.390**	0.162	-0.238	0.173
OBC	-0.203**	0.082	0.026	0.068	0.050	0.073
SC	-0.184**	0.090	-0.167**	0.075	0.011	0.080
ST	-0.171**	0.069	-0.013	0.057	0.159***	0.061
Muslim	-0.273**	0.114	0.010	0.095	0.235**	0.102
Rural residence	-0.001	0.070	0.232***	0.058	0.030	0.063
Round 3	-0.324	0.297	-0.525**	0.240	0.045	0.257
Round 4	0.000	0.000	0.000	0.000	0.000	0.000
Constant	7.660***	0.895	2.893***	0.728	-0.754	0.775
Observations	3,415		3,415		3,415	
Number of newid	1,851		1,851		1,851	

Note: L. stands for lagged values of the time-varying variables. *** p<0.01, ** p<0.05, * p<0.1
Source: Author's own compilation based on Young Lives survey

4.2 Effect of shocks on input Indicators of children's education

Though shocks might affect time inputs into the education of children, we do not know if the effects are transitory or permanently affect the child's cognitive development. To investigate this, we estimate the effect of shocks on children's cognitive ability captured through vocabulary and mathematics tests conducted by the Young Lives survey. The receptive vocabulary skills of the children are captured through the PPVT Version III conducted in Telugu and English across Rounds 2-4. However, the raw scores of PPVT may not be appropriate for comparing across rounds since a subset of the test is same across rounds while remaining items are different. Thus, we use standardized measures of PPVT by employing Item Response Theory (IRT). In IRT, scores are first estimated considering item's difficulty, discrimination, and pseudo-guessing, they are then corrected for biases and then standardized across rounds. We present the effect of shocks for both raw scores and standardized scores. This is because PPVT scores could only be standardized for those who took the test in Telugu and those who took the test in English could not be included rendering a smaller sample. Also, such standardized scores could not be obtained for Mathematics for Rounds 2-4 since a different quantitative assessment was conducted in Round 2 and hence we do not have common items across rounds to employ IRT to standardize the scores.[2]

We find that livestock loss and paternal health shocks significantly affects the cognitive ability of children through lowering the math scores. This is because we found that these shocks reduce time spent in school by children. Increase in education expenditure though might affect households financing of other goods improves cognitive ability through its positive effect on PPVT scores. We also find that drought periods that lead to increase in time spent in schooling and studying at home also improves both raw and standardized PPVT scores.

Male children and those of lower birth order also have significantly higher achievement in both vocabulary and math skills. While children with educated and richer parents performed better those from disadvantaged backgrounds had poorer scores. This, in turn, implies that lower schooling inputs translate into lower cognitive achievement by children.

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[2] Refer Young Lives (2017) for more information on IRT procedure followed in the study.

Table 4 : Effect of shocks on outcome indicators of children's education

VARIABLES	(1) PPVT raw scores coeff	(2) se	(3) PPVT standardized scores coeff	(4) se	(5) Math raw scores coeff	(6) se
Lagged scores	0.043	0.031	0.100***	0.034	0.199***	0.030
Crop shock	0.020	0.053	0.055	0.039	-0.040	0.045
Drought	0.207**	0.082	0.105*	0.061	0.113	0.070
Flood	0.014	0.104	0.052	0.077	0.096	0.088
Livestock loss	-0.020	0.077	0.001	0.056	-0.175***	0.065
Father ill/died	-0.005	0.066	-0.067	0.050	-0.123**	0.055
Mother ill/dies	-0.062	0.071	-0.057	0.054	-0.075	0.059
Job loss	0.045	0.142	-0.049	0.122	-0.017	0.116
Divorce	0.017	0.284	-0.263	0.204	-0.150	0.232
Fertility shock	0.148	0.135	0.087	0.105	-0.188*	0.109
Education expenditure	0.168**	0.086	0.114*	0.067	-0.007	0.069
Housing damager	-0.114	0.233	-0.131	0.165	-0.098	0.185
Child's age	0.020***	0.004	0.012***	0.003	0.021***	0.004
Female	-0.115***	0.030	-0.072***	0.023	0.019	0.025
Eldest child	0.114***	0.030	0.070***	0.023	0.094***	0.025
L.Head female	0.107	0.089	0.026	0.067	0.117	0.075
L.head education	0.015***	0.004	0.007**	0.003	0.014***	0.004
Mother education	0.036***	0.005	0.029***	0.004	0.049***	0.004
L.household size	-0.012	0.008	0.000	0.006	0.015**	0.007
L.wealth index	0.523***	0.131	0.505***	0.100	0.666***	0.109
OBC	-0.117**	0.055	-0.071*	0.043	-0.197***	0.046
SC	-0.306***	0.060	-0.211***	0.047	-0.383***	0.051
ST	-0.221***	0.046	-0.167***	0.037	-0.150***	0.039
Muslims	-0.541***	0.077	-0.104	0.076	-0.478***	0.064
L.Rural residence	0.048	0.047	-0.024	0.037	0.266***	0.039
Round 3	-2.172***	0.412	-0.173	0.153	-2.659***	0.366
Round 4	-3.158***	0.606	0.000	0.000	-3.709***	0.539
Constant	0.000	0.000	-1.497***	0.484	0.000	0.000
Observations	3,280		2,800		3,329	
Number of newid	1,808		1,540		1,823	

Note: L. stands for lagged values of the time-varying variables. *** p<0.01, ** p<0.05, * p<0.1
Source: Author's own compilation based on Young Lives survey

5. Discussions

In this study, we find that idiosyncratic shocks like paternal health shocks and livestock loss translate into lower inputs of children's education which in turn reduce their cognitive ability

captured through vocabulary and mathematics tests. We also find that these shocks mainly affect children's development through decreased time spent in school. It is important to note that, a decrease in time spent in school might imply that children are taken out of school when households face negative income shocks. However, time spent at school does not capture a low percentage of attendance, if any among the school-goers since the survey question only asks a number of hours a child typically spends on school-going day. If children maintain low attendance during seasons like floods and high attendance during other seasons, the data cannot capture the effect of shocks well since we do not know the average time spent in schools in the entire year. However, it might also be the case that children may be taken out of private school and enrolled in public schools in order to reduce the expenditure incurred by households on school fees etc. since private schools are in general costlier than public schools. This, in turn, might lead to less time spent in schools since children enrolled in private schools spend more time studying (at school and at home) on an average than children enrolled in public schools. To verify the channels, we investigated the effect of shocks on enrolment in schools in general and enrolment in private schools. We find that paternal health shocks and livestock loss affect children's enrolment in general; however, we do not find evidence that shocks affect enrolment into private schools. Thus, we find that children are taken out of school and made to work in domestic or paid activities when households face idiosyncratic income shocks like health shocks and livestock loss and lack sufficient risk-coping mechanisms.

Children from poorer and more disadvantaged groups receive lesser investments in education which in turn translate into poorer cognitive achievements thus perpetuating inequality from one generation to next. This effect remains even after accounting for initial conditions like land and livestock possessed by the households in a different set of regressions. In another set of regressions, we consider wealth index, ownership of land, livestock and migration as endogenous variables, but the results obtained are similar. Effects of certain shocks might not be significant in the empirical analysis if the shocks are highly correlated with other shock variables, for instance, crop shock can be highly correlated with natural disasters like flood and drought. So we also perform analysis by using only sub-sets of shocks and we find that the effects remain similar. Separate regressions for girls and boys are also conducted, but we do not find evidence that shocks have differential effects on boys and girls though we find that girls are in general disadvantaged

compared to boys in terms of educational investments received which in turn affect their cognitive achievement.

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Appendix A
Table A1 : Summary statistics of Household characteristics across rounds

Variable		Younger Cohort			
		R1	R2	R3	R4
Age of the child in months		40.36	92.99	124.05	171.62
Female child		47.93%	48.00%	47.99%	47.76%
Eldest child		55.20	55.44	55.15	55.09
Age of the household head		40.0	38.5	38.6	41.2
Male household heads		91.6%	94.8%	94.6%	89.5%
No. of years of education of the household head		3.4	4.7	5.4	6.5
No. of years of education of mother		2.4	2.9	3.3	3.6
Household size		5.4	5.5	5.4	4.9
Dependency ratio		0.3	0.2	0.2	0.2
Wealth Index		0.4	0.5	0.5	0.6
Land owned (in hectares)		0.8	0.7	0.7	0.7
Ownership of livestock		44%	39%	41%	43%
Ethnicity	SC	21.0%	21.1%	21.0%	21.2%
	ST	10.8%	10.8%	10.9%	11.2%
	BC	46.4%	46.5%	46.6%	46.3%
	Others, Muslim	6.2%	6.1%	6.1%	6.0%
	Others, Hindu, Christian, Buddhist	15.6%	15.5%	15.5%	15.3%
Rural residence		75.1%	75.5%	75.1%	69.8%
Migration		0.0%	4.5%	7.1%	21.6%

Source: Authors' own compilation based on Young Lives survey data

Appendix B
Table B1: Differences in questionnaires across rounds

Shocks	Round 1	Round 2	Round 3	Round 4
Questions	Since you found you/ 'NAME's' mother was pregnant with 'NAME' have there been any big changes or events that decreased the economic welfare of your household?	Now I am going to ask you about the most important events and changes that have happened since the last time we came to see you.	Now I am going to ask you about the most important events and changes that have happened (that affected the household economy negatively) since the last time we came to see you.	Now I am going to ask you about the most important events and changes that have happened (that negatively affected the household economy) since 2010.
Crop loss /	Crops failed	Crops failed	Crop failed	Crops failed
Damage		Pests or diseases that affected crops before they were harvested	Pests or diseases that affected crops before they were harvested	Pests or diseases that affected crops before they were harvested
		Pests or diseases that led to storage losses	Pests or diseases that led to storage losses	Pests or diseases that led to storage losses
Livestock loss/ disease	Livestock died	Livestock died	Livestock died	Livestock died
		Pests or diseases that affected livestock	Pests or Diseases that affected livestock	Pests or diseases that affected livestock
Health shock	Death/ reduction in household members			
	Severe Illness or injury			
		Death of child's father	Death of NAME'S Father	Death of [YL Child]'s father
		Death of child's Mother	Death of NAME'S Mother	Death of [YL Child]'s mother

		Death of another person from the household	Death of another person in the household	Death of another person in the household
		Illness of child's father	Illness of NAME'S Father	Illness of [YL Child]'s father
		Illness of child's mother	Illness of NAME'S Mother	Illness of [YL Child]'s mother
		Illness of another household member		Illness of another household member
				Illness of non-household member
Natural Disaster	Natural Disaster			
		Drought	Drought	Drought
		Too much rain or flood	Too much rain or flood	Too much rain or flood
		Erosion	Erosion, Cracks or landslide	Erosion, Cracks or landslide
		Frosts or hailstorm	Frosts or hailstorm	Frosts or hailstorm
Fertility Shock	Birth/new household member	Birth/new household member	Birth new household member	Birth/new household member
Divorce/ Separation	Divorced or separated	Divorce, separation or abandonment	Divorce, Separation or abandonment	Divorce, separation or abandonment
Education expenditure	Paying for child's education	Child's school enrolment - having to pay school fees	Child's school enrolment-having to pay school fees	Child's school enrolment – having to pay school fees
Crime	Victim of Crime			
	Crops stolen	Theft of crops		
	Livestock stolen	Theft of livestock		
		Destruction or theft of tools or inputs for production		
		Theft of cash		
		Theft/destruction of housing/consumer goods		

		Crime resulting in death or disablement of working adult household member		
		Imprisonment		
			Theft or destruction	Theft or destruction (e.g. cash, crops, livestock, destruction of housing)
Price fluctuations		Large increase in input prices	Large Increase in input price	Large increase in input prices
		Large decrease in output prices	Large decrease in output prices	Large decrease in output prices
			Increase in the price of food that I buy	Increase in the price of food that I buy
Job loss	Job loss/ source of income/ family enterprises	Job loss/source of income/ family enterprise	Job loss/ source of income/ family enterprise	Job loss/ source of income/ family enterprise
		Place of employment shutdown/ destroyed		
Housing Damages		Fire		
		Building collapsed		
			Fire or collapse of building	Fire or collapse of building
Regulatory and economic shocks		Conscription, abduction or draft		
		Land redistribution in the PA		
		Resettlement, forced migration		
		Ban or restrictions on migration		
		Eviction		
		Industrial action		
		Contract disputes regarding purchased inputs		
		Contract disputes regarding sale of output		

		Credit source disbanded		
		Confiscation of assets		
		Disputes with extended family members regarding land or assets		
		Forced contributions or arbitrary taxation or protection money	Forced contributions or arbitrary taxation or protection money	Forced contributions or arbitrary taxation or protection money
		Disputes with neighbours/ PA members regarding land or assets	Disputes with neighbours/PA members regarding land and assets	Disputes with neighbours/ village members regarding land or assets
	Decrease, change in food availability			
	Moved/ migrated/ fled			
Other Shocks	Other	Others	Others	Other, specify

Source: Authors' own compilation based on Young Lives questionnaires

Table B2: Shocks faced by households across rounds

Shocks	Variable names	Younger Cohort			
		R1	R2	R3	R4
Crop loss / damage	Crop failure	28.2	13.4	18.6	21.6
	Pests on crops	-	7.2	8.1	3.9
	Pests or diseases that led to storage losses	-	0.4	0.8	0.5
Livestock loss/ disease	Death of livestock	5.8	5.7	6.7	7.4
	Pests on livestock	-	1.0	2.3	0.8
Health shock	Death/ reduction household members	2.9	-	-	-
	Severe illness or injury	16.6	-	-	-
	Death of father	-	1.3	1.8	2.0
	Death of mother	-	0.5	0.8	0.8
	Death of another household member	-	6.8	5.0	6.0
	Illness of father	-	8.1	7.1	8.7
	Illness of mother	-	8.0	7.2	9.7
	Illness of another household member	-	10.0	-	10.3
	Illness of non-household member	-	-	-	0.6
Natural Disaster	Natural disaster	22.3	-	-	-
	Drought	-	27.8	7.0	10.2
	Flooding	-	5.9	2.6	5.4
	Erosion	-	-	0.6	-
	Frost	-	0.3	0.4	0.3
Fertility Shock	Birth of new household member	7.4	18.4	4.5	1.1
Divorce/Separation	Divorce or separation	1.4	3.5	1.2	0.7
Education expenditure	Enrolment of child in school	3.2	4.1	7.5	3.5
Crime	Victim of crime	3.0	-	-	-
	Theft of crops	2.8	0.6	-	-
	Theft of livestock	1.0	1.0	-	-
	Destruction/theft of tools of production	-	0.9	-	-
	Theft of cash	-	1.7	-	-
	Theft/destruction of housing/consumer goods	-	1.7	-	-
	Crime that resulted in death/disablement	-	0.1	-	-
	Imprisonment	-	0.4	-	-
	Theft/destruction of cash, crops, livestock	-	5.4	4.2	1.9
Price fluctuations	Increase input prices	-	9.7	9.8	3.5
	Decrease output prices	-	3.9	8.4	4.9
	Increase in food prices	-	-	78.6	49.6

Job loss	Job loss	5.1	1.2	1.4	1.8
	Closure place of employment	-	0.4	-	-
Housing Damages	Fire affecting house	-	0.6	-	-
	House collapse	-	1.1	-	-
	Fire or collapse of building	-	1.6	1.2	0.2
Regulatory and economic shocks	Conscription, abduction or draft	-	0.1	-	-
	Land redistribution	-	0.2	-	-
	Resettlement or forced migration	-	2.2	-	-
	Restrictions on migration	-	0.1	-	-
	Eviction	-	0.1	-	-
	Industrial action	-	-	-	-
	Contract disputes (purchase of inputs)	-	0.1	-	-
	Contract disputes (sale of output)	-	0.1	-	-
	Disbanding credit	-	1.9	-	-
	Confiscation of assets	-	0.4	-	-
	Disputes with family about assets	-	1.1	-	-
	Forced contributions	-	0.1	0.8	0.4
	Disputes with neighbours about assets	-	0.6	2.3	0.9
Other shocks	Decrease in food availability	5.3	-	-	-
	Move/ migration	3.4	-	-	-
	Other shocks	2.9	2.6	8.9	3.5

Source: Authors' own compilation based on Young Lives survey data