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The Impact of Income and Non-Income Shocks on Child Labor: Evidence from a Panel Survey of Tanzania

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Summary. — This paper investigates the impact of income and non-income shocks on child labor using a model in which the household maximizes utility from consumption as well as human capital development of the child. We also investigate if access to credit and household assets act as buffers against transitory shocks. Our results indicate significant effects of agricultural shocks on the child's overall work hours and agricultural work hours, with higher effects for boys. Crop shocks also have significant adverse effects on school attendance, with girls experiencing a more-than 70% increase in the probability of quitting schooling. The results also indicate that access to a bank account has a buffering effect on the impact of shocks on child hunger. Having a bank account reduces both male child labor and household work hours of a girl child. While assets reduce working hours of girls, we do not find it having a significant effect on boys. We also do not see assets to act as a buffer against shocks.

Key words — child labor, buffer stocks, agricultural shocks, consumption smoothing

1. INTRODUCTION

Tanzania has made considerable progress in economic development during the past decade. Average economic growth has been over 7% since 2000. Even during the global economic and financial turbulences it remained robust – real gross domestic product grew by around 6.5% during 2009–11, well above the regional and global averages. Despite this recent progress, poverty remains a critical development challenge in Tanzania as over 28% of the population lives below the national poverty line. Poverty in rural areas remains consistently high with over a third living below the poverty line as per the latest survey data. [1] Two-thirds of the rural population are below the international poverty line of $1.25. The high average household size in rural Tanzania of 7–8 persons adds pressure on household consumption (see summary statistics Table 1). Parents' relatively low level of education (nearly one third of fathers and one half of mothers did not go to school, while less than 3% completed secondary school or above) could also have some influence on their decisions on child's time allocation.

The rural population, which constitutes 75% of the total population, in particular, is trapped in slow growing agriculture, its mainstay, and thereby in a status of low income. Rural poor are also subject to a plethora of crop shocks affecting their income. Attacks by rodents, insects, or pests account for 84% of crop losses in rural Tanzania. Agriculture in Tanzania is primarily rain-fed with only 2% of arable land having irrigation infrastructure (FAO, 2009) with high probability of crop failure. Formal coping mechanisms to shocks such as crop insurance and social protection are either extremely limited or do not exist. Limited household asset holdings and credit constraints also restrain their coping strategies. According to Finscope Tanzania (2013), 27% of the Tanzanian population are financially excluded with only 14% having a bank account. In such circumstances households tend to use child labor as a buffer against such shocks in smoothing consumption. The use of child labor and child labor bonding is seen in Sub-Saharan African countries when households either do not have or reluctant to sell their assets during extreme shocks (Fafchamps, 1999). In Tanzania, only 18.4% of children aged 5–17 years in our sample do not work. The majority (80.7%) of them work in the agricultural sector. Shocks such as falling sick or the death of the mother or father could have similar effects on their children.

A close relationship between transitory income shocks and child labor has been reported for rural Tanzania (Beegle, Dehejia, & Gatti, 2006). This is not surprising given the limited farm income, their exposure to shocks, and limited coping arrangements, formal or informal. Although Tanzania is a signatory to a host of international conventions on children rights, including the UNICEF's Child Rights Convention (CRC), the ILO Minimum Age Convention (No. 138) and the Worst Forms of Child Labour Convention (No. 182) and introduced the Employment and Labour Relations Act of 2004, the Child Development Policy of 2008 and the National Action Plan for the Elimination of Child Labour in 2009, exploitation of children through child labor persists. [2] It is a problem that is found at the household and community levels and in all sectors of the economy. Children in rural areas are more likely to be engaged in hazardous labor (22.7%) than in urban areas (5.6%). [3] While child labor is partly driven by a

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Table 1. *Summary Statistics*

Variables	(1) Full sample No crop shock (Round 1)	(2) Full sample Crop shock (Round 1)	(3) Full sample Difference	(4) Male No crop shock	(5) Male Crop shock	(6) Male Difference	(7) Female No crop shock	(8) Female Crop Shock	(9) Female Difference
Per Capita Consumption (Round 1)	25,141	13,755	−11,386***	24,366	14,322	−10,045***	25,893	13,174	−12,719***
	(592.5)	(610.9)	(851.0)	(774.5)	(860.8)	(1,158)	(893.3)	(867.2)	(1,245)
Female	0.507	0.494	−0.0139						
	(0.00872)	(0.0232)	(0.0248)						
Age (Round 1)	10.89	11.09	0.195	10.90	11.20	0.292	10.88	10.97	0.0948
	(0.0452)	(0.121)	(0.129)	(0.0641)	(0.174)	(0.186)	(0.0639)	(0.168)	(0.180)
Household Size (Round 1)	7.380	7.599	0.219	7.438	7.660	0.222	7.324	7.537	0.213
	(0.0624)	(0.142)	(0.155)	(0.0946)	(0.202)	(0.223)	(0.0818)	(0.200)	(0.216)
Father's Education (Round 1)	2.675	2.474	−0.201***	2.692	2.528	−0.165**	2.658	2.419	−0.239***
	(0.0229)	(0.0492)	(0.0542)	(0.0326)	(0.0699)	(0.0771)	(0.0321)	(0.0692)	(0.0763)
Mother's Education (Round 1)	2.504	2.170	−0.334***	2.482	2.247	−0.236***	2.525	2.092	−0.433***
	(0.0208)	(0.0488)	(0.0530)	(0.0291)	(0.0713)	(0.0770)	(0.0297)	(0.0662)	(0.0726)
Value of Household-Cultivated Plots (Round 1)	4.256e+06	2.798e+06	−1.457e+06*	4.413e+06	2.896e+06	−1.517e+06	4.105e+06	2.698e+06	−1.407e+06
	(726,713)	(311,302)	(790,582)	(1.053e+06)	(449,147)	(1.145e+06)	(1.004e+06)	(431,496)	(1.092e+06)
Working and Not in School (Round 1)	0.0346	0.0539	0.0192*	0.0401	0.0596	0.0195	0.0293	0.0480	0.0187
	(0.00319)	(0.0105)	(0.0110)	(0.00487)	(0.0155)	(0.0162)	(0.00413)	(0.0142)	(0.0148)
In School (Round 1)	0.933	0.914	−0.0186	0.936	0.908	−0.0280	0.930	0.921	−0.00963
	(0.00461)	(0.0141)	(0.0148)	(0.00649)	(0.0208)	(0.0218)	(0.00655)	(0.0190)	(0.0201)
In School (Round 2)	0.841	0.780	−0.0610***	0.842	0.765	−0.0772**	0.840	0.795	−0.0444
	(0.00656)	(0.0201)	(0.0211)	(0.00932)	(0.0289)	(0.0303)	(0.00924)	(0.0279)	(0.0294)
Left School Between Rounds	0.0600	0.108	0.0478***	0.0651	0.103	0.0382	0.0552	0.112	0.0571**
	(0.00448)	(0.0161)	(0.0167)	(0.00667)	(0.0225)	(0.0235)	(0.00601)	(0.0232)	(0.0239)
Total Child Labor Hours (Round 1)	61.81	74.84	13.02***	55.46	69.36	13.90***	67.98	80.46	12.47**
	(1.336)	(3.628)	(3.866)	(1.793)	(4.904)	(5.221)	(1.963)	(5.344)	(5.693)
Total Child Labor hours (Round 2)	32.47	47.86	15.39***	31.62	47.43	15.81***	33.30	48.30	15.00***
	(1.061)	(3.037)	(3.217)	(1.486)	(4.373)	(4.618)	(1.514)	(4.220)	(4.483)
Agricultural Child Labor Hours (Round 1)	12.66	18.57	5.914***	15.23	22.81	7.589**	10.17	14.22	4.053*
	(0.682)	(1.849)	(1.971)	(1.011)	(3.001)	(3.166)	(0.915)	(2.102)	(2.293)
Agricultural Child Labor Hours (Round 2)	16.79	28.57	11.78***	18.81	31.50	12.69***	14.83	25.56	10.74***
	(0.732)	(2.350)	(2.461)	(1.095)	(3.563)	(3.728)	(0.973)	(3.045)	(3.196)
Wage Child Labor Hours (Round 1)	1.228	1.136	−0.0919	1.473	1.441	−0.0319	0.991	0.823	−0.167
	(0.300)	(0.625)	(0.694)	(0.448)	(1.046)	(1.138)	(0.400)	(0.676)	(0.785)
Wage Child Labor Hours (Round 2)	4.015	2.983	−1.031	4.405	2.845	−1.560	3.636	3.125	−0.511
	(0.507)	(0.972)	(1.097)	(0.732)	(1.279)	(1.473)	(0.703)	(1.472)	(1.632)
Household Work Hours (Round 1)	11.07	11.66	0.583	9.075	8.285	−0.790	13.02	15.12	2.103
	(0.511)	(1.052)	(1.170)	(0.714)	(1.294)	(1.478)	(0.729)	(1.639)	(1.794)
Household Work Hours (Round 2)	9.350	13.86	4.507***	6.233	10.75	4.518***	12.38	17.04	4.669**
	(0.392)	(1.341)	(1.398)	(0.448)	(1.631)	(1.692)	(0.629)	(2.125)	(2.216)
Insufficient Food Situation in Past 12 Months (Round 2)	0.195	0.274	0.0786***	0.204	0.298	0.0943***	0.187	0.249	0.0621**
	(0.00691)	(0.0207)	(0.0218)	(0.0100)	(0.0299)	(0.0315)	(0.00954)	(0.0286)	(0.0302)
Death of household member	0.0577	0.0754	0.0177	0.0561	0.0766	0.0205	0.0593	0.0742	0.0150
	(0.00407)	(0.0123)	(0.0129)	(0.00572)	(0.0174)	(0.0183)	(0.00578)	(0.0174)	(0.0183)
Do you or anyone in the HH have a bank account?	0.193	0.0991	−0.0939***	0.189	0.0936	−0.0952***	0.197	0.105	−0.0923***
	(0.00688)	(0.0139)	(0.0155)	(0.00972)	(0.0190)	(0.0214)	(0.00974)	(0.0203)	(0.0225)
Household assets	0.352	−0.612	−0.964***	0.365	−0.473	−0.838***	0.339	−0.756	−1.094***
	(0.0638)	(0.0742)	(0.0979)	(0.0986)	(0.109)	(0.147)	(0.0816)	(0.0997)	(0.129)

high incidence of poverty, particularly in rural areas, and low or inadequate social protection, inadequate enforcement of prevailing laws relating to child labor tend to perpetuate it. Child labor, whether it is used as a buffer against household income shocks or a result of non-income shocks, tends to interfere with the development of child's human capital and the country's development potential. This is particularly relevant as Tanzania is pushing for a paradigm shift in economic development where human capital will play a critical role.

The objectives of the paper are to examine the relationship between household income and non-income shocks and child labor and if the availability of other coping strategies such as social protection mechanisms, access to credit, or asset holdings reduce child labor. Child labor and shocks have been previously studied, including in Tanzania. This paper uses new data, which are well suited to find new insights on the topic. The paper originated with the release of the second round of the Tanzanian National Bureau of Statistics' National Panel Survey. Conducted every two years beginning 2009, this survey systematically elicits data from a larger, nationally representative panel of Tanzanians than previously available: both urban and rural and both from mainland Tanzania and Zanzibar. This survey offers a more comprehensive sample of children of school age in Tanzania, household-, individual-, and community-level characteristics, and is measured with greater frequently than previously available datasets. The higher quality and frequency of the data allow us to identify a wider variety of more immediate responses to shocks, in particular within two years of the shock *vs.* within four years or more of the shock as previously studied.

Our main contribution to the literature is to study the impact of shocks on child labor in Tanzania with a comprehensive nationally representative set of survey data. This allows us to make some meaningful and relevant contribution to the policy debate on how to address child labor in the face of shocks.

The remainder of the paper is organized as follows. Section 2 provides a brief literature review relating to child labor. Section 3 will describe the model. Section 4 describes the data, and outlines the estimation methodology. An analysis of the estimation results is provided in Section 5 along with robustness checks of our results. Section 6 discusses the policy implications of our findings, and Section 7 concludes.

2. LITERATURE REVIEW

There are several underlying factors that contribute to the existence of child labor despite being banned or considered undesirable. The key among them seem to be poverty, credit market imperfections, imperfect land and labor markets and household characteristics. Basu and Van (1998) is a seminal model of child labor. In their model, which depends on a well-functioning labor market, poverty is shown to drive child labor. Households send their children to work only if the adult wage falls below a certain point where the household subsistence requirements cannot be met without an alternative source of income. Child labor provides that source (the so-called Luxury Axiom). On the other hand, child labor is considered a substitute for adult labor (the Substitution Axiom). Although household survival is the main underlying reason for child labor in this model, it also relates to the permanent income hypothesis and consumption smoothing.

Households can smooth consumption from income variations by depleting or accumulating assets, borrowing or savings, crop portfolio diversification, making adjustments to their labor supply or through formal insurance. According to Zeldes (1989), with sufficient wealth, consumption is proportional to permanent income and would change only by the annuity value of expected future wealth. Assets play the role of a buffer stock absorbing most of the transitory income shocks. Using household panel data for Tanzania, Beegle *et al.* (2006) showed that households with a sufficiently high level of assets are able to fully offset the transitory income shocks. Sale or purchase of livestock is a primary means through which households smooth their consumption, sometimes selling their livestock to purchase grain instead of eating meat (Sandford, 1983). Livestock thus becomes a substitute for insurance (Binswanger & McIntire, 1987). Even such substitutes could be incomplete in rural Tanzania as a relatively large proportion of households often do not have any livestock for use as insurance at times of income losses due to crop failure. For example, Dercon (1998) found that only half the households in a sample in Western Tanzania own cattle, even though cattle are an important farming tool and an asset. In a study of Tanzania, Dercon (1996) established evidence of crop portfolio diversification by households to smooth consumption. In the absence of formal coping strategies such as insurance or assets holdings or access to credit as buffers, households tend to use alternative coping mechanisms such as child labor in the presence of shocks in smoothing consumption (see for example, Chaudhuri & Ravallion, 1997; Townsend, 1994; Zeldes, 1989 and Morduch, 1999). While most of these studies support the view that households succeed in smoothing consumption to a certain degree by managing risks, they may not achieve a Pareto efficient level of risk mitigation. Morduch (1999) notes that while informal insurance mechanisms may be efficient in coping with risks in right circumstances, they are often weak and costly in the long run.

Imperfections in the labor and credit markets also help explain child labor. According to Dumas (2013), labor market imperfections increase child labor. Alvi and Dendir (2011) in their study of the impact of the Great Floods in Bangladesh in 1998 found child labor to increase with the magnitude of the shock but only if households do not receive credit. Ranjan (2001) showed that credit constraints could lead to child labor as the inability to borrow against labor income could adversely affect consumption. If the households can borrow and if education is profitable poverty will not be a constraint in sending children to school. Similar results are also found in Baland and Robinson (2000), Dehejia and Gatti (2002) and Beegle *et al.* (2006). The latter also found access to credit to mitigate the effects of transitory income shocks on child labor. In contrast, Shimamura and Lastarria-Cornhiel (2010) in their study of Malawi found that credit uptake could decrease school attendance by young girl children. Jacoby and Skoufias (1997) considered seasonal fluctuations in schooling as a form of self-insurance in the face of imperfect credit markets but one which did not result in substantial losses in the accumulation of human capital. In the Tanzanian context, as in other countries, access to capital also plays a role in the type of activity that the households choose to undertake which could in turn affect household income (Dercon & Krishnan, 1996).

Another aspect is the use of children as insurance. For example, Cain (1982) proposed the role of children as an insurance against unforeseen shocks on household income. A similar approach was taken by Grootaert and Kanbur (1995),

who examined how child labor could minimize the risk of temporary shocks to household incomes. Pörtner (2001) contended that children have often been used as insurance against adverse income shocks. In the African context, formal insurance and credit markets, particularly in rural areas are weak or missing. In such circumstances households tend to smooth their consumption through a variety of informal insurance arrangements. Likewise, Dillon (2013) showed that there is an increase in child labor at the intensive and extensive margin in response to shocks.

Child labor could also be linked to the buffer stock literature (Deaton, 1992). The riskier the environment, the greater the incentives for households to build buffer stocks which could be utilized at times of shocks. The earning potential of children makes them a valuable asset for households.

Household characteristics are also among the factors that determine child labor. One such factor is parental altruism toward their children. While it is often assumed that parents are altruistic (Basu & Van, 1998) and send their children to school, even altruistic parents may resort to child labor in the face of credit constraints (Baland & Robinson, 2000), poverty (Basu & Van, 1998) and social norms (Emerson & Knabb, 2007). If on the other hand, in situations where parents are non-altruistic or show low level of altruism child labor may be prevalent. Parental education is another determining factor of child labor. In one commonly observed pattern, parents with higher education tend to educate their children rather than sending them to work (Strauss & Thomas, 1995), although the opposite pattern is also possible. According to a study of Tanzania using household data (Al-Samarrai & Peasgood, 1998), father's education has a greater influence on boys' education whereas mother's primary education has a greater influence on girls.

3. THE MODEL

Consider an economy where parents make all relevant household decisions including those on children's schooling and their participation in the labor market. The household consists of one parent and one child. The household derives utility from consumption and human capital development of the child according to the following function:

$$U(c_{it}, h_{it})_{i,t} = \frac{c_{it}^{\sigma}}{\sigma} + \alpha h_{it} \tag{1}$$

where c_{it} is consumption of household i at time t and h_{it} is human capital of the child. σ, the elasticity of substitution, and α are constant parameters with $0 < \sigma < 1$ and $\alpha > 0$.

(a) *Households with no asset holdings*

We start with a simplified version of the household problem taking into account of some of the features of the Tanzanian rural households. Parents fully participate in the labor market and derive income $f(l_{pit}, \theta_{it-1})$.

$$f(l_{pit}, \theta_{it-1}) = w_{pit} l_{pit} + \lambda \theta_{it-1} + \tau \emptyset_{pit} \tag{2}$$

where w_{pit} is the parent wage rate and l_{pit} the labor input. θ_{it-1} is a transitory random shock at $t-1$ and $\emptyset_{pit}$ is a vector of household characteristics, such as parent's education, that affect parent income. λ and τ are constant parameters. The child allocates his time between work (at a wage rate w_{cit}) and schooling. The child's human capital $h_{it} = \beta e_{cit}^{\sigma}$, where β is a technological component. [4] e_{cit} is child's time allocated for schooling (investment in human capital) according to $e_{cit} + l_{cit} = t_{cit}$, where l_{cit} is time allowed for work and t_{cit} is the total amount of time available for the child. Initially we assume that households have neither risk free assets nor access to credit.

The household problem is thus given by:

$$\max_{c_{it}, e_{cit}} \left\{ \frac{c_{it}^{\sigma}}{\sigma} + \alpha \beta e_{cit}^{\sigma} \right\} \tag{3}$$

Subject to the budget constraint

$$c_{it} = w_{cit}(1 - e_{cit}) + w_{pit} l_{pit} + \lambda \theta_{it-1} + \tau \emptyset_{pit} \tag{4}$$

Defining λ as the multiplier on the full-income constraint, first-order conditions for c_{it} and e_{cit} are, respectively,

$$c^{\sigma-1} = \lambda \tag{5}$$

and

$$\alpha \beta \sigma e^{\sigma-1} = \lambda w_c \tag{6}$$

The second first-order condition in (5) characterizes the household decision on whether to send the child to school or work. If $\alpha\beta\sigma e^{\sigma-1} > c^{\sigma-1} w_c$, the marginal value of one unit of time invested in child's human capital is higher, so the household decides to send the child for schooling. On the other hand, if $\alpha\beta\sigma e^{\sigma-1} < c^{\sigma-1} w_c$, marginal value of child labor is higher than the marginal gain in schooling, prompting parents to send her to work. If $e^{\sigma-1} = c^{\sigma-1} w_c$, the household is indifferent between investing in human capital of the child (schooling) and child work.

Assuming that the ratio between the wage rates of the parent and the child to be constant and setting child's wage rate as the *numéraire*, the solution to the first-order conditions from the above household problem can be given by:

$$l_{cit} = \delta + \varphi \chi_{pit} + \lambda \theta_{it-1} + \tau \emptyset_{pit} + \eta e_{cit} + \varepsilon_{it} \tag{7}$$

where χ_{pit} is parent income from labor (farm) and ε_{it} is a random error term with mean zero. δ is a household fixed effects term. According to Eqn. (7), child labor could be affected by parent income and the child's time allocated for human capital development. Note that parent income could be affected by transitory random shocks such as pest attacks which affect their crop production. In the absence of asset holdings, child labor will be the only insurance that acts as a buffer against such shocks in an imperfect credit markets setting. We expect higher parent income and investments in human capital development to reduce child labor hours while transitory random shocks to increase child labor. As such, we expect $\varphi, \eta < 0$ while $\lambda > 0$.

(b) *Households with asset holdings*

We now relax the above assumption that households do not have risk free asset holdings. Liquid asset holdings could exhibit both wealth and substitution effects with respect to child labor depending on the assets' ability to generate income. With this relaxation of earlier assumption the new household budget constraint is:

$$c_{it} = w_{cit}(1 - e_{cit}) + w_{pit} l_{pit} + \lambda \theta_{it-1} + \tau \emptyset_{pit} + (1 + r) a_{it} - a_{it+1} \tag{8}$$

where r is the rate of interest and a_{it} is the household asset holdings at time t. Regardless of whether the assets are monetary or non-monetary assets, or whether the assets are sold/disposed of to meet consumption needs in the face of

shocks, current period assets could be considered as a function of previous period assets, if the rate of growth (depletion) is assumed to be constant.[5] The solution to the first-order conditions from the household problem under this scenario can be given by:

$$l_{cit} = \rho + \varphi\chi_{pit} + \lambda\theta_{it-1} + \tau\emptyset_{pit} + \eta e_{cit} + \mu a_{it} + u_{it} \quad (9)$$

where ρ is a fixed effects term, μ a constant parameter and u_{it} a random error term. A higher level of household asset holdings is expected to reduce child labor ($\mu < 0$) as parents could use such assets as a buffer stock to minimize the effects of shocks on household consumption.

(c) *Households with asset holdings and access to credit*

We further relax the assumption of no access to credit in order to investigate if access to credit reduces child labor. With this relaxation, the budget constraint the household face can be given as:

$$c_{it} = w_{cit}(1 - e_{cit}) + w_{pit}l_{pit} + \lambda\theta_{it-1} + \tau\emptyset_{pit} + (1 + r)a_{it} - a_{it+1} + b_{it} - (1 + r)b_{it+1} \quad (10)$$

where b_{it} is borrowing at time t at an interest rate r. Note that the model allows the households to borrow while keeping assets. The solution to the household problem can be given by:

$$l_{cit} = \phi + \varphi\chi_{pit} + \lambda\theta_{it-1} + \tau\emptyset_{pit} + \eta e_{cit} + \mu a_{it} + \vartheta b_{it} + \omega_{it} \quad (11)$$

where ϕ is the new fixed effects term, ϑ a constant parameter and ω_{it} a random error term.[6]

4. DATA AND EMPIRICAL STRATEGY

(a) *Data set*

(i) *Overview*

This study uses data from two rounds of The Tanzania National Panel Survey (TZNPS). The first round sampled 16,709 individuals in 3,280 households, between October 2008 and October 2009. The second round sampled 20,559 individuals in 3,924 households, between October 2010 and November 2011. Approximately one third of the sample is urban and two thirds is rural. The sample includes households from all regions and districts in Tanzania, including Zanzibar. Over 97% of Round 1 households were re-interviewed. Only 7% of household members present in Round 1 were missing in Round 2. Attrition is thus low, and is not generally associated with the phenomena we study in this paper.[7]

We limit our sample to 3,755 children and youth who were of school age in both rounds, i.e., individuals between 7 and 15 years of age during Round 1.[8] Table 1 includes summary statistics for outcomes, our measures of agricultural shocks, demographic and household variables, and the buffering mechanisms we investigate. Consistent with our working sample, the average age of children is approximately 11 in Round 1, with household size approximately 7.5. Parental education is close to 2.5, where education is coded as: 1 = no education, 2 = some primary, 3 = completed primary, 4 = some secondary, 5 = completed secondary, 6 = more than secondary. Over 90% of children are in school. It is noteworthy that there are some significant differences in Round 1 measures between households that experience agricultural shocks and those that do not, in particular higher education and land value in the latter group. We will see below that these differences are not significant with a full set of control variables.

(ii) *Outcome measures*

We use as outcomes measures children's Round 2 work patterns and human capital development. We use four labor measures: hours worked per (30-day) month for wages, household-run businesses, and household-run farming and hours per month spent on the household tasks of collecting firewood or fuels and water. We find significant seasonal variation, and accordingly control for seasonality using month fixed effects. Note that by the International Labour Organization definition of child labor, not all of these necessarily qualify as child labor, since this depends on intensity and age. So in a strict sense, our dependent variable is child work (see for example Edmonds, 2008).

For human capital attainment, we have an indicator variable for current school enrollment as well as one-year-lagged enrollment before each survey round. We use these to construct an indicator for students who had dropped out of school between survey rounds. This amounts to 373 children, nearly 8% of the student sample. As there is significant variation by gender (with a sharper increase among girls rather than boys) we split our main results by gender. Finally, we also use a measure of food security as an outcome. We measure food security using an indicator variable, equal one if a household answers yes to the question: "In the last 12 months, have you been faced with a situation when you did not have enough food to feed the household?"

(iii) *Measuring shocks*

Our primary measure of household income shocks is crop shocks in Round 1 of the data. We measure these with an indicator variable for a household losing any of its crops after the harvest. Rodents, insects, or pests are the reason for 83.86% of these lost crops. In our student sample, 12.36% of children are drawn from a household which was affected by such a shock in the first round.

We also examine the impact of deaths in the household in Round 1 on child labor and related outcomes in Round 2. Among all deaths we focus on those most likely to be unexpected shocks: sudden deaths due to illness (deaths from illnesses lasting less than 30 days) and deaths due to other causes (including traffic accident, other accident or injury, childbirth, murder, suicide). These shocks are not as cleanly exogenous as crop shocks, with the possibility of reverse causality and omitted variable bias. We refer to deaths as non-income shocks in the sense that the uncertainty does not originate from a household's income-generating activity. At the same time, a death presumably affects both the income and labor supply (and possibly labor demand, for example caring for the sick) within the household. Despite this murkiness in interpretation, this is an important source of uncertainty for households, so we present the results with these qualifications.

(iv) *Controls and buffering mechanisms*

Control variables at the child level are limited to age and gender, but since our children's sample is within 692 households this provides a range of household-level variables such as parental education and household size that we can use as controls. We can also include total value of the land that the family cultivates and consumption per capita in Round 1. These are important controls for household income and wealth, i.e., both characteristics are plausibly correlated both with child labor intensity and the prevalence of agricultural shocks. We note significant differences in both these variables between shocked and not-shocked households. This raises the possibility that these differences could in part be due to the

agricultural shocks that we are examining and in that sense these are outcomes rather than controls. Since omitted variable bias is a paramount concern, we ultimately opt to include both as control variables. Furthermore, to the extent that controlling for some of the effect of the shocks bias our results, the bias should be toward zero.

The buffering mechanism we would ideally examine is access to credit, which is of course not observed in our data. We use two household level proxies instead. First, we use an indicator variable for families that have a bank account (from Table 1, the mean ranges between 9% and 19%); access to a bank account provides access not only to the ability to save (and self-insure) but also potentially to borrow. Second, we use ownership of durable assets (specifically, a principal component analysis index) as a proxy for collateralizable assets and hence the ability to borrow; assets can also be used as a buffer stock (i.e., drawn down in response to a shock).

It is important to note that we use Round 1, rather than Round 2, values of these variables; the latter are likely to be endogenous with respect to the shocks we examine, whereas the former were determined at or prior to the point in time that the shocks occur.

(b) *Empirical strategy*

Our empirical strategy is motivated by Eqns. (7), (9) and (11). Following the model, we are interested in the relationship between child labor intensity and measures of parental income, crop shocks, and credit constraints. The main challenge in implementing this approach is the potential simultaneity of child labor and parental income. Common local shocks (e.g., weather or local market conditions) could increase both parents' and children's labor hours. A second challenge is omitted variable bias with respect to crop shocks and child labor. For example, agricultural practices in a region could favor crops that are both more prone to shocks and benefit from greater labor input. Furthermore, crop shocks might be linked to features of a household that could also lead to increased levels of child labor.

We have a fourfold strategy for addressing these concerns. First, rather than regress child labor on parental labor (or labor income) we use parents' level of education as a proxy for parental income; the advantage of this is that parents' education is predetermined and highly unlikely to be simultaneously determined with child labor. Second, to deal with omitted variable bias we include a broad range of controls, including household controls such as the size of the household and the size of the household's accessible land holdings (to control for differences in household wealth), along with parental education as mentioned above. Third, we empirically investigate whether household agricultural shocks are correlated with household, child, or parental characteristics. While this does not preclude the possibility of correlation with unobservable variables, it does increase the plausibility of the view that agricultural shocks are exogenous, effectively random with respect to household labor practices.

Fourth, we also present specifications that include region fixed effects. This allows us to control for all time-invariant unobservables at the region level that could be correlated with child labor and crop shocks (such as agricultural practices, and also differences in social norms with respect to child labor and the availability of governmental and non-governmental safety nets). At the same time, region fixed effects absorb a significant amount of legitimate variation, for example due to weather shocks at the region level. As a result we will present both OLS and fixed effects specifications.

As a robustness check, we exploit the panel structure of the data and also present household fixed effects results. By focusing just on the within-household variation this specification controls for a wide range of time-invariant household unobservables. At the same time, the specification also discards more than one third of the variation in child labor hours, and magnifies the effect of between-child unobservables. With these caveats in mind, we will discuss these results below.

5. ESTIMATION RESULTS AND ANALYSIS

(a) *Are shocks exogenous with respect to child labor and transitory?*

We begin by investigating whether crop shocks are plausibly exogenous with respect to child labor intensity and other household and individual characteristics. In order to do this, we use a linear probability model to regress crop shocks against our individual, parental, and household control variables. The results are presented in Table 2, columns (1)–(5).

In column (1) we see that there is no significant relationship between agricultural shocks and the child's age or gender, and the size of the household. Mother's education is a negative predictor of crop shocks, statistically significant at the one% level, while father's education is not. This motivates our inclusion of parental education as a control in our subsequent specifications. In column (2) we add controls for household's land holdings and per capita household consumption, which could *a priori* affect shocks positively or negatively: either poorer households face more risk or wealthier farmers are willing to plant riskier crops. We, in fact, find a negative relationship, which is significant at the 10% level for per capita consumption; however, this effect does not remain significant with the inclusion of region fixed effects in column (5).

In column (3) we add an indicator for child labor (that the child is working, and not in school), and in column (4) we add child labor hours. Neither is statistically significant. This is important because it suggests that the relationship between agricultural shocks and child labor in Round 2 is probably not driven by reverse causality, i.e., households that use child labor are not more likely to experience agricultural shocks. Finally, in column (5) we add region fixed effects; as mentioned above, only mother's education remains a statistically significant predictor of crop shocks.

Overall Table 2 lends credence to a causal interpretation of the effect of crop shocks in Round 1 on subsequent outcomes; only mother's education is a significant predictor of crop shocks and we control for this variable, along with the additional variables from this table (sex, age, father's education, land value, and household size), in our subsequent specifications. Our specifications will also include season dummies and region fixed effects.

(b) *Child labor and agricultural Shocks: direct effects*

In this section we examine the direct, reduced-form effect of agricultural shocks on child labor hours, school withdrawal and food security outcomes. We estimate OLS and region fixed effects specifications of Eqn. (7), with a pooled sample, a boys' sample and a girls' sample. In all tables, direct-effect OLS estimates for the pooled sample are reported in columns (1) (in order to keep the tables manageable, we suppress OLS estimates in the boys' and girls' samples). Fixed effects estimates are reported in columns (4), (7), and (10) for the pooled, boys', and girls' samples respectively.

Table 2. *Predicting crop shocks in Round 2*

Variables	(1) OLS Individual level	(2) OLS Individual level	(3) OLS Individual level	(4) OLS Individual level	(5) Region FE Individual level
Female	−0.00432	−0.00495	−0.00452	−0.00621	−0.00689
	(0.0111)	(0.0138)	(0.0136)	(0.0134)	(0.0135)
Age (Round 1)	0.00217	0.00343	0.00310	0.00174	0.00249
	(0.00160)	(0.00219)	(0.00227)	(0.00248)	(0.00223)
Household Size (Round 1)	0.00129	−0.000132	−0.000149	−0.000289	−0.00218
	(0.00330)	(0.00383)	(0.00380)	(0.00385)	(0.00294)
Father's Education (Round 1)	−0.00326	0.00130	0.00148	0.00128	−0.00135
	(0.00491)	(0.00648)	(0.00644)	(0.00642)	(0.00662)
Mother's Education (Round 1)	−0.0238***	−0.0184*	−0.0182*	−0.0183*	−0.0150*
	(0.00781)	(0.00919)	(0.00921)	(0.00921)	(0.00870)
Per Capita Consumption (Round 1)		−1.15e−06***	−1.12e−06**	−1.05e−06**	−5.41e−07
		(4.07e−07)	(4.11e−07)	(4.11e−07)	(4.79e−07)
Value of Household-Cultivated Plots (Round 1)		−1.28e−10	−1.29e−10	−1.45e−10	−8.13e−11
		(1.01e−10)	(1.01e−10)	(9.96e−11)	(7.89e−11)
Working and Not in School (Round 1)			0.0292	0.00808	0.0132
			(0.0434)	(0.0413)	(0.0434)
Total Child Labor Hours (Round 1)				0.000200	8.29e−05
				(0.000127)	(0.000127)
Crop Shock (Round 1)					
Constant	0.115**	0.143**	0.144**	0.149**	0.141
	(0.0418)	(0.0540)	(0.0542)	(0.0553)	(0.119)
Observations	3,754	2,960	2,960	2,960	2,960
R-squared	0.022	0.023	0.024	0.025	0.111
% main effect	−0.0365	−0.0418	−0.0381	−0.0524	−0.0581
t-Stat main effect	0.388	0.360	0.332	0.463	0.511

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

In Table 3 we begin by looking at overall work hours as an outcome: total hours spent on wage work, agricultural work, household work, and non-paying household-run business work. In column (1) we see that the overall effect of a crop shock is a 7.7-h increase in child labor hours per month, significant at the 5% level. Relative to the mean of approximately 32 h in the overall sample, this is approximately a 12% increase in work hours for children. The inclusion of region fixed effects in column (4) reduces the effect by almost one third, and it is no longer significant at standard levels. When we split the sample by gender, we find that the effect for boys is larger in magnitude than the effect for girls, and almost significant at the 10% level. The shock effect on male hours is 8.66 additional hours per month, a 13% increase. The effect on female child labor is not statistically significant at or near standard levels.

In Table 4 we turn to agricultural work hours. In the full sample and boys' sample, the effect of a shock on agricultural work hours is significant at standard levels in the OLS specification and in the full sample also for the fixed effects specification. For girls the effects are not significant at standard levels. The absolute magnitudes are similar to the overall work hour increase (a 7-h increase in agricultural hours in the pooled sample), although the percent increase is somewhat larger (a 22% increase in agricultural work hours).

In Table 5, we examine the impact of agricultural shocks on wage work hours. We find a decrease in wage work hours. This decrease is consistently significant at the 5% level in the pooled sample, boys', and girls' sample. The pooled sample decrease is of 2.73 and 3.56 h in the OLS and fixed effects specifications respectively. This is a 13 to 17% decrease relative to mean monthly wage work hours. For boys, the fixed effects reduction is 3.79 h, a 17% reduction relative to the boys' mean. Girls experience a 3.3-h (16%) decrease in wage work hours due to crop shocks, although the effect is only significant at the 10% level in the fixed effects specification.

In Table 6, we look at the effect of agricultural shocks on household work hours: hours spent fetching water, firewood, and fuels. In the full sample, we find a significant increase (at the 10% level) in the region fixed effects specification. This is an increase of 3.5 h, 36% relative to the mean. In the boys' sample, the increase is significant at the 10% level in both OLS and fixed effects specifications. The boys' increase is 42–49% relative to the mean. While girls do spend more time on average engaged in household work, the effect is not statistically significant at standard levels.

In Table 7, we examine the effect of crop shocks on an indicator for students who left school between survey rounds. We use a linear probability model. Both OLS and fixed effects in the pooled sample show a nearly 4 percentage point increase in children exiting school, significant at the 5% and 1% levels respectively. The effect is large relative to the 6% probability of leaving school for children who did not experience crop shocks (and is about 50% with respect to the overall mean). When we split the sample by gender, we observe that the effect is driven by the girls' sample. For girls the effect is 79%, somewhat larger in size compared to the full sample. For boys, the effect is only one percentage point in the region fixed effects specification, and not significant at standard levels.

Finally in Table 8, we examine the effect of crop shocks on food security. For all specifications and samples except the fixed effects specification for girls we find a positive and statistically significant effect (i.e., an increase in the prevalence of hunger over the year prior to Round 2 of the survey). The

Table 3. *Total child labor hours (Round 2)*

Variables	(1) OLS Full sample	(2) OLS Full sample	(3) OLS Full sample	(4) Region FE Full sample	(5) Region FE Full sample	(6) Region FE Full sample	(7) Region FE Male	(8) Region FE Male	(9) Region FE Male	(10) Region FE Female	(11) Region FE Female	(12) Region FE Female
Crop Shock (Round 1)	7.686**	7.717**	10.62***	5.389	4.839	8.819**	8.657	8.192	13.27**	1.992	1.527	2.392
	(3.078)	(3.304)	(3.137)	(3.586)	(3.650)	(3.933)	(5.501)	(5.134)	(5.888)	(4.638)	(4.980)	(5.859)
Crop Shock × Bank Account		−0.785			6.103			4.430			5.283	
		(10.73)			(10.69)			(23.68)			(13.40)	
Bank Account (Round 1)		−8.888*			−10.29*			−12.12			−8.412*	
		(4.338)			(5.007)			(8.181)			(4.850)	
Asset Index × Crop Shock			5.031***			5.348***			8.489**			1.147
			(1.725)			(1.682)			(3.456)			(2.811)
Asset Index (Round 1)			−3.443***			−3.352***			−3.065			−3.544**
			(0.969)			(0.969)			(1.817)			(1.468)
Constant	−4.032	3.733	−3.509	26.10**	25.99*	20.58	14.62	9.877	10.11	44.14***	34.51***	28.21*
	(12.41)	(11.13)	(11.43)	(9.412)	(13.32)	(13.05)	(24.29)	(24.56)	(19.62)	(13.48)	(12.08)	(15.01)
Observations	2,960	2,959	2,960	2,960	2,959	2,960	1,457	1,457	1,457	1,503	1,502	1,503
R-squared	0.109	0.111	0.115	0.145	0.146	0.150	0.185	0.187	0.191	0.130	0.130	0.135
% main effect	0.117	0.117	0.161	0.0817	0.0734	0.134	0.131	0.124	0.201	0.0302	0.0232	0.0363
t-Stat main effect	2.497	2.336	3.387	1.503	1.326	2.242	1.574	1.596	2.254	0.429	0.307	0.408
% interaction effect		−0.102	0.137		1.261	0.175		0.541	0.185		3.459	0.139
t-Stat interaction		0.0535	44.26		0.205	29.42		0.0642	17.72		0.0125	1.877

Notes: All specifications include the following controls: age, sex, father's and mother's education, household size, household land value, and month-of-interview dummies. Standard errors clustered by region are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

effect is more than 35% relative to the mean for girls and between 44% and 49% for boys. These results reveal that households are not fully able to cope with the agricultural shocks they face by adjusting children's level of labor hours, i.e., that despite working additional hours children's food security nonetheless suffers.

Overall these results suggest that crop shocks lead not only to an increase in child labor hours but a change in the composition of child time use: children are spending less time engaged in wage work and more time in agricultural and household work, and girls are less likely to be in school.

(c) *Buffering of child labor effects of agricultural shocks*

In this section we examine whether access to credit can buffer the negative impact of agricultural shocks, using the same outcomes examined in the previous section. We use whether the household has a bank account and a composite measure of durable assets owned by the household, constructed using principal component analysis, as proxies for access to credit. Following Eqns. (9) and (11), we interact these proxies of access to credit with the crop shock indicator used in the previous analysis to investigate whether the mechanisms we are investigating mitigate the effect of the shock.

Again, we estimate OLS and region fixed effects specifications for the pooled sample and region fixed effects specifications for the boys' and girls' samples. In Tables 2–8, OLS estimations with the bank account proxy are in columns (2). Fixed effects estimates for this proxy are in columns (5), (8), and (11) for the pooled, boys', and girls' samples respectively. OLS estimations with the durable asset index proxy are in column (3) for the pooled sample, and fixed effects estimates for this proxy are in columns (6), (9), and (12) for the pooled, boys' and girls' samples respectively.

Returning to Table 3, we find that the direct effect of the household having a bank account is a reduction on child labor hours, consistent with the model discussed in section 3. Using the pooled sample, OLS and fixed effects estimates are an 8.89- and a 10.29-h reduction in child labor hours, respectively. These results are both significant at the 10% level. The magnitude and significance of this coefficient varies in the boys' and girls' samples. Having a bank account mitigates male child labor by 12 h per month on average in the fixed effects estimates, although this is not significant at standard levels. For the female sample, the fixed effects estimate is significant at the 10% level, and indicates an 8.5-work hour reduction. At the same time, the interaction effect is not statistically significant. In principle, a buffering effect would correspond to an attenuation of the main crop shock effect, although we find no evidence for this for access to a bank account.

In Tables 4–8, the only significant access-to-bank effect is in Table 6, where we find access to a bank significantly and negatively associated with household work hours. The effect is significant in the full sample, but when we split by gender we note that the effect is driven by the girls' sample. The interaction effects are not significant. In Table 8 however we do find significant buffering effects of access to a bank account on hunger. Both the direct effect of access to banking is significant for most samples and specifications, and the interaction effect is significant in all samples and specifications. The magnitudes of the interaction effects are large, indeed larger than the main effect of crop shocks.

Turning to our second proxy of access to credit, we find that assets, like access to a bank account, are associated with a lower level of overall child labor hours in Table 3. A full standard deviation increase in the asset index (3.5 index points) is

Table 4. *Child Agricultural Labor Hours (Round 2)*

Variables	(1) OLS Full sample	(2) OLS Full sample	(3) OLS Full sample	(4) Region FE Full sample	(5) Region FE Full sample	(6) Region FE Full sample	(7) Region FE Male	(8) Region FE Male	(9) Region FE Male	(10) Region FE Female	(11) Region FE Female	(12) Region FE Female
Crop Shock (Round 1)	7.050**	7.136*	8.540**	5.911*	5.652	7.862**	8.415	8.465	11.78*	3.236	2.805	2.058
	(3.277)	(3.693)	(3.247)	(3.278)	(3.643)	(3.389)	(5.316)	(5.132)	(5.853)	(4.618)	(4.881)	(4.931)
Crop Shock × Bank Account		−1.298			2.930			−1.152			4.687	
		(10.44)			(10.29)			(19.42)			(9.479)	
Bank Account (Round 1)		−6.318			−6.023			−7.283			−4.943	
		(3.750)			(4.280)			(6.414)			(3.864)	
Asset Index × Crop Shock			2.550			3.046			6.344*			−1.255
			(2.016)			(1.992)			(3.587)			(1.657)
Asset Index (Round 1)			−1.727**			−1.695**			−1.723			−1.610
			(0.744)			(0.702)			(1.723)			(1.087)
Constant	5.067	10.14	7.052	13.87*	19.79	17.40	12.30	9.168	10.49	9.619	18.63	1.613
	(9.275)	(11.45)	(10.89)	(7.110)	(13.82)	(13.12)	(21.35)	(21.49)	(16.84)	(9.885)	(11.69)	(12.31)
Observations	2,960	2,959	2,960	2,960	2,959	2,960	1,457	1,457	1,457	1,503	1,502	1,503
R-squared	0.109	0.110	0.112	0.143	0.144	0.145	0.165	0.167	0.171	0.135	0.136	0.139
% main effect	0.219	0.222	0.266	0.184	0.176	0.245	0.262	0.263	0.367	0.101	0.0873	0.0641
t-Stat main effect	2.151	1.933	2.630	1.803	1.552	2.320	1.583	1.650	2.013	0.701	0.575	0.417
% interaction effect		−0.182	0.0863		0.518	0.112		−0.136	0.156		1.671	−0.176
t-Stat interaction		0.0905	17.50		0.130	19.49		0.0259	17.10		0.0616	0.586

Notes: All specifications include the following controls: age, sex, father's and mother's education, household size, household land value, and month-of-interview dummies. Standard errors clustered by region are in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 5. *Child Wage Labor Hours (Round 2)*

Variables	(1) OLS Full sample	(2) OLS Full sample	(3) OLS Full sample	(4) Region FE Full sample	(5) Region FE Full sample	(6) Region FE Full sample	(7) Region FE Male	(8) Region FE Male	(9) Region FE Male	(10) Region FE Female	(11) Region FE Female	(12) Region FE Female
Crop shock (Round 1)	−2.728**	−2.651**	−2.576**	−3.576**	−3.779**	−3.335**	−3.789**	−3.677**	−3.417**	−3.343*	−3.884**	−3.243*
	(1.201)	(1.120)	(1.138)	(1.463)	(1.357)	(1.470)	(1.659)	(1.746)	(1.580)	(1.751)	(1.514)	(1.634)
Crop Shock × Bank Account		−0.773			2.204			−1.264			5.397	
		(4.498)			(4.690)			(3.047)			(8.987)	
Bank Account (Round 1)		2.141			1.401			0.493			2.679	
		(1.870)			(1.927)			(2.836)			(3.275)	
Asset Index × Crop Shock			0.310			0.364			0.530			0.281
			(0.368)			(0.423)			(0.685)			(0.452)
Asset Index (Round 1)			−0.776***			−0.774***			−0.766**			−0.848***
			(0.228)			(0.212)			(0.308)			(0.217)
Constant	−12.00***	−3.314	−6.525	−0.407	3.156	0.228	3.476	3.589	1.619	2.673	1.256	−1.137
	(3.380)	(6.262)	(6.193)	(3.733)	(4.366)	(4.497)	(6.749)	(7.010)	(7.152)	(4.588)	(5.746)	(4.757)
Observations	2,960	2,959	2,960	2,960	2,959	2,960	1,457	1,457	1,457	1,503	1,502	1,503
R-squared	0.028	0.028	0.029	0.049	0.050	0.051	0.068	0.068	0.069	0.051	0.052	0.053
% main effect	−0.128	−0.125	−0.121	−0.168	−0.178	−0.157	−0.178	−0.173	−0.161	−0.157	−0.182	−0.152
t-Stat main effect	2.272	2.366	2.263	2.444	2.784	2.268	2.285	2.106	2.163	1.909	2.565	1.985
% interaction effect		0.292	−0.0348		−0.583	−0.0316		0.344	−0.0448		−1.390	−0.0250
t-Stat interaction		0.101	21.80		0.363	19.79		0.421	13.12		0.252	16.62

Notes: All specifications include the following controls: age, sex, father's and mother's education, household size, household land value, and month-of-interview dummies. Standard errors clustered by region are in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 6. *Child Chore Labor Hours (Round 2)*

Variables	(1) OLS Full sample	(2) OLS Full sample	(3) OLS Full sample	(4) Region FE Full sample	(5) Region FE Full sample	(6) Region FE Full sample	(7) Region FE Male	(8) Region FE Male	(9) Region FE Male	(10) Region FE Female	(11) Region FE Female	(12) Region FE Female
Crop shock (Round 1)	3.266	2.938	3.880*	3.550*	3.308	4.118*	4.462*	3.920	4.727**	2.202	2.412	2.955
	(1.924)	(2.189)	(1.958)	(2.041)	(2.302)	(2.035)	(2.441)	(2.893)	(2.237)	(2.456)	(2.971)	(2.905)
Crop Shock × Bank Account		3.525			2.674			6.125			-1.835	
		(4.262)			(4.097)			(8.158)			(6.485)	
Bank Account (Round 1)		−3.618***			−4.080***			−2.028			−5.894***	
		(1.198)			(1.260)			(1.940)			(1.525)	
Asset Index × Crop Shock			1.040			0.885			0.374			1.085
			(1.393)			(1.378)			(1.166)			(2.609)
Asset Index (Round 1)			−0.580			−0.605			−0.550			−0.578
			(0.388)			(0.383)			(0.552)			(0.454)
Constant	9.978**	5.365	4.913	19.84***	12.30***	12.04***	6.808	6.412	5.471	39.29***	24.56***	37.08***
	(4.174)	(3.579)	(4.323)	(3.926)	(3.256)	(4.257)	(5.071)	(5.326)	(5.366)	(5.854)	(5.798)	(7.055)
Observations	2,960	2,959	2,960	2,960	2,959	2,960	1,457	1,457	1,457	1,503	1,502	1,503
R-squared	0.045	0.046	0.046	0.061	0.062	0.062	0.059	0.060	0.060	0.061	0.065	0.062
% main effect	0.357	0.321	0.424	0.388	0.361	0.450	0.487	0.428	0.516	0.240	0.263	0.323
t-Stat main effect	1.697	1.342	1.981	1.739	1.437	2.023	1.828	1.355	2.113	0.897	0.812	1.017
% interaction effect		1.200	0.0775		0.808	0.0621		1.563	0.0229		−0.761	0.106
t-Stat interaction		0.249	7.272		0.281	6.685		0.177	4.129		0.202	2.252

Notes: All specifications include the following controls: age, sex, father's and mother's education, household size, household land value, and month-of-interview dummies. Standard errors clustered by region are in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 7. *Child left school between rounds*

Variables	(1) OLS Full sample	(2) OLS Full sample	(3) OLS Full sample	(4) Region FE Full sample	(5) Region FE Full sample	(6) Region FE Full sample	(7) Region FE Male	(8) Region FE Male	(9) Region FE Male	(10) Region FE Female	(11) Region FE Female	(12) Region FE Female
Crop Shock (Round 1)	0.0398**	0.0443***	0.0331*	0.0394***	0.0419**	0.0369**	0.0112	0.0105	0.00971	0.0624***	0.0688***	0.0637**
	(0.0143)	(0.0151)	(0.0163)	(0.0141)	(0.0151)	(0.0171)	(0.0202)	(0.0219)	(0.0188)	(0.0220)	(0.0238)	(0.0265)
Crop Shock × Bank Account		−0.0520			−0.0288			0.00334			−0.0698	
		(0.0309)			(0.0299)			(0.0368)			(0.0441)	
Bank Account (Round 1)		−0.0149			−0.0198			−0.0364			−0.0105	
		(0.0172)			(0.0189)			(0.0303)			(0.0237)	
Asset Index × Crop Shock			−0.0107			−0.00444			−0.0109			0.00516
			(0.0132)			(0.0139)			(0.0197)			(0.0154)
Asset Index (Round 1)			−0.0126***			−0.0122***			−0.0123**			−0.0120**
			(0.00409)			(0.00398)			(0.00574)			(0.00502)
Constant	−0.198***	−0.203***	−0.239***	−0.131**	−0.139**	−0.171***	−0.0826	−0.0937	−0.146	−0.253***	−0.260***	−0.308***
	(0.0488)	(0.0515)	(0.0552)	(0.0502)	(0.0542)	(0.0597)	(0.0993)	(0.103)	(0.112)	(0.0765)	(0.0810)	(0.0888)
Observations	2,463	2,462	2,463	2,463	2,462	2,463	1,189	1,189	1,189	1,274	1,273	1,274
R-squared	0.091	0.092	0.097	0.116	0.116	0.120	0.138	0.139	0.143	0.133	0.134	0.138
% main effect	0.501	0.557	0.417	0.497	0.528	0.465	0.141	0.133	0.122	0.786	0.866	0.802
t-Stat main effect	2.787	2.934	2.025	2.806	2.780	2.155	0.555	0.481	0.516	2.833	2.893	2.406
% interaction effect		−1.174	−0.0934		−0.687	−0.0348		0.316	−0.324		−1.014	0.0234
t-Stat interaction		3.628	4.214		1.850	2.408		0.0210	0.473		3.156	5.555

Notes: All specifications include the following controls: age, sex, father's and mother's education, household size, household land value, and month-of-interview dummies. Standard errors clustered by region are in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 8. *Insufficient food situation in past 12 months (Round 2)*

Variables	(1) OLS Full sample	(2) OLS Full sample	(3) OLS Full sample	(4) Region FE Full sample	(5) Region FE Full sample	(6) Region FE Full sample	(7) Region FE Male	(8) Region FE Male	(9) Region FE Male	(10) Region FE Female	(11) Region FE Female	(12) Region FE Female
Crop Shock (Round 1)	0.0723***	0.0920***	0.0481	0.0714**	0.0895**	0.0519	0.0923**	0.112**	0.0785*	0.0657	0.0842*	0.0377
	(0.0258)	(0.0289)	(0.0362)	(0.0312)	(0.0336)	(0.0431)	(0.0411)	(0.0434)	(0.0453)	(0.0387)	(0.0418)	(0.0515)
Crop Shock × Bank Account		−0.225***			−0.196***			−0.232***			−0.183***	
		(0.0347)			(0.0288)			(0.0441)			(0.0538)	
Bank Account (Round 1)		−0.0707**			−0.0863***			−0.0657			−0.0988**	
		(0.0275)			(0.0287)			(0.0401)			(0.0411)	
Asset Index × Crop Shock			−0.0370			−0.0315			−0.0366			−0.0321
			(0.0230)			(0.0251)			(0.0217)			(0.0342)
Asset Index (Round 1)			−0.0265***			−0.0276***			−0.0283***			−0.0258***
			(0.00543)			(0.00581)			(0.00661)			(0.00810)
Constant	0.345***	0.245***	0.176***	0.421***	0.253***	0.184***	0.230	0.185	0.136	0.408***	0.252**	0.275***
	(0.0439)	(0.0658)	(0.0553)	(0.0620)	(0.0717)	(0.0546)	(0.149)	(0.168)	(0.130)	(0.0747)	(0.0907)	(0.0837)
Observations	2,960	2,959	2,960	2,960	2,959	2,960	1,457	1,457	1,457	1,503	1,502	1,503
R-squared	0.029	0.037	0.043	0.060	0.068	0.073	0.088	0.096	0.102	0.063	0.073	0.076
% main effect	0.381	0.485	0.253	0.376	0.472	0.273	0.486	0.589	0.413	0.346	0.443	0.198
t-Stat main effect	2.800	3.184	1.328	2.293	2.667	1.204	2.244	2.580	1.731	1.701	2.013	0.732
% interaction effect		−2.449	−0.222		−2.188	−0.175		−2.074	−0.135		−2.179	−0.247
t-Stat interaction		9.025	2.735		5.630	2.425		5.653	6.935		3.835	0.813

Notes: All specifications include the following controls: age, sex, father's and mother's education, household size, household land value, and month-of-interview dummies. Standard errors clustered by region are in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

associated with a 12-h decrease in both the OLS and fixed effects specifications. The magnitudes are somewhat larger for girls, for whom the effect is significant at standard levels, and somewhat smaller for boys and not statistically significant. However, the sign of the interaction effect for assets is opposite to what we would expect if assets were primarily a buffer for child labor. The effect is positive and significant at the 1% level in the full sample, in both OLS and fixed effects specifications. The mean level of asset holdings magnifies the effect of a crop shock between 13.7% and 17.5%. Comparing the boys' and girls' sample, the interaction effect is significantly larger in percentage terms for boys than girls, and the effect is statistically significant in the former sample. The unexpected signs for the asset-shock interaction points to a key limitation of the proxies we use; although both are presumably correlated with the access to credit, both could also be correlated with other variables that could in turn be related to child labor.

The effect of assets on agricultural work hours follows a similar pattern in Table 4, with negative direct effects and positive interaction effects, at least for the significant coefficients in the boys' sample. Tables 5 and 6 show similar patterns for wage and household work hours, although the coefficients are not in general statistically significant. In Tables 5 and 6, for leaving school and hunger, we find negative and statistically significant main effects and insignificant interaction effects.

In conclusion, we find one set of statistically significant buffering effects that go in the direction we expected: access to a bank account seems to buffer children against hunger when household experience agricultural shocks. The buffering effects of this proxy on other outcomes, although not statistically significant, do generally go in the expected direction. However, we also find that household asset holdings magnify—rather than attenuate—the effect of agricultural shocks on children's work hours.

(d) *The intensive and extensive margins*

Our results in the previous sections do not distinguish between the intensive and extensive margin: if crop shocks increase child labor, is it through children working who did not work before or is it increased work intensity among those already working? We examine this in Table 9. In panel (a) we find a statistically significant extensive margin response for total child labor hours and for agricultural work hours, but not for chore work hours. Instead, we see a statistically significant intensive margin response for chore hours, which increase between 60% and 70% with a crop shock.

For the buffering effects, looking at the extensive margin, unlike our results in the previous section, we find a significant buffering effect of access to a bank account on total and agricultural child labor hours, although the magnitudes are modest (12% and 5.6% respectively). We also find the same buffering effects at the intensive margin in panel (b).

Distinguishing between the intensive and extensive margin throws some of our results from the previous section into sharp relief: crop shocks matter significantly at the extensive margin for total and agricultural work hours, and access to a bank account does seem to offering buffering against these effects.

(e) *The effect of deaths in the household*

In this section we examine the impact of another shock—the death of a member of the household—on the same range of child labor, education, and food security outcomes. As discussed in Section 4, death of a household member is less likely to be an exogenous shock than a crop shock. Simultaneity is a concern (both child labor and shocks to adult heath can be caused by a contemporaneous negative shock), as is omitted variable bias. Furthermore, death of a household member is by definition a permanent, rather than a transitory, shock. Hence it is also potentially a significant shock to the household's permanent income. As a result, any observed increases in child labor might reflect the household's response to a lower standard of living. At the same time, since deaths in the household are a significant source of uncertainty, we proceed to examine their effect, bearing these caveats in mind. These results are presented in Table 10.

In panel (a), we observe that a death in the household leads to significant increase in child labor hours in the region fixed effects specification for the male sample. The effect is approximately 24 or 25 h per month or more than 36% relative to the mean. The effect is not statistically significant at standard levels for girls. In panel (b) we see that the boys' effect is driven by increased agricultural work hours. No other impacts are significant for boys. For girls the only statistically significant impact we find is a reduction in household work hours (significant at the 10% level in the region fixed effects specification in column (4) and more than 40% relative to the mean).

Table 10 also examines the buffering impact of assets on a death in the household (there were no significant buffering effects of the household having a bank account). Most notable is a positive effect of assets interacted with a death in the household on overall and agricultural work hours for boys. This is consistent with our previous finding that assets, although associated with a lower level of work hours, are also correlated with the demand for child labor when households experience shocks. For girls, we find a statistically significant and negative buffering effect of assets on hunger.

(f) *Robustness check: household fixed effects*

In Table 11, we present results from a household fixed effects specification. As discussed in Section 4, this specification focuses just on within-household variation. While these results are less exposed to omitted variables, they also discard some potentially valid variation in child labor hours. The former will lead to less bias, and the latter to less precision in the results.

In Table 11, column (1), the effect of crop shocks on overall child labor hours is, although positive, no longer statistically significant at standard levels, with a much smaller magnitude than our results in Table 3. Looking within households a significant piece of both the variation in child labor hours and the shock is averaged out. This motivates the introduction of the crop shock-age interaction in column (2). It allows us to differentiate the effects of shocks within households by age. We now find a negative and statistically significant shock effect and a positive and statistically significant shock-age interaction. The interaction implies that looking within households children aged 10.75 or older experience an increase in labor hours (e.g., 3 h a month for a 12-year old and 10.5 h a week for a 15-year old). From the subsequent columns we note that the increase in overall child labor hours is driven by an increase in unpaid work in household businesses. For this category, even the youngest children experience some increase in work hours in response to a shock (1.5 h a month at age 7 increasing to almost 12.5 h a month at age 15).

The contrast between the household fixed effects and OLS specifications has several possible interpretations. It could reflect the bias-variation tradeoff discussed above (less bias but also less variation in child labor hours) or simply the shorter time elapsed between the shocks and the outcomes. But in part it can also be seen as a characterization of the

Table 9. *The intensive and extensive margins*

Variables	(1) Total child labor hours	(2) Total child labor hours	(3) Child agricultural labor hours	(4) Child agricultural labor hours	(5) Child wage labor hours	(6) Child wage labor hours	(7) Child chore labor hours	(8) Child chore labor hours
A. Extensive Margin (zero vs. positive hours)								
Crop shock (Round 1)	0.0526*	0.0741***	0.0803***	0.0866***	−0.00113	−0.00242	0.00911	0.0302
	(0.0285)	(0.0244)	(0.0199)	(0.0235)	(0.0105)	(0.00922)	(0.0320)	(0.0343)
Crop Shock × Bank Account	0.0182		−0.0402		−0.0358*		0.0935	
	(0.0751)		(0.102)		(0.0176)		(0.0791)	
Bank Account (Round 1)	−0.121***		−0.0358		0.0108		−0.0664	
	(0.0423)		(0.0353)		(0.0120)		(0.0409)	
Asset Index × Crop Shock		0.0309**		0.0168		0.00383		0.0208
		(0.0128)		(0.0188)		(0.00433)		(0.0220)
Asset Index (Round 1)		−0.0219***		−0.0137*		−0.00853**		−0.00717
		(0.00736)		(0.00711)		(0.00322)		(0.00908)
Observations	2,959	2,960	2,959	2,960	2,959	2,960	2,959	2,960
R-squared	0.098	0.097	0.124	0.125	0.045	0.048	0.068	0.068
% main effect	0.0960	0.135	0.266	0.287	−0.00960	−0.0205	0.0287	0.0951
t-Stat main effect	1.845	3.043	4.026	3.687	0.108	0.262	0.284	0.879
% interaction effect	0.347	0.120	−0.500	0.0560	31.59	−0.458	10.26	0.200
t-Stat interaction	0.158	23.83	0.320	18.48	0.000359	0.167	0.00677	3.550
B. Intensive Margin (non-zero hours)								
Crop shock (Round 1)	1.482	5.919	3.247	7.191	−56.31**	−78.08	5.673*	6.968*
	(4.851)	(6.319)	(6.867)	(6.841)	(19.85)	(48.92)	(3.181)	(3.807)
Crop Shock × Bank Account	15.43		12.35		193.5**		4.773	
	(14.77)		(26.71)		(68.19)		(8.361)	
Bank Account (Round 1)	−5.428		−14.47**		53.48		−4.763	
	(6.371)		(6.874)		(53.01)		(3.391)	
Asset Index × Crop Shock		4.675		4.037		−15.33		1.322
		(3.086)		(4.110)		(37.04)		(4.261)
Asset Index (Round 1)		−2.855**		−2.849		31.71		−0.950
		(1.295)		(2.401)		(19.59)		(0.768)
Observations	1,804	1,804	948	948	109	109	1,298	1,298
R-squared	0.174	0.177	0.117	0.117	0.309	0.300	0.047	0.047
% main effect	0.0225	0.0898	0.101	0.224	−2.646	−3.669	0.619	0.761
t-Stat main effect	0.305	0.937	0.473	1.051	2.836	1.596	1.784	1.830
% interaction effect	10.41	0.228	3.805	0.162	−3.436	0.0568	0.841	0.0548
t-Stat interaction	0.00810	8.419	0.0213	4.600	1.413	5.158	0.274	2.153

Notes: All specifications include the following controls: age, sex, father's and mother's education, household size, household land value, region fixed effects, and month-of-interview dummies. Standard errors clustered by region are in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Notes: All specifications include the following controls: age, sex, father's and mother's education, household size, household land value, region fixed effects, and month-of-interview dummies. Standard errors clustered by region are in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 10. *The Impact of deaths on child labor outcomes*

A. Total work hours					B. Farm work hours				
Variables	(1) OLS Full sample	(2) Region FE Full sample	(3) Region FE Male	(4) Region FE Female	Variables	(1) OLS Full sample	(2) Region FE Full sample	(3) Region FE Male	(4) Region FE Female
Household death Round 2	9.845	8.644	23.80**	−4.157	Household death Round 2	13.98	13.43	26.50**	2.347
	(9.657)	(8.847)	(10.84)	(6.785)		(9.751)	(9.423)	(11.03)	(6.767)
Index of HH assets owned × Household death Round 2	9.749**	9.949**	16.31***	1.460	Index of HH assets owned × Household death Round 2	9.044**	8.784**	14.98***	0.750
	(3.741)	(3.758)	(4.153)	(4.557)		(3.405)	(3.324)	(3.928)	(2.727)
Index of HH assets owned	−3.190***	−3.029***	−2.446	−3.540**	Index of HH assets owned	−1.699**	−1.547**	−1.326	−1.758*
	(1.026)	(1.006)	(1.920)	(1.332)		(0.811)	(0.733)	(1.814)	(0.914)
Constant	−15.28	16.96	12.49	29.56*	Constant	−0.548	9.945	12.20	2.401
	(14.47)	(11.04)	(23.90)	(15.47)		(10.30)	(6.826)	(20.60)	(11.88)
Observations	2,960	2,960	1,457	1,503	Observations	2,960	2,960	1,457	1,503
R-squared	0.114	0.150	0.193	0.135	*R*-squared	0.113	0.147	0.176	0.138
% main effect	0.149	0.131	0.361	−0.0630	% main effect	0.435	0.418	0.825	0.0731
t-Stat main effect	1.019	0.977	2.195	0.613	*t*-Stat main effect	1.434	1.425	2.403	0.347
% interaction effect	0.286	0.333	0.198	−0.102	% interaction effect	0.187	0.189	0.163	0.0924
t-Stat interaction	5.169	3.690	26.69	0.718	*t*-Stat interaction	22.17	21.18	60.08	0.520
C. Wage work hours					**D. Household work hours**				
Household death Round 2	−0.609	−0.827	2.295	−3.340	Household death Round 2	−3.317**	−3.601**	−2.721	−3.934*
	(2.071)	(2.098)	(3.875)	(2.100)		(1.292)	(1.372)	(1.917)	(2.264)
Index of HH assets owned × Household death Round 2	−0.0527	0.455	1.285	−0.418	Index of HH assets owned × Household death Round 2	−0.0107	−0.0643	−0.287	−0.00919
	(0.676)	(0.840)	(1.069)	(1.641)		(0.758)	(0.812)	(0.719)	(1.743)
Index of HH assets owned	−0.733***	−0.763***	−0.782**	−0.821***	Index of HH assets owned	−0.500	−0.532	−0.455	−0.533
	(0.228)	(0.233)	(0.302)	(0.202)		(0.496)	(0.501)	(0.510)	(0.690)
Constant	−15.67***	−4.605	0.715	−1.954	Constant	8.930	19.40***	6.820	38.43***
	(3.848)	(4.371)	(6.958)	(4.643)		(5.910)	(5.605)	(5.973)	(7.539)
Observations	2,960	2,960	1,457	1,503	Observations	2,960	2,960	1,457	1,503
R-squared	0.028	0.049	0.067	0.051	*R*-squared	0.044	0.060	0.055	0.062
% main effect	−0.0286	−0.0389	0.108	−0.157	% main effect	−0.362	−0.393	−0.297	−0.430
t-Stat main effect	0.294	0.394	0.592	1.590	*t*-Stat main effect	2.567	2.625	1.420	1.738
% interaction effect	0.0250	−0.159	0.162	0.0362	% interaction effect	0.000928	0.00516	0.0305	0.000675
t-Stat interaction	0.192	1.233	1.375	1.619	*t*-Stat interaction	0.213	1.222	5.488	0.0412

E. Left school between rounds

Variables	(1) Full sample	(2) Region FE Full sample	(3) Region FE Male	(4) Region FE Female
Household death Round 2	0.0442	0.0411	0.0653	0.0285
	(0.0403)	(0.0407)	(0.0437)	(0.0467)
Index of HH assets owned × Household death Round 2	0.00480	0.00845	0.0469**	−0.0112
	(0.0115)	(0.0108)	(0.0223)	(0.0209)
Index of HH assets owned	−0.0135***	−0.0124***	−0.0149**	−0.0116**
	(0.00434)	(0.00419)	(0.00608)	(0.00506)
Constant	−0.233***	−0.164***	−0.124	−0.287***
	(0.0554)	(0.0585)	(0.0989)	(0.0911)
Observations	2,463	2,463	1,189	1,274
R-squared	0.095	0.118	0.145	0.132
% main effect	0.557	0.517	0.822	0.358
t-Stat main effect	1.096	1.009	1.496	0.609
% interaction effect	0.0313	0.0594	0.208	−0.113
t-Stat interaction	5.163	6.985	10.99	2.625

F. Experienced hunger

Variables	(1) OLS Full sample	(2) Region FE Full sample	(3) Region FE Male	(4) Region FE Female
Household death Round 2	0.00345	−0.0171	0.0101	−0.0547
	(0.0573)	(0.0572)	(0.0906)	(0.0474)
Index of HH assets owned × Household death Round 2	−0.0339	−0.0393	−0.0298	−0.0610*
	(0.0298)	(0.0305)	(0.0404)	(0.0342)
Index of HH assets owned	−0.0297***	−0.0299***	−0.0309***	−0.0283***
	(0.00671)	(0.00717)	(0.00699)	(0.00879)
Constant	0.227***	0.300***	0.152	0.295***
	(0.0504)	(0.0724)	(0.141)	(0.0887)
Observations	2,960	2,960	1,457	1,503
R-squared	0.038	0.069	0.093	0.073
% main effect	0.0182	−0.0898	0.0533	−0.288
t-Stat main effect	0.0601	0.298	0.112	1.153
% interaction effect	−2.847	0.666	−0.852	0.322
t-Stat interaction	0.00131	0.109	0.0163	2.479

Notes: All specifications include the following controls: age, sex, father's and mother's education, household size, household land value, and month-of-interview dummies. Standard errors clustered by region are in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

mechanisms through which crop shocks affect households. While crop shocks lead to a similar overall increase in child labor within and between households, when comparing between households much of the increase is due to increased agricultural work. But this increase in agricultural work affects all children within the household, and so when that increase is dummied out with household fixed effects, we instead highlight the change in child labor across children within the household, which turns out to be in work hours devoted to household businesses by older children.

6. POLICY IMPLICATIONS

Child labor is prohibited in most countries, including Tanzania. It is also considered undesirable at the societal level. Empirical research provides evidence for adverse effects of child labor on the welfare of children both in the short and long term. For example, in a case study of Tanzania, Akabayashi and Psacharopoulos (1999) found children's grade repetition and decrease in reading competence to be associated with child labor. Beegle, Dehejia, Gatti, and Krutikova (2008), in a study using longitudinal data in rural Tanzania, showed child labor to result in loss of schooling and marrying at a younger age. Evidence from rural Tanzania also points to large impacts of transitory income changes on body weight, especially of female children (Bengtsson, 2010).

Yet despite these the practice continues with long-term adverse implications on children, their future and a country's development potential. Our results support earlier observations that factors such as income poverty, credit market imperfections, and imperfect asset and labor markets tend to drive this force. So do some household characteristics.

In particular, our results point to several policy implications: (i) the significant effect of income shocks on child labor and the resulting impact on future human capital development, (ii) the possible mitigating measures as indicated by some buffering effects, (iii) possibilities of using household characteristics such as parental education as a policy instrument in reducing child labor, (iv) possible adverse gender biases of some coping strategies: girls suffering heavily in the face of household income shocks.

Agriculture is inherently risky but such risks could be managed in several ways. In the sample for Tanzania, over 80% of the crop losses are due to attacks by rodents, insects, or pests. One of the first policy considerations could be to reduce the probability of occurrence of such shocks thereby reducing the magnitude of the adverse effect. Among the risk mitigation measures are development and improvement of access to disease and drought resistant crop varieties, and development of small-scale irrigation systems. Measures to improve the income-generating capacity of households could mitigate the effects of transitory income shocks.

As discussed earlier, our results also indicate the tendency to use child labor as an alternative coping strategy in the presence of shocks in smoothing consumption. However, such informal insurance arrangements are inefficient in the long run as they adversely affect human capital development. An effective policy response to minimize such action could be to strengthen access to rural credit and formal insurance schemes. Although a Social Protection Policy has been drafted in 2011, its implementation has been stalled since then. Contributory agricultural insurance schemes have become important risk mitigation mechanisms against unforeseen crop shocks. The government could also step into provide re-insurance to insurance schemes operated by the private sector or community groups in order to meet the demand and ensure sustainability.

Table 11. *Household fixed effects specification*

Outcome: Variables	(1) Total child labor hours	(2) Total child labor hours	(3) Agricultural labor hours	(4) Agricultural labor hours	(5) Wage labor hours	(6) Wage labor hours	(7) Unpaid work in household business	(8) Unpaid work in household business	(9) Chore labor hours	(10) Chore labor hours	(11) Left school between rounds	(12) Left school between rounds
	Full sample	Full sample	Full sample	Full sample	Full sample	Full sample	Full sample	Full sample	Full sample	Full sample	Full sample	Full sample
Crop shock	1.276	−26.64*	−3.945	−14.12	0.316	1.946	7.327**	−8.087	−2.533	−6.870	0.0208	0.0165
	(6.043)	(15.79)	(3.361)	(9.918)	(1.216)	(4.231)	(3.404)	(8.264)	(2.236)	(5.929)	(0.0252)	(0.0808)
Asset Index × Crop shock		2.474*		0.903		−0.145		1.368*		0.384		0.000380
		(1.440)		(0.927)		(0.426)		(0.756)		(0.478)		(0.00807)
Asset Index	7.755***	7.399***	3.788***	3.659***	1.012***	1.033***	2.048***	1.852***	0.885***	0.830***	−0.0539***	−0.0539***
	(0.482)	(0.479)	(0.336)	(0.332)	(0.196)	(0.207)	(0.263)	(0.264)	(0.190)	(0.204)	(0.00308)	(0.00321)
Observations	5,860	5,860	5,870	5,870	5,870	5,870	5,870	5,870	5,860	5,860	5,305	5,305
R-squared	0.113	0.114	0.048	0.048	0.021	0.021	0.222	0.223	0.009	0.009	0.183	0.183
Number of households	1,514	1,514	1,514	1,514	1,514	1,514	1,514	1,514	1,514	1,514	1,467	1,467
% main effect	0.0261	−0.544	−0.249	−0.891	0.125	0.771	0.366	−0.404	−0.240	−0.650	0.0237	0.0188
t-Stat main effect	0.211	1.687	1.174	1.424	0.260	0.460	2.152	0.979	1.133	1.159	0.826	0.205
% interaction effect		−1.059		−0.729		−0.848		−1.929		−0.638		0.262
t-Stat interaction		19.01		7.519		1.227		1.652		5.181		0.00565

Notes: All specifications include household fixed effects and the following controls: age, sex, and month-of-interview dummies. Standard errors clustered by region are in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

The fact that household characteristics such as parental (in particular mothers') education could reduce the use of child labor as a partial insurance against shocks implies that education of parents could make a difference in child labor outcomes. In this respect, promoting equal access to and the quality of education could play a vital role. While Tanzania has already achieved gender equality in primary enrollment, gender gaps emerge at the secondary completion and beyond. Our results show gender bias in school attendance when households face income shocks – girls having a larger and significant adverse effect. This is an undesirable outcome not only in terms of efficiency but also on equity. Intergenerational effects of such outcomes through below potential cognition abilities as well as health outcomes of their children are well established. While this happens when social norms and societal biases prevail against girls and require long-term strategies to address them, immediate results could be attained through programs such as conditional cash transfers when households are faced with transitory income shocks. Promoting community-based awareness programs could play an effective role in eliminating such biases.

The Tanzania National Action Plan for the Elimination of Child Labour (2009) also points to some social and cultural issues that contribute to persistence of child labor. Cultural practices, especially in rural Tanzania, influence gender-biased household decisions against girls. Girls' education becomes a lesser priority, leading to their diminished capabilities in the long run. Such cultural biases need to be addressed at the community level. Also important are steps to guarantee access to education by children from poorer families and make education relevant to the community.

It is also important to strengthen the enforcement of child-welfare related laws to mitigate the adverse child labor outcomes. Three key areas that could be considered in this respect include: (i) strengthening human resource capacity of labor officers, both at the national and local levels, (ii) strengthening capacity to investigate and prosecute cases of child labor, and (iii) promoting awareness of the legislative provisions on child welfare among law enforcement officials, policy makers, civil servants, and civil society.

7. CONCLUSION

This study investigated the impact of income and non-income shocks on child labor using data from two rounds of the Tanzania National panel Survey conducted in 2009 and 2011. Our investigations considered two types of shocks: agricultural shocks as an income shock and the death of parents or relatives as a non-income shock. Our results indicate a significant effect of crop shocks on a child's overall work hours and agriculture work hours. The effect seems to be higher for boys. For example, the overall effect of a crop shock is a 7.7-h increase in child labor per month with boys experiencing a 9.6-h increase (15%). Our investigations show that increase in agricultural hours is the most important component of the household's response to agricultural shocks. For example, agricultural shocks have an effect of similar magnitude to overall work hours but a larger percentage increase (a 22% increase in agricultural work hours). We also find crop shocks to lead to a 13–17% drop in wage work hours, with boys experiencing a larger decrease (3.8 h or 17%). Our results also show a significant increase in household work hours due to an agricultural income shock – again with boys' household work hours increasing by 42–49%.

The effect of crop shocks on school attendance is noteworthy. About 50% of students tend to leave school in the face of shocks with girls having a higher probability (of over 70%) to quit

school. This is in contrast to 6% probability of children leaving school in a household not affected by shocks. While boys are the ones who significantly spend more time at agricultural work, girls are the ones who are significantly more likely to quit school. The notion that a shock leads households to re-allocate child time from school to the field may be overly simplistic, as those children who are leaving school are not necessarily those children who are working more. We see a nuanced conclusion in these findings. Children's time is not the only child resource that is re-allocated in response to a shock. In the wholesale re-allocation of children's resources in response to a shock, boys are more likely to spend more time working while girls sacrifice their schooling. Under duress, the household invests an even greater portion of its scarce resources in boys' success.

We also examined if access to credit and household assets can act as buffers against agricultural income shocks. Both access to credit and assets seem to reduce child labor. While having a bank account reduces male child labor by 12 h, it greatly reduces household work hours for girls. We also find significant buffering effects of access to a bank account on hunger and on the extensive margin of total and agricultural child labor hours. On the other hand, while assets reduce working hours of girls, we do not find it having a significant effect on boys. We also do not see assets acting as a buffer against shocks.

The findings of the paper point to several policy implications and directions. Transitory income shocks tend to drive children to work, be it in the field, home, or other work places. Improved agricultural practices and inputs along with social safety nets (insurance mechanisms) could play an important role in reducing the adverse effects of transitory shocks on household income and thereby the use of child labor in response to such shocks. Improved access to credit, particularly in rural areas as well as creation of opportunities for income generation could buffer against such shocks. Easy access to and improvements in the quality of education and thereby the returns to education could be an incentive for parents to keep children in school. These efforts could be reenforced by effective implementation of laws to reduce child labor.

NOTES

1. Tanzania Household Budget Survey 2011–12 preliminary results available at http://www.nbs.go.tz/.

2. The definition of a "Child" in the National Plan of Action is guided by the Employment and Labor Relations Act No. 6 of 2004 and the 2008 Child Policy, which recognizes any person under the age of 18 as a child and prohibits employment of a person who is under 15 years and also prohibits employment of a person in hazardous jobs and working conditions, in line with the CRC and the ILO Minimum Age Convention (No. 138) and the Worst Forms of Child Labor Convention (No. 182).

3. Ministry of Labour, Employment and Youth Development (2009).

4. A more generalized form of human capital could be given by $h_{it} = \beta e_{cit}^{\gamma}$, where γ is a constant parameter. We assume $\gamma = \sigma$ for simplicity in the mathematical formulation of the model but could easily be relaxed.

5. In essence, $\mu = (1 + r) - \frac{1}{\partial}$ where ∂ is the rate of growth of risk free assets.

6. $\vartheta = \left(1 - \frac{1+r}{1+\pi}\right)$, where π is the rate of inflation.

7. The one notable exception to this is that hours worked per month is negatively associated with attrition from the sample. No other demographic or labor measures predict attrition from the sample.

8. Several age ranges are considered in the child labor literature, including children younger than age 5 and older than 15, the range considered here. The reason that we exclude children beyond this age range is that there is limited variation: for younger children there is little child labor and for older children school is rarer and work is common.

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