NBER WORKING PAPER SERIES

CHILD LABOR, CROP SHOCKS, AND CREDIT CONSTRAINTS

Kathleen Beegle
Rajeev Dehejia
Roberta Gatti

Working Paper 10088
http://www.nber.org/papers/w10088

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
November 2003

An earlier version of this paper circulated under the title "Child Labor, Income Shocks, and Access to Credit" (World Bank Working Paper No. 3075, May 2003). We thank Jishnu Das, Lena Edlund, Larry Katz, Martin Ravallion, John Strauss, Steven Zeldes, and participants of the NEUDC 2002 conference, the World Bank Social Protection seminar, and the World Bank Economists' Forum for useful comments. Dehejia acknowledges the National Bureau of Economic Research and the Industrial Relations Section, Princeton University, for their kind hospitality while working on this project. Support from the World Bank's Research Committee is also gratefully acknowledged. The views expressed here do not necessarily reflect those of the World Bank or its member countries. The views expressed herein are those of the authors and not necessarily those of the National Bureau of Economic Research.

Child Labor, Crop Shocks, and Credit Constraints
Kathleen Beegle, Rajeev Dehejia, and Roberta Gatti
NBER Working Paper No. 10088
November 2003
JEL No. J82, J22, G20, O16

ABSTRACT

This paper examines the relationship between household income shocks and child labor. In particular, we investigate the extent to which transitory income shocks lead to increases in child labor and whether household access to credit mitigates the effects of these shocks. Using panel data from a survey in Tanzania, we find that both relationships are significant. Our results suggest that credit constraints play a role in explaining child labor and consequently that child labor is inefficient, but we also discuss alternative interpretations.

Kathleen Beegle
Development Research Group
The World Bank
1818 H Street, NW
Washington, DC 20433
kbeegle@worldbank.org

Rajeev Dehejia
Department of Economics and SIPA
Columbia University
420 W. 118th Street, Room 1022
New York, NY 10027
and NBER
rd247@columbia.edu

Roberta Gatti
Development Research Group
The World Bank
1818 H Street, NW
Washington, DC 20433
rgatti@worldbank.org

1. Introduction

This paper examines the relationship between household income shocks and child labor. In particular, we investigate the extent to which transitory income shocks lead to increases in child labor and whether household access to credit mitigates the effects of these shocks. Using panel data from a survey in Tanzania, we find that both relationships are significant. Our results suggest that credit constraints play a role in explaining child labor and consequently that child labor is inefficient, but we also discuss alternative interpretations.

The question and our results are important for three reasons. First, they point to a significant determinant of child labor and to mechanisms that can potentially be used to tackle it. Traditionally, child labor has been viewed primarily as a consequence of poverty (see for example Fallon and Tzannatos [1998]). However, this relationship has been put into question by a number of recent within-country studies (see inter alia Canagarajah and Nielsen [1999], Boozer and Suri [2001], and Bhalotra and Heady [2001]). In light of this recent work, it is natural to consider other factors that can account for the prevalence of child labor and remedies other than on-going economic growth to alleviate it. Our focus on the effect of transitory shocks and access to credit suggests two possible remedies: namely, insurance and increased access to credit. Furthermore, to the extent that incomplete or imperfect markets drive our results, it suggests that the child labor we observe is, in fact, inefficient.[1]

Second, in the recent theoretical literature (reviewed below), lack of access to credit plays a central role in determining the prevalence of child labor. From the household's point of view, child labor entails a trade-off between immediate benefits (increased current income) and, to the extent it interferes with the accumulation of the child's human capital, potential long-run costs (lower future earnings potential).[2] A number of recent models show that, by interfering with an optimal intertemporal trade off of resources, credit constraints can give rise to inefficiently high child labor. Despite their theoretical centrality (for example, see the discussion in Grootaert and Patrinos [1999]), little empirical research has been undertaken to examine the connection between income shocks, access to credit, and child labor. Indeed, to our knowledge, this is

[1] Credit market imperfections can also impact child health; Foster (1995) finds that credit market imperfections influence growth patterns for children in landless households in Bangladesh.

[2] In outlining child labor issues and directions for the World Bank, Fallon and Tzannatos [1998] point out that child labor can have additional costs in terms of harmful effects on physical health and mental well-being (such as psychological and social adjustment) of children. Moreover, others contend that the working conditions for children are far below those of adults in terms of hours worked, wages, and safety.

among the first studies explicitly examining this link (two concurrent studies, Edmonds [2002] and Guarcello et al. [2002], are discussed below).

Third, our work relates to an important literature on the permanent income hypothesis, consumption smoothing, and credit constraints. To the extent that transitory income shocks have an effect on the household use of child labor, and access to credit mitigates this effect, our results provide evidence of credit constraints and suggest that child labor is a mechanism that rural households in developing countries use to smooth their consumption (though there are alternative interpretations, which we discuss below). As such, our work provides a bridge between studies such as Zeldes [1989], who documents the importance of credit constraints in preventing optimal smoothing of consumption over time, and Townsend [1984], who demonstrates that household consumption follows a smoother path than household income (although this result is controversial; see Chaudhuri and Ravallion [1997]). As documented extensively in work by Morduch [1994, 1995, 1999], if households succeed in smoothing their consumption profile, but are credit constrained, they are likely to resort to mechanisms other than borrowing to cope with income shocks. This paper examines one such mechanism, namely child labor. In this context, our work is complementary to Jacoby and Skoufias [1997] and Kochar [1999], who examine respectively the role of schooling and parental labor supply as buffers to income shocks.

Using four rounds of household panel data from the Kagera region of Tanzania, we show that transitory income shocks – as measured by accidental crop loss – lead to significantly increased child labor. Moreover, we find that households with collateralizable assets – which, in line with the existing literature (see for example Jacoby [1994]) we interpret as a measure of access to credit – are better able to offset the effects of these shocks. There are, of course, alternative interpretations to our results. A higher level of collateralizable assets could mitigate the effect of child labor for reasons other than the ability to borrow, e.g., a wealth effect or if the level of collateralizable assets is correlated with unobservables such as a household's social network. We find that our results are robust to controlling for other sources of wealth and for household fixed effects. Another issue is whether a mechanism other than credit constraints could account for increased child labor in the face of a crop shock (e.g., the effect of crop shocks on the demand for child labor). We examine the effect of crop shocks on the child wage rate and

argue that our results are consistent with credit constraints rather than a change in the demand for child labor.

The paper is organized as follows. Section 2 provides a brief review of the literature. Section 3 sketches a framework within which to interpret our results. The empirical strategy is outlined in Section 4. In Section 5, we describe our data. In Section 6, we present our results, and Section 7 concludes.

2. Literature Review

2.1 Theoretical Perspectives on Child Labor

Basu [1999] partitions the child labor literature into two groups: papers that examine intra-household bargaining (between parents, or parents and children) and those that examine extra-household bargaining (where the household is a single unit and bargains with employers). In the intra-household bargaining framework, child labor is the outcome of an optimization process that places different weights on members of the household, for example parents and children (see Bourguignon and Chiappori [1994] and Moehling [1995]), or the mother and the father (who care for children to different degrees; see Galasso [1999]). The inter-household bargaining framework considers each household as a unitary entity (see Becker [1964] and Gupta [2000]). The motivation behind this approach is that children's bargaining power is inherently very limited.[4]

The unitary model of the family is best suited to understanding the role of borrowing constraints as determinants of child labor (Parsons and Goldin [1989], Baland and Robinson [2000], and Ranjan [2001]). If parents care about their children, but parents' bequests are at a corner (due for example to poverty), child labor is generally not efficient. The basic intuition is that child labor creates a trade-off between current and future income (by reducing current schooling, which reduces future earnings potential). Financial market imperfections are another factor that interferes with parents' ability to make intertemporal tradeoffs and that could lead to children supplying an inefficiently high level of labor.

[4] Most theoretical models of child labor (and certainly the empirical literature) focus on supply-side factors. Canagarajah and Nielsen [1999] outline demand-side factors that can play critical roles in perpetuating child labor. These include the non-pecuniary characteristics of children that may make them desirable employees for employers, such as being more willing to take orders and do monotonous work, and less aware of rights, among other factors.

2.2 Empirical Work on Child Labor

Although the recent theoretical literature highlights income shocks and borrowing constraints as an important source of inefficiency in the allocation of resources within the family and, in particular, of inefficiently high child labor, the direct link between income shocks, access to credit, and child labor has not been widely unexplored in the empirical literature.

Many studies have examined child labor at the micro-level using household survey datasets. These studies typically estimate reduced-form participation equations for child work. For example, Grootaert and Patrinos [1999] review studies from Côte D'Ivoire, Colombia, Bolivia, and the Philippines, and Canagarajah and Nielsen [1999] studies from Côte D'Ivoire, Ghana, and Zambia. A consistent finding is that the child's age and gender, education and employment of the parents, and rural versus urban residency are robust predictors of child labor. Few studies examine child labor in Tanzania using household survey data (see Beegle [1998]), although several studies focus on schooling determinants in Tanzania.[5]

There are a number of studies that assess the relationship between schooling outcomes and shocks. Jacoby [1994] examines the relationship between borrowing constraints and progression through school among Peruvian children. He concludes that lack of access to credit perpetuates poverty because children in households with borrowing constraints begin withdrawing from school earlier than those with access to credit. Jacoby and Skoufias [1997] examine whether poor households draw upon child labor when faced with negative income shocks. Using data on school attendance patterns from six Indian villages, they find evidence for this phenomenon. However, these studies focus only on schooling and not on child labor activities, which would likely be more directly affected by income shocks and inability to access credit. Furthermore, it is not obvious that for children there is a one-to-one trade-off between time spent in school and time spent working. Hours in either activity may be sufficiently low on average that an increase in time spent in one activity will simply crowd out leisure time (see Ravallion and Wodon [2000]). In Indonesia, Fitzsimmons (2002) finds that aggregate (village-level) risk is associated with lower schooling for children in general, and the effect is larger in villages without formal credit.

[5] See inter alia Al-Samarrai and Peasgood [1998], Mason and Khandker [1997]), Bommier and Lambert [2000]), Al-Samarrai and Reilly [2000]), Burke [1998], Burke and Beegle [2003]), and Ainsworth et al [2002].

The only work that we are aware of that examines the link between access to credit and child labor is Dehejia and Gatti [2002], Edmonds [2002], and Guarcello et al. [2002]. Dehejia and Gatti [2002], using cross-country data, find a significant negative relationship between child labor and access to credit (as proxied by financial development); they show that households use significantly more child labor in response to aggregate income variability in countries with less-developed financial markets. Guarcello et al. [2002], using data from Guatemala, find that child labor increases in response to broadly defined income shocks (loss of employment, death in the family, droughts in the region, etc.) and self-reported credit rationing. Their results, though suggestive, do not control for other household level characteristics that could be correlated with credit (e.g., household fixed effects), and do not examine whether there is an interaction between shocks and credit. We discuss Edmonds [2002] in the next section.

2.3 The Permanent Income Hypothesis and Consumption Smoothing

As indicated in the introduction, this paper bridges two strands of the empirical literature on the permanent income hypothesis (PIH). One strand of this literature examines whether credit constraints can be used to account for apparent rejections of the PIH. In particular, Zeldes [1989] splits households in his sample by their holding of financial assets and examines the extent to which the Euler equation implied by the PIH hold for both groups. He concludes that credit constraints are an important impediment to intertemporal consumption smoothing for many households. A second strand of the literature examines the extent to which households can insure themselves against idiosyncratic income shocks. Studies showing that the profile of household consumption is smoother than the profile of household income reveal that households are able to some extent to smooth away income shocks (see Deaton [1992], Morduch [1995], and Townsend [1994]). The two results together suggest that households – even when credit constrained – are resorting to some means other than borrowing (or explicit insurance) to smooth away shocks.[6]

In this paper we examine whether child labor is one such mechanism that can account for household income smoothing. In particular, we examine the response of agricultural households to a transitory income shock. To the extent that the shock is transitory, the PIH suggests that households should borrow to smooth away much of the shock. In this context, our test has three

[6] Consumption smoothing in the face of income shocks may come at a high price. Rose (1999) shows that survival probabilities for girls fall significantly relative to boys' when households experience a rainfall shock.

parts. First, do households with limited borrowing capacity indeed increase child labor in response to a transitory shock? Second, is this effect mitigated for households with greater borrowing capacity? Third, we try to rule out some alternative interpretations.

Related work on smoothing and responses to shocks includes: Paxson [1992], who documents that households save most of their transitory income; Jacoby and Skoufias [1997], who demonstrate that households adjust their children's school attendance in response to shocks; and Jalan and Ravallion (1999) and Gertler and Gruber (2002), who find that wealthier households are better able to insure their consumption streams against shocks.

Two papers that are closely related to our own are Gertler, Levine, and Moretti [2001] and Edmonds [2002]. Edmonds [2002] uses a different identification strategy, but also examines child labor as an outcome. Whereas our identification of credit constraints is based on finding an effect of an unanticipated transitory income shock, Edmonds examines an anticipated permanent increase in income (an increase in old-age pension support in South Africa). The two approaches are clearly complementary. A caveat to Edmonds' approach is that households may fail to borrow against their future old-age pension simply because they are myopic, not credit constrained. In this case, the effect he estimates would simply be a wealth effect. Furthermore, Edmonds does not provide evidence that households that are not credit constrained do in fact borrow against future increases in old-age pension.

Gertler, Levine, and Moretti [2001] use the Indonesian Family Life Surveys to investigate whether households experiencing health shocks reduce their level of consumption, and whether families that are in proximity to a financial institution experience a smaller impact of such shocks. By examining the impact of shocks and the interaction of shocks with an access to credit proxy, the Gertler, et al., paper resembles this paper. There are however important differences. First, the health shocks considered in the Gertler, et al., paper are not necessarily transitory. To the extent that the health shocks they observe could be permanent, the consumption effects that they estimate are not necessarily evidence of credit constraints. Second, they use proximity to a financial institution as a proxy of access to credit. We will use collateralizable assets, and control for non-collateralizable forms of wealth. Furthermore, we document empirically that the assets we label as collateralizable do indeed function in this way (namely, they are not drawn down like cash and increase the probability of obtaining a loan) and that households with collateralizable assets do tend to borrow in response to shocks.

3. The Effect of Shocks on the Demand for and Supply of Child Labor

In this section, we sketch a simple two-period framework within which to think about the effects of shocks on the demand for and supply of child labor. We develop our framework within the context of a rural, agricultural economy (see Baland and Robinson [2000] and Ranjan [2001] for related models). In keeping with our empirical strategy, we examine the effect of transitory crop shocks. We consider firms, parents, and children in turn.

Firms

Labor is demanded by a profit-maximizing firm (producing agricultural output), which for simplicity we assume is not forward looking. Though typically the household runs the farm, we abstract from this issue since it does not add to our analysis. Firms use parent and child labor to produce a homogenous agricultural output. We assume that the production function is separable in child and adult labor. Firms demand labor up to the point that w_{jt}= MRP$_{jt}$= $P\cdot$ MP$_{jt}$, where j=c (children) or p (parent), t=1 or 2, w_{jt} is the wage rate, P is the price of output (which is fixed by a larger regional or national market), and MPR$_{jt}$ and MP$_{jt}$ are the marginal revenue product and marginal product of labor. For simplicity, we assume that the production function $f_j(\cdot)$ (j=c, p) is affected by crop shocks multiplicatively, $f_j(L_{jt})$=$A_t g_j(L_{jt})$, where L_{jt} is child (j=c) or adult (j=p) labor in period t, A_t is a scalar measure of the shock, $g_j(\cdot)$ is the production technology, and other inputs are suppressed for simplicity. The demand for labor is then given by $w_{jt} = P\cdot A_t\cdot f'_j(L_{jt})$. Crop shocks shift the demand for labor, presumably downward for negative crop shocks (though we discuss the alternatives and their empirical implications below).

Parents

Parents (a single entity) supply labor inelastically, L_p=1, in both periods, and obtain a wage, w_{pt}. They are completely altruistic, and transfer everything, other than a subsistence amount, to their children. Transfers in each period, T_t, t=1, 2, are given by T_t= $w_{pt} - S$ (which we assume to be positive), where S is subsistence consumption. Parents can also borrow or save at an interest rate r such that $B_2 = (1+r)B_1$, where we interpret B_1 as period 1 borrowing and B_2 as period 2 repayment. (If both are positive, parents borrow and repay. If both are negative, parents save and are repaid.) Constraints on borrowing and saving are given by $B_1 + w_{p1} - S \geq 0$ (if parents save)

and $B_2 \leq w_{p2} - S$ (if parents borrow). Parents borrow and save altruistically, so we discuss this decision along with the child labor decision.

The child

We consider a two-period setting in which children work, $L_{c1} \in [0,1]$, and attend school $(1\text{-}L_{c1})$ in the first period. In the second period they work fulltime (L_{c2}=1), but their productivity is enhanced by the schooling they have received in the first period, $S(1\text{-}L_{c1})$ units of effective labor (S is assumed to be twice continuously differentiable and concave). We assume a separable utility function, U=$u(c_1) + u(c_2)$, which is a (twice differentiable, concave) function of earnings (or normalized consumption). Consumption is given by $c_1 = w_{c1}L_{c1} + T_1 + B_1$ and $c_2 = w_{c2}S(1\text{-}L_{c1}) + T_2 - B_2$.

The first-order conditions are: for child labor,

$$w_{c1} \cdot u'(w_{c1}L_1 + T_1 + B_1) \geq w_{c2} \cdot S'(1 - L_1) \cdot u'(w_{c2}L_1 + T_2 - B_2), \quad (1)$$

with strict equality if $L_{c1} \in (0,1)$, and for borrowing,

$$u'(w_{c1}L_1 + T_1 + B_1) \geq -(1+r) \cdot u'(w_{c2}L_1 + T_2 - (1+r)B_1), \quad (2)$$

with strict equality if the borrowing and saving constraints do not bind.

Shocks and borrowing

Consider first the case in which there is no borrowing (or saving). An agricultural shock shifts the demand for adult and child labor in period 1. Begin with the case where for both adults and children the demand for child labor decreases. From the wage equation, we predict that w_{p1} decreases and T_1 decreases. From equation (1), since u is a concave function of earnings, if T_1 decreases the marginal utility of working in period 1 increases, and the supply of child labor will increase. The agricultural shock also leads to a reduction in the demand for child labor. Combining the two, the prediction is an unambiguous decrease in wages. The use of child labor will increase if the magnitude of the increase in the supply of child labor is sufficiently large. If instead the agricultural shock increases the demand for adult and child labor, then both the demand for and supply of child labor would increase, leading to an increase in the child labor wage rate, with the quantity effect depending on the relative magnitudes.

Now consider the case in which borrowing is permitted (but assume it is at an interior with respect to the borrowing constraint, i.e., households are not credit constrained). Prior to the

shock parents have the option of borrowing on their children's behalf. They will do this if the returns to schooling, as embodied in *S*, exceed the rate of interest on loans. Consider a transitory shock. Within a two-period setting, we define a transitory shock as one that reduces the adult wage rate (and consequently transfers) in period 1 but increases the wage (and transfers) by (1+*r*) times the same amount in period 2. Parents will fully borrow to offset such a shock (provided that the size of the shock does not cause the borrowing constraint to bind). By revealed preference, parents could always have reduced (or increased) their borrowing, but chose not to do so. Hence, credit unconstrained households will borrow to offset a transitory shock.

We will see, below, that agricultural shocks are large in magnitude. If the shock were sufficiently large that the borrowing constraint binds, we would expect household borrowing to offset only part of the shock.

Finally note that by construction, the shocks we use in our empirical implementation are mean zero. Given a positive interest rate, in a two-period model, this implies that they have a positive present discounted value, and are not transitory in the sense used above. A positive present discounted value shock causes a permanent shift in wealth. As such, we would expect household borrowing partially to offset such a shock.

4. Empirical Strategy and Specification

We discuss first the specifications we use to examine the effect of income shocks on child labor, and then return to the question of whether or not the income shocks we examine are plausibly transitory.

We examine the effect of shocks on child labor hours. Our basic specification is:

$$y_{ijt} = \beta_0 + \beta_1 X_{ijt} + \beta_2 shock_{ijt} + \varepsilon_{ijt} \tag{3}$$

where: subscripts index individuals (*i*), households (*j*), and survey rounds (*t*=1,…,*T*); *y* is child labor hours; *shock* is our measure of the income shock (discussed in detail in the next section); and *X* contains a set of controls including individual, household, and community characteristics. We anticipate transitory shocks to lead to an increase in child labor if access to credit or insurance is limited, i.e. we expect $\beta_2 > 0$. Of course, there are other reasons why we could find this effect; for example, if the shock increases the demand for child labor. In our empirical

results below, we will also examine the effect of shocks on the child-labor wage, which will allow us to distinguish these cases to some extent.

To further investigate if the effect of shocks on child labor is due to credit constraints, we examine whether the effect of shocks varies with households' access to credit. In particular, we estimate the following specification:

$$y_{ijt} = \beta_0 + \beta_1 X_{ijt} + \beta_2 shock_{ijt} + \beta_3 (shock_{ijt} \cdot credit_{ijt}) + \beta_4 credit_{ijt} + \varepsilon_{ijt} \quad (4)$$

where credit measures households' ability to access to credit. Measuring credit constraints is notoriously difficult. We follow the previous literature (Zeldes [1989], and Jacoby [1994]) by using the value of collateralizable assets as a measure of household access to credit. The effect of interest is β_3, which captures the differential impact of a shock among households with different levels of collateralizable assets. To the extent that we believe $\beta_2 > 0$ in equation (3) is due to credit constraints, we expect access to credit to mitigate the effect of shocks, i.e. $\beta_3 < 0$.

There are, of course, alternative explanations. Our measure of access to credit could be correlated with omitted variables that in turn are associated with reduced child labor, for example the labor intensity of a household's production technology or the extent of its social networks. Examples such as these motivate our inclusion of household fixed effects in the above specifications:

$$y_{ijt} = \alpha_j + \delta_t + \gamma_w + \beta_1 X_{ijt} + \beta_2 shock_{ijt} + \varepsilon_{ijt} \quad (3')$$

$$y_{ijt} = \alpha_j + \delta_t + \gamma_w + \beta_1 X_{ijt} + \beta_2 shock_{ijt} + \beta_3 (shock_{ijt} \cdot collateral_{ijt}) + \beta_4 collateral_{ijt} + \varepsilon_{ijt} \quad (4')$$

where α_j, δ_t, γ_w, are household, time (season), and survey round fixed effects respectively. Including household fixed effects also implies that our measure of crop shock is relative to a household-level mean (thus, by construction is mean-zero). Another implication is that we are

examining the effect of idiosyncratic risk, after aggregate (i.e., community) and non-time varying household risk factors have been purged.[7]

In order to add further credibility to our interpretation of the results, we also investigate directly the effect of the shocks on both borrowing activity within households and the child wage rate.

$$\Pr(B_{jt}=1)=f(shock_{jt}, X_{jt}) \tag{5}$$

and

$$w_v = \alpha_j + \beta_1 X_{ijt} + \beta_2 shock_{ijt} + \varepsilon_{ijt} \tag{6}$$

where B_{jt} is an indicator if a member of household j at time t has obtained a loan, w_v is the child labor wage rate in village v, α_j is a household fixed effect, and X_{ijt} are household-level controls. We use a probit specification in (5). Equation (5) provides direct evidence on the borrowing behavior of households, and by considering the wage rate in equation (6) we will be able to sort out whether the observed effect on child labor is consistent a shift in the demand for labor, the supply of labor, or both.

Finally, we return to the question of whether the shocks that we consider are plausibly exogenous and transitory. With respect to the first question, the concern is that the households who are most affected by shocks may systematically differ from those that are not. For example, Morduch (1994) discuss the possibility that vulnerable households may be more likely to experience shocks. We address this concern by controlling throughout for a wide range of time-varying household characteristics and household-fixed effects. Controls include mother's and father's schooling, the presence of the mother and father in the household, and the child's age. We also allow for interview wave and season fixed effects. We might also want to control for (lagged) levels child labor, if households with high levels of child labor are more likely to experience shocks. This is very challenging for the outcome equations (because of the fixed

[7] In comparing our framework to Jacoby and Skoufias (1997) or Fitzsimons (2003), it is worth underlining this point. Their measures of aggregate and idiosyncratic risk are fully absorbed by our household fixed effects.

effects framework), but we can examine whether lagged child labor predicts which households experience shocks:

$$\Pr(shock_{ijt}=1)=f(child\ labor_{ijt-1}, X_{jt}). \quad (7)$$

Regarding the transitory nature of the shocks, the concern then is not whether (lagged) household characteristics predict crop shocks (since we control for these), but whether households that have experienced a shock are more likely to experience shocks in the future. If this were the case, then a household experiencing a shock would anticipate a permanent reduction in income. We investigate this empirically by examining:

$$\Pr(shock_{ijt}=1)=f(shock_{ijt-1}, X_{jt}). \quad (8)$$

If households that have experienced shocks in the past are not more likely to experience them in the future, it will lend credence to our claim that crop shocks are transitory. Finally, note that since our outcome specifications allow for fixed effects, this controls for an additional source of selection not captured in (8) and ensures that the shocks are mean zero (since the inclusion of fixed effect implies we are implicitly taking out the household mean of shocks).

5. Data Description and Summary Statistics

The data for this study are from a panel dataset in the Kagera region in Tanzania. The Kagera Health and Development Survey (KHDS) was part of a research project conducted by the World Bank and the University of Dar es Salaam. The KHDS surveyed over 800 households in the region up to four times from 1991-1994 with an average interval between surveys of six to seven months.[8] Households are drawn from 51 communities, mostly villages, in the six districts of Kagera.

[8] The explicit objectives of the KHDS were to measure the economic impact of fatal illness (primarily due to HIV/AIDS) in the region and to propose cost-effective strategies to help survivors. For more information about this project, see Ainsworth et al. [1992] and World Bank [1993]. Overall, more than 90% of all households remained in the sample for all interviews. Of those that dropped after at least one interview, 57 percent moved out of the village for various reasons, 23 percent [19] moved out due to a death in the household, and 16 percent [13] refused. The survey design included an over-sample of households considered to be at risk based on the following criterion: those with a sick adult and/or those households that had experienced an adult death in the past 2 years at the time of the household listing (about 6 months

This dataset has several features that make it particularly appropriate for the proposed analysis. First, the detailed household survey has a wide array of individual and household characteristics, including information on time use of all household members aged seven and older. This includes time spent in the previous week working on household businesses (farm and non-farm), for wages in non-household business, and in household chores. The household survey also includes information on crop loss, as well as measures of physical and financial assets in each of the four interviews. The data are longitudinal and, as such, they allow us to control for unobservable variables that may bias cross-sectional results.

Our definition of child labor is the total hours in the last week spent working in economic activities and chores (including fetching water and firewood, preparing meals, and cleaning the house). Economic activities for children consist predominately of farming, including tending crops in the field, processing crops, and tending livestock. We include chores as well as economic activities for two reasons. First, the concept of child labor (by ILO standards) is not restricted to only economic activities.[9] Second, in the largely rural sample of households in this study, it may be difficult to distinguish time in household chore activities and time spent preparing subsistence food crops. For our study, we focus on two age samples. Our primary age group includes children 10-15 years old. We also include a second group, children 7-15 years old. Given the well-documented low enrollment levels and delayed enrollment in Tanzania, along with the low hours of work among younger children (7-9), our main focus is children aged 10 and older. The upper age range for child-labor studies is typically 14 or 15 years, the age of completed primary schooling if enrolled on time.

Table 1 presents summary statistics of the sample in our study, broken down by the three samples on which the regressions are run. In addition, the last 2 columns show summary statistics for the main sample separated into those children in households that had experienced an income shock and those that had not. In the pooled data, children worked on average about 21 hours in the previous week. Mean hours as well as most other covariates have a similar distribution in households with and without a shock. More than 90 percent of children worked at

---

before the first survey round). To the extent that these latent characteristics are an omitted household-level variable, it will be important to control for household fixed-effects in the analysis.

[9]It should also be mentioned that the concept of child labor does not necessarily refer to simply any work done by a child, but, rather, work that stunts or limits the child's development or puts the child at risk. However, in survey data it is difficult (perhaps impossible) to appropriately isolate the portion of time spent working on the farm that

least 1 hour in the last week. About one-third of children reside in households that report some crop loss.[10] About one-half of children reside in households with any durables, our primary indicator of collateral. Among those households that experienced a shock, the total value of the shock is about twice (in log terms) the value of per capita durable goods. The prevalence of alternative wealth indicators, cash holdings and physical assets, is larger. Nearly three-quarters of children live in households with some cash and all children live in households with some physical assets (including the value of land, business equipment, livestock, and dwellings). The average household size is quite large, over 7 members on average. In part, this reflects the sample of households with children; in the entire sample (including households with no children age 10-15), the average size is about 5.7 members. Levels of parental education are extremely low. Few children have fathers who had attended school beyond the primary level (12 percent of children) and almost none had mothers with more than primary schooling (2 percent).

Turning to our measure of income shock, for the identification strategy to be credible, we ideally want an income shock that is: of a sufficient magnitude to potentially affect household time allocation; exogenous to child labor decisions; and transitory. The data include reports of the value of crop loss due to insects, rodents, and other calamities (such as fire) in each survey round. We compute the total value of crop loss for all crops farmed. Our measure of income shock has several advantages. First, since agriculture is the main economic activity in the Kagera region, many households experience shocks and these shocks are extremely relevant with respect to household income. Second, these shocks are plausibly exogenous and transitory. We provide evidence for both of these claims below. (Furthermore, since our empirical specification will include household fixed effects, crop shocks are measured relative to the household mean, and in this sense are transitory by construction.)

We measure access to credit with collateralizable assets. This is in keeping with the related literature, including Zeldes [1989] and Jacoby [1994]. Consistent with this approach, fully 80 percent of all lenders (banks, NGOs, private individuals) report requiring collateral for loans, as reported in the community questionnaires. As noted by Jacoby, it is important to select a class of assets that is associated with a household's borrowing capacity, but is not directly linked to its demand for child labor. Collateralizable assets in this setting include the value of

---

qualifies under this very nuanced definition. Therefore, we follow the standard convention in the empirical literature.

durable goods, such as radios, bicycles, fans, lamps and pots. This excludes cash holdings, business, and land value which might be directly correlated with demand for child labor within the household. We use two other asset measures – the value of physical assets (which includes land) and cash holdings – as additional measures of wealth. Evidence from field interviews suggests that durable assets are used as collateral for loans, but that cash and physical assets (mainly land holdings) are unlikely to be used as collateral.[11] Cash is too liquid to serve as collateral, and is more likely to be an immediate buffer against shocks. Physical assets are comprised of land, business equipment, and livestock. Land is unlikely to serve as collateral because the land market is very thin in the Kagera region of Tanzania, which also implies that reported values may be not be very reliable. Instead other types of physical assets are likely to be used as immediate buffers against shocks (e.g, cattle, which is a highly liquid asset). We examine the empirical validity of these claims below.

6. Results

We first examine whether crop shocks are plausibly exogenous and are economically significant. We then examine the effect of these shocks on child labor and whether the shocks have a smaller effect for households with greater access to credit. Finally, we consider corroborative evidence for, and alternatives to, our interpretation of the results.

6.1 The Occurrence and Effect of Crop Shocks

We begin by examining empirically our claim in previous section that crop shocks are transitory and a plausibly exogenous source of variation at the household level. In Table 3A, we predict the occurrence of a shock based on current and lagged household characteristics, a range of measures of household wealth, and the lagged occurrence of shocks. In column (1) we see that neither household characteristics nor current asset holdings (individually or jointly) are significant predictors of contemporaneous shocks. When we control for lagged asset holdings instead, lagged assets are not in themselves significant (individually or jointly), but female-headed households are significantly more likely to experience shocks. Column (3) introduces the key variable, lagged crop loss. The coefficient is negative and not statistically significant. To the

[10] For zero values of shock, durables, cash, and physical assets, the bottom value is coded at 1.
[11] Field interviews conducted in July-August 2003 by Beegle.

extent that the occurrence of a lagged shock is not a significant predictor of a current shock, these results lend credence to our view that agricultural shocks are transitory at the household level. (The inclusion of household fixed effects in subsequent specifications further increases the credibility of this view, since shocks will be measured relative to the household mean.)

Table 3B examines a related issue regarding the occurrence of shocks: are households that resort to child labor more likely to experiences shocks? This is certainly a plausible view (see Morduch [1994]), and if true in our data would undermine a causal interpretation of the shock coefficient. Column (1) examines whether child labor hours predicts log crop lost, and column (2) the share of crop lost, both of which will be used as measures of shocks in our results below. For both measures of crop loss, households with more educated heads and female-headed households are less likely to experience shocks, though only the former is ever significant. Log per capita cash holdings is a negative predictor of the share of crop lost. However, in both specifications, lagged child labor is not a significant predictor of future shocks. Though this does not rule out all forms of reverse causation from child labor to shocks, it does rule out the most obvious link and lends support to our causal interpretation of the crop shock effect.

Having established the plausibility of crop losses as transitory and conditionally exogenous shocks, we next examine whether these shocks are sufficiently frequent and large to have an effect on child labor. Table 2, Panel A, shows that the shocks affect a significant number of households in all rounds except round 4. The fact that few households are affected in round 4 is useful for our identification, since with household fixed effects coefficients are identified from switchers. Panel B shows that when shocks occur they are substantial in magnitude: just under half the shocks wipe out between one and three quarters of the household's crop. Complete crop destruction is uncommon, which again is useful because complete crop destruction might render child labor useless.

Table 4 presents a more detailed view of the effect of a crop shock on the household. In columns (1) to (4), we regress per capita household expenditure, cash holdings, the value of physical assets, and the value of durables on lagged crop shocks, controlling for a range of household characteristics and household fixed effects. The most significant effect of a shock is to lead to a reduction in the value of physical assets per person. This reflects the fact that assets such as cattle are quite liquid in rural Tanzania. Instead, neither durables nor cash holdings are significantly affected by shocks. The lack of a significant effect on durables is important,

because it corroborates our institutional claim that these assets are not used as a direct buffer against shocks, but are instead a form of wealth that can serve as collateral. Evidence from the community questionnaire further confirms that lenders (both formal and informal) require collateral on loans and evidence from the field confirms that households tend to use durable assets (rather than physical assets, such as land) as collateral. Consequently, in our subsequent specifications we will use the value of durable assets as a measure of collateralizable assets, and as such as a proxy for households' ability to borrow.

In columns (5) to (7) we interact the level of durable assets with the crop shock. We find that for households with low levels of durable assets, shocks have a significantly negative effect on expenditure and cash holdings. In terms of magnitude, household expenditure is 8 percent lower if they experienced a shock last period and cash holdings are 64 percent lower. The direct effect of shocks on the value of physical assets is large, but not statistically significant. The direct effect of durable assets is not significant. However, the interaction of lagged shocks and durable assets is highly significant. Households that experience shocks and have durable assets are significantly less likely to reduce their expenditure and less likely to draw down cash holdings. These effects are significant at the one percent level. The effect on physical assets is more difficult to interpre t: households with a higher level of durables are more likely to draw down physical assets when they experience a shock.

Overall, we believe that these results lend credence to the use of crop shocks as a source of variation in our subsequent specifications.

6.2 The Effect of Crop Shocks on Child Labor

Table 5 reports estimates of regressing child labor hours on crop shocks; all specifications control for wave and season fixed effects, in addition to age of the child. We begin with an OLS specification that considers children between the ages of 10 and 15 and controls for household characteristics. We find a positive effect, significant at the one percent level. In column (2) we control for community level dummies, and find the coefficient is robust in magnitude and significance. Our discussion in Section 3 suggests these results should not be taken too seriously since a range of household characteristics are potentially omitted from this specification.

Column 3 reports the estimates from a household fixed effect model. Since we are now also controlling for omitted time-invariant household characteristics, it is not surprising that the

estimated coefficient is smaller than the OLS estimate (0.22 vs. 0.33), but the effect is still statistically significant at the one percent level. We obtain similar results if we expand our sample to the 7-15 age range (column 4). Not surprisingly, we find that the magnitude of the coefficient on shocks decreases once the sample is enlarged to include 7-10 year old children. Younger children work less on average, and moreover, we expect their labor supply to be less responsive to shocks. In terms of magnitudes, our results suggest that a typical shock causes approximately a 10% increase in the level of child labor hours.

Although this is a reduced form result, and as such does not shed light on what mechanisms could give rise to the increase in child labor, it is of independent interest. It establishes that rural households are significantly exposed to crop shocks and they respond to these shocks along a dimension that is undesirable from the policy perspective. It also suggests that insuring rural households against such shocks would be one means of reducing (although not eliminating) child labor. Evidence from Jacoby and Skoufias (1997) and Kocher (1999) establishes related benefits of insuring against household crop shocks in terms of child schooling and parental labor supply.

6.3 Are the Shocks Effects Due to Credit Constraints?

In this section, we provide evidence that the effect of crop shocks on child labor is consistent with the existence of household credit constraints. It must, however, be emphasized that there are alternative interpretations, some (though not all) of which can be ruled out (we discuss this in Section 6.4).

In Table 6, we examine not only the effect of crop shocks on child labor but also the effect of collateralizable assets, both directly and interacted with crop shocks. As discussed in Section 3, our key coefficient of interest is the interaction term. It measures the extent to which households with collateralizable assets, which proxies for access to credit are able to mitigate the effect of crop shocks on child labor.

In column (1), we examine our baseline fixed-effects specification. The effect of the shock is comparable to Table 5. Collateral enters positively, though not significantly. The coefficient of interest, the interaction of collateral and shocks, is positive and significant at the 10 percent level. This corroborates the view the access to credit could account for the effect of shocks on child labor: households with greater access to credit are able to offset part of the

shock. The magnitude of the effect is such that a household with a median level of durables is able to offset 50 percent of the shock.

There are several factors that could confound our interpretation of this result. First, the data contain some significant outliers in terms of landholdings, both at the lower end (landless, non-farmers) and large landowners. In column (2), we exclude these outliers, and find that our result is slightly larger, and now significant at the 5 percent level. Second, crop losses may be significantly correlated within communities over time. As such, shocks may, in part, simply be capturing community-time events. In columns (3) and (4), we control for these through community time trends and community-time fixed effects. The coefficients of interest are virtually unchanged. Third, in columns (1) to (4) we cannot rule out that collateralizable assets are also picking up wealth effects; presumably different forms of wealth are correlated. To address this concern, in column (5) we include our two other measures of wealth (physical assets and cash holdings) as additional controls. Our results are unchanged. Finally, it is possible that other sources of wealth can also allow households to cope with shocks, through means other than borrowing. In column (6) we interact all three wealth measures with shocks. Our coefficient of interest is very robust in magnitude, and remains significant at the 10 percent level. There is no evidence that other forms of wealth have a significant effect on child labor.

Another concern with the results in Table 6 is issues of specification rather than interpretation, namely the definitions we use for crop shock and collateralizable wealth. The concern with our definition of shocks is that we might be more likely to observe large crop losses among richer households – the more you have, the more you would expect to lose if you have a loss. In Table 7, column (1), we use an indicator of whether a significant crop loss occurred (greater than 10 percent of the total value of crops), which still identifies households that experience shocks without necessarily inducing a strong correlation with the level of income. With this alternative definition of shock, shocks are still positively and significantly associated with child labor hours: crop losses of 10 percent or more of overall crop value are associated with a 7 percent increase in child labor hours. In column (2) we find that the interaction between this new measure of shock and collateral is negative and significant. Children in households with no durables have 12 percent higher labor hours (evaluated at mean hours) when crop losses occur, compared to 4 percent higher hours for children in households with median per capita durable assets. Column 3 reports the results for the sample restricted by land ownership; the

results are stronger (shocks induce a 19 percent increase in child labor; households with a mean level of durables experience only an 8 percent increase).

Finally, we examine alternative specifications for the value of collateralizable assets. In column (4), we use an indicator for zero versus positive levels of collateral; the estimated coefficient on the interaction of interest is unchanged in sign and significance, although of course the magnitude changes since collateral is now a dummy rather than a continuous variable. In column (5), we use the total value of durables in the household, as opposed to its per capita value; the estimates of our effects of interest remain statistically significant and are similar in magnitude when rescaled for comparability to the previous definition of collateral.

6.4 Alternative Interpretations

There are several alternative explanations for our results. The most direct concern is reverse causation: that the use of child labor causes shocks, rather than the reverse. This issue was examined in Section 6.1 (Table 3, Panel B), where it was shown that the use of child labor does not, in fact, predict the occurrence of shocks. More directly, evidence from the field interviews suggests that child labor on farms is used primarily in domestic activities relating to farming rather than direct agriculture such as planting or pest control. Thus, our evidence suggests that reverse causation is not a strong concern, though of course it cannot be ruled.

Another concern is that shocks affect not only households' income but also their production technology. As such, a negative crop shock could directly induce an increased demand for child labor. We offer several pieces of evidence against this being the only explanation for our results. First, we have shown that the shock effect is weaker among households with a greater level of collateral. Thus, the demand shock story would require that households with more collateral also use a production technology that is less affected by crop shocks. To the extent that households are unlikely to switch production technology over the horizon covered by this survey (four waves, six months apart), we believe that our inclusion of household fixed effects makes this alternative explanation much less plausible. More generally, household, time, and cluster-time fixed effects rule out an array of omitted variable issues, such as village-level fertilizer or pesticide price shocks or household-level tastes for child labor.

In Table 8 we examine two additional pieces of evidence in favor of our interpretation. In column (1) we examine directly the probability that members of a household borrow when faced

with shocks. We introduce all three measures of wealth and their interactions with the shock. We find that both shocks and collateral (durable assets) are significantly and positively associated with loans. Furthermore, the positive shock-collateral interaction demonstrates that households who experience shocks are significantly more likely to take out loans.[12] In contrast, greater cash holdings make a loan less likely, which is congruent with our finding in Table 4 that cash is used an immediate buffer against shocks. The direct effect of physical assets on loans is not significant. Interestingly, households with larger cash holdings are also more likely to take loans when faced with a shock. In contrast, households with greater levels of physical assets are less likely to resort to loans in response to a shock. These results corroborate our interpretation of the results in Section 6.

Finally in column (2) we examine the effect of crop shocks on the community-level child labor wage. We find that crop shocks are associated with a significant reduction in child wage rates. When combined with the increased use of child labor within the demand and supply framework sketched in Section 3, this implies that any increase in demand for child labor must also be accompanied by an increase in the supply of child labor.

Thus, though we cannot rule out the possibility that crop shocks affect the demand for labor, we believe that our results suggest that credit constraints also play a role.

7. Conclusions

This paper has examined the link between crop shocks, household durable asset holdings, and child labor. Based on institutional knowledge of the Kagera region and on econometric analysis, we have argued that it is plausible to view crop shocks as transitory shocks to household income, that shocks are significant relative to household wealth, and that households use durable assets as collateral for borrowing. We find that crop shocks lead to a significant increase in the level of child labor and that households with durable assets are able to offset approximately half of this shock. We interpret this as evidence that households are credit constraints and that credit constraints play a role in explaining child labor.

We have presented a range of evidence to corroborate this interpretation of our results: (i) our results control for a wide range of household characteristics and household fixed effects;

[12] The fact that households even with few collateralizable assets do borrow in response to a shock suggests that households are not fully credit constrained. But the interaction term shows that households with collateral

this rules out time-invariant (over a two year horizon) features of the household explaining away our results (e.g., the household's attitude toward child labor, its social network, or its production technology); (ii) our results are robust to controlling for cluster-time fixed effects; this rules out time-specific cluster shocks explaining away our results; (iii) we control for other forms of wealth (cash holdings and physical assets), and show that these assets are not significantly associated with child labor either directly or when interacted with shocks and that holding these other forms of wealth does not significantly increase the probability that households obtain loans; (iv) we show that households are more likely to take loans when they experience a shock and when they hold durable assets, and that the probability of taking a loan in response to a shock increases more among households holding durable assets; and (v) we show that the child wage rate declines in response to shocks; given that the use of child labor increases, in a demand and supply framework this implies that shocks must lead to an increase in the supply of child labor and that demand-side explanations cannot completely explain away our results.

It must, however, be acknowledged that there are alternative interpretations to our results. The effect of shocks on households could be explained by myopia or an extremely high discount rate relative to the interest rate. A shock could also simply increase child labor if it leads to school closure; although our definition of shocks does not include village level catastrophes such as floods and our results are robust to controlling for village-time dummies, this is certainly possible. The differential effect of shocks on households with a high level of collateralizable assets could be explained away if households with a higher level of durable assets also have a greater demand for credit when they experience a crop shock (although this would have to be true conditional on household fixed effects and other wealth, including landholding, for which we control). Although we cannot rule out all of these alternatives, we believe that we offer the most plausible interpretation of our results.

Our results have a number of important implications. Regardless of how they are interpreted, our results do demonstrate that households increase their use of child labor in response to crop shocks. To the extent that child labor is viewed as a policy problem, this result implies that policies buffering agricultural households against such shocks will lead to a reduced level of child labor. Furthermore, the credit constraint interpretation of these results implies not

---

specifically respond to shocks by increasing their borrowing.

only that child labor is inefficient but also that increasing household access to credit, specifically in response to crop shocks, will reduce child labor and increase household welfare.

There are clearly many questions that we have not addressed in this paper. It would be ideal examine to loan-level information from agricultural households; this would fill in the last missing link between shocks and credit constraints. It is also important to consider whether the level of child labor that we observe in agricultural households in developing countries in fact has negative consequences on children's long-run development, as this is the impetus for efforts aimed at reducing child labor. These are subjects of ongoing research.

REFERENCES

Ainsworth, M., G. Koda, G. Lwihula, P. Mujinja, M. Over and I. Semali, "Measuring the Impact of fatal Adult Illness in Sub-Saharan Africa." Living Standards Measurement Study no. 90. World Bank, Washington, D.C. (1992).

Ainsworth, M., K. Beegle, and G. Koda, "The Impact of Adult Mortality of Primary School Enrollment in Northwestern Tanzania." Africa Region Human Development Working Paper Series, World Bank (2002).

Al-Samarrai, S. and B. Reilly, "Urban and Rural Differences in Primary School Attendance: An Empirical Study for Tanzania." *Journal of African Economies,* IX (2000), 430-474.

Al-Samarrai, S. and T. Peasgood, "Education attainments and household characteristics in Tanzania." *Economics of Education Review,* XVII (1998), 395-417.

Baland, J. and J. Robinson, "Is Child Labor Inefficient?" *Journal of Political Economy*, CVIII (2000), 663-679.

Basu, K., "Child Labor: Cause, Consequence, and Cure with Remarks on International Labor Standards," *Journal of Economic Literature*, XXXVII (1999), 1083-1119.

Becker, G., *Human Capital*, New York: Columbia University Press, 1964.

Becker, G. and K. Murphy, "The Family and the State," *Journal of Law and Economics*, XXXI, (1988), 1-18.

Beegle, K., "The Impact of Adult Mortality in Agricultural Households: Evidence from Rural Tanzania," mimeo. (1998).

Bhalotra, S. and C. Heady, "Child Farm Labour: The Wealth Paradox," mimeo. (2001).

Blunch, N. and D. Verner, "Revisiting the Link between Poverty and Child Labor," World Bank Policy Research Working Paper no. 2488. (2000)

Bommier, A. and S. Lambert, "Education Demand and Age at School Enrollment in Tanzania," *Journal of Human Resources,* XXXV (2000), 177-203.

Boozer, M. and T. Suri (2001) "Child Labor and Schooling Decisions in Ghana," mimeo.

Bourguignon, F. and P.A. Chiappori, "The Collective Approach to Household Behavior," in *The Measurement of Household Welfare*, Richard Blundell, Ian Preston, and Ian Walker, eds. Cambridge: Cambridge University Press, 1994.

Burke, K. and K. Beegle, "Why children aren't attending school: The case of rural Tanzania," mimeo. (2003).

Burke, K, "Investing in children's human capital in Tanzania: Does household illness play a role?" Dissertation, SUNY Stony Brook, Stony Brook , NY. (1998).

Canagarajah, S. and H. Nielsen, "Child Labor and Schooling in Africa: A Comparative Study," mimeo. (1999).

Chaudhuri, Shubham, and Martin Ravallion (1997). "Risk and Insurance in Village India: Comment," *Econometrica*, 65, 171-184.

Deaton, A., *Understanding Consumption*. Oxford: Clarendon Press, 1992.

Dehejia, R. and R. Gatti, "Child Labor: The Role of Income Variability and Access to Credit Across Countries," World Bank Policy Research Working Paper no.2767 and National Bureau of Economic Research Working Paper No. 9018. (2002).

Edmonds, E., "Is Child Labor Inefficient? Evidence from Large Cash Transfers," mimeo. (2002)

Fallon, P. and Z. Tzannatos, "Child Labor: Issues and Directions for the World Bank," Washington D.C.: World Bank. (1998).

Fitzsimmons, E, "The Effect or Risk on Education and Child Labor," Institute for Fiscal Studies, Working Paper 02/07. (2003).

Foster, A, "Prices, Credit Markets and Child Growth in Low-Income Rural Areas," *Economic Journal*, 105(430) (1995), 551-570.

Galasso, E., "Intra-Household Allocation and Child Labor in Indonesia," mimeo, Boston College. (1999).

Gertler, Paul, and Jonathan Gruber, "Insuring Consumption Against Illness," *American Economic Review*, 92 (March 2002), 51-70.

Gertler, Paul, David Levine, and Enrico Moretti, "Do Microfinance Programs Help Families Insure Consumption Against Illness?" Manuscript, University of California, Berkeley.

Guarcello, L., F. Mealli, and F.C. Rosati, "Household Vulnerability and Child Labor: The Effect of Shocks, Credit Rationing and Insurance," Manuscript, Innocenti Research Center, UNICEF. (2002).

Grootaert, C. and H. Patrinos, *The Policy Analysis of Child Labor: A Comparative Study* . New York: St. Martin's Press, 1999.

Gupta, M., "Wage Determination of a Child Worker: A Theoretical Analysis," *Review of Development Economics*, IV (2000), 219-228.

Jacoby, H., "Borrowing Constraints and Progress Through School: Evidence from Peru," *The Review of Economics and Statistics,* LXXVI (1994), 151-160.

Jacoby, H. and E. Skoufias, "Risk, Financial Markets, and Human Capital in a Developing Country," *Review of Economic Studies*, LXIV (1997), 311-335.

Jalan, Jyotsna, and Martin Ravallion, "Are the poor less well insured? Evidence on vulnerability to income risk in rural China," *Journal of Development Economics*, 58 (1999), 61-81.

Kochar, A., "Smoothing Consumption by Smoothing Income: Hours-of-Work Responses to Idiosyncratic Agricultural Shocks in Rural India," *Review of Economics and Statistics*, LXXXI (1999), 50-61.

Krueger, A., "Observations on International Labor Standards and Trade," National Bureau of Economic Research, Working Paper No.5632 (1996).

Mason, A. and S. Khandker, "Household schooling decisions in Tanzania," Draft, Poverty and Social Policy Department. World Bank, Washington, DC. (1997).

Morduch, J., "Poverty and Vulnerability," *American Economic Review Papers and Proceedings*, 84 (1994), 221-225.

Morduch, J., "Income Smoothing and Consumption Smoothing," *Journal of Economic Perspectives*, IX (1995), 103-114.

Morduch, J., "Between the State and the Market: Can Informal Insurance Patch the Safety Net," *The World Bank Research Observer*, XIV (1999), 187-207.

Moehling, C., "The Intrahousehold Allocation of Resources and the Participation of Children in Household Decision-Making: Evidence from Early Twentieth Century America," mimeo, Northwestern University. (1995).

Parsons, D. and C. Goldin, "Parental Altruism and Self-Interest: Child Labor Among Late Nineteenth-Century American Families," *Economic Inquiry*, XXIV (1989), 637-59.

Paxson, C., "Using Weather Variability to Estimate the Response of Savings to Transitory Income in Thailand," *American Economic Review*, 82 (1992), 15-33.

Ranjan, P., "Credit Constraints and the Phenomenon of Child Labor," *Journal of Development Economics*, LXIV (2001), 81-102.

Ravallion, M. and Q. Wodon, "Does Child Labour Displace Schooling? Evidence on Behavioral Responses to an Enrollment Subsidy," *The Economic Journal*, CX (2000), 158-175.

Rose, E, "Consumption Smoothing and Excess Female Mortality in Rural India," *Review of Economics and Statistics* 81(1) (1999), 41-49.

Townsend, R., "Risk and insurance in village India," *Econometrica*, LXII (1994), 539-591.

World Bank, "Report of a workshop on: The economic impact of fatal illness in Sub-Saharan Africa." World Bank, Washington, D.C. and the University of Dar es Salaam. (1993).

Zeldes, S., "Consumption and Liquidity Constraints: An Empirical Investigation," *Journal of Political Economy*, XCVII (1989), 305-346.

Table 1: Summary Statistics

	(1) Ages 10-15	(2) Ages 7-15	(3) Ages 10-15 Land restriction	(4) Ages 10-15 with shock	(5) Ages 10-15 without shock
Hours:					
Mean	21.23	18.13	21.27	22.41	20.62
	(14.91)	(14.83)	(14.87)	(16.35)	(14.09)
% > 0	0.94	0.90	0.94	0.95	0.94
log value of crop loss:					
Mean	2.92	2.96	3.00	8.60	0.00
	(4.21)	(4.23)	(4.26)	(1.87)	
% > 0	0.34	0.34	0.35	1.00	0.00
log per capita durables:					
Mean	4.28	4.21	4.30	4.22	4.31
	(4.13)	(4.12)	(4.08)	(4.03)	(4.18)
% > 0	0.54	0.53	0.55	0.55	0.53
log per capita cash:					
Mean	5.24	5.20	5.25	5.11	5.30
	(3.21)	(3.20)	(3.16)	(3.29)	(3.16)
% > 0	0.78	0.78	0.79	0.75	0.80
log per capita physical assets:					
Mean	11.20	11.15	11.28	11.15	11.23
	(1.44)	(1.46)	(1.28)	(1.35)	(1.48)
% > 0	1.00	1.00	1.00	1.00	1.00
Farm household =1 if yes, else 0	0.76	0.76	0.79	0.77	0.76
	(0.43)	(0.43)	(0.41)	(0.42)	(0.43)
Household size	7.86	7.83	7.99	7.83	7.87
	(3.74)	(3.66)	(3.77)	(3.41)	(3.90)
Father's schooling: 1-6 years =1 if yes, else 0	0.43	0.42	0.46	0.45	0.42
	(0.50)	(0.49)	(0.50)	(0.50)	(0.49)
Father's schooling: 7 years =1 if yes, else 0	0.30	0.33	0.30	0.28	0.31
	(0.46)	(0.47)	(0.46)	(0.45)	(0.46)
Father's schooling: 8+ years =1 if yes, else 0	0.12	0.12	0.10	0.13	0.11
	(0.32)	(0.32)	(0.29)	(0.34)	(0.32)
Mother's schooling: 1-6 years =1 if yes, else 0	0.37	0.35	0.37	0.39	0.35
	(0.48)	(0.48)	(0.48)	(0.49)	(0.48)
Mother's schooling: 7 years =1 if yes, else 0	0.28	0.31	0.26	0.28	0.29
	(0.45)	(0.46)	(0.44)	(0.45)	(0.45)
Mother's schooling: 8+ years =1 if yes, else 0	0.02	0.02	0.01	0.02	0.02
	(0.13)	(0.13)	(0.09)	(0.13)	(0.13)
Observations	3839	5591	3234	1302	2537

Notes: Standard deviations are in parentheses.

Table 2: Frequency and Magnitude of Shocks

Panel A: Frequency of shocks

Number of shocks across four survey rounds	Number of households	%
0	58	12.0
1	224	46.4
2	166	34.4
3	33	6.8
4	2	0.4
Total	483	100

Panel B: Magnitude of shocks, among households with one shock

Share of the value of crop loss to total crop value	% of sample
1-24%	38.8
25-49%	24.1
50-74%	25.0
75-100%	12.1
Observations	224

Table 3: Predicting the Occurrence of Shocks

Panel A: Any crop loss

	(1)	(2)	(3)
Specification:	Probit	Probit	Probit
Lagged any crop loss			-0.022
			(0.109)
Head of the HH years of schooling	0.024	0.023	0.025
	(0.019)	(0.018)	(0.019)
Head of the HH is female	0.216*	0.224**	0.217*
	(0.111)	(0.109)	(0.111)
Head of the HH's age	0.002	0.001	0.002
	(0.003)	(0.003)	(0.003)
Log per capita durables	0.008		0.008
	(0.013)		(0.013)
Log per capita cash	-0.025		-0.026
	(0.015)		(0.015)
Log per capita physical assets	0.033		0.033
	(0.036)		(0.036)
Lagged log per capita durables		0.002	
		(0.013)	
Lagged log per capita cash		-0.025	
		(0.015)	
Lagged log per capita physical assets		0.083	
		(0.034)	
Observations	1585	1585	1585
R-squared	0.30	0.30	0.30

Notes: Standard errors are in parentheses. *** indicates significance at 1%; ** at 5%; and, * at 10%. Community, district, survey round, and season dummies are included but not reported.

Table 3: Predicting the Occurrence of Shocks

Panel B: Crop loss in period t conditional on child labor in period t-1

	(1)	(2)
Specification:	FE	FE
Dependent variable:	log value of crop loss	share lost
Mean child labor hours (t-1)	-0.006	-0.0001
	(0.007)	(0.0004)
Head of the HH years of schooling	-0.079	-0.013*
	(0.161)	(0.008)
Head of the HH is female	-1.066	-0.062
	(0.772)	(0.040)
Head of the HH's age	0.032	0.001
	(0.024)	(0.001)
Log per capita durables	0.0004	0.002
	(0.054)	(0.003)
Log per capita cash	-0.035	-0.003*
	(0.035)	(0.002)
Log per capita physical assets	0.062	0.0005
	(0.103)	(0.005)
Number of observations	1677	1677
R-squared	0.32	0.24

Notes: Standard errors are in parentheses. *** indicates significance at 1%; ** at 5%; and, * at 10%. Dependent variables are log value of crop loss and share of crop loss due to shock to total crop value. Survey round and season dummies are included but not reported.

Table 4: The Effect of Crop Shocks on Household Expenditure and Wealth

Dependent variable	(1) Household expenditure	(2) Per person cash	(3) Value of per person physical assets	(4) Per person durables	(5) Household expenditure	(6) Per person cash	(7) Value of per person physical assets
Lagged shock *t*–1	-94	60	-51,914***	-46	-887***	-723***	-22,448
	(232)	(211)	(12,382)	(210)	(299)	(271)	(16,042)
effect on mean of dep. variable of one sd shock	*0.01%*	*5%*	*90%*	*2%*	*8%*	*64%*	*39%*
Lagged collateral					-265	-105	22,971
					(468)	(425)	(25,130)
Lagged shock * collateral					176***	165***	-6,583***
					(42)	(38)	(2,253)
Observations	3680	3678	3678	3678	3680	3678	3678
Number of households	622	622	622	622	622	622	622
R-squared	0.16	0.02	0.01	001	0.16	0.04	0.02

Notes: Regressions also control for education, sex, and age of household head, wave, season, and household fixed effects. Standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 5: Hours Worked in the Last Week and Income Shocks

Specification:	(1) OLS Ages 10-15	(2) OLS with community dummies Ages 10-15	(3) FE Ages 10-15	(4) FE Ages 7-15
Shock: log value of crop loss	0.33***	0.30***	0.22***	0.17***
	(0.09)	(0.09)	(0.08)	(0.07)
Father's schooling:1-6 years	-1.61*	-1.31	-0.36	-0.55
	(0.94)	(0.93)	(1.61)	(1.20)
Father's schooling: 7 years	-1.64*	-1.69*	0.13	0.44
	(0.98)	(0.98)	(1.61)	(1.22)
Father's schooling: 8+ years	-1.44	-0.61	-2.20	-0.14
	(1.34)	(1.27)	(2.26)	(1.63)
Mother's schooling: 1-6 years	-0.61	-0.76	0.44	0.15
	(0.79)	(0.74)	(1.34)	(1.01)
Mother's schooling: 7 years	-0.02	0.27	1.54	0.43
	(0.89)	(0.83)	(1.40)	(1.00)
Mother's schooling: 8+ years	-7.36***	-3.72**	1.82	-0.23
	(2.01)	(1.83)	(3.38)	(2.55)
Observations	3839	3839	3839	5591
Number of households	636	636	636	716
R-squared	0.05	0.09	0.04	0.15

Notes: Standard errors are in parentheses. In columns 1 and 2, standard errors are computed correcting for heteroskedasticity and correlation within household clusters. Fixed effects are computed at the household level. Hours include time spent on economic activities and household chores. *** indicates significance at 1%; ** at 5%; and, * at 10%. Other regressors included, but omitted from the table, are age and age squared and indicator variables for missing parental education, the season at time of interview, district (columns 1 & 2) and the round of the interview.

Table 6: Hours Worked in the Last Week, Income Shocks, and Collateral

Specification:	(1) FE	(2) FE	(3) FE with cluster-time trends	(4) FE with cluster-time dummies	(5) FE with cluster-time trends	(6) FE with cluster-time trends
Sample restriction 1: Age	10-15	10-15	10-15	10-15	10-15	10-15
Sample restriction 2: Land acres		1-25.5	1-25.5	1-25.5	1-25.5	1-25.5
Shock: log value of crop loss	0.34***	0.37***	0.42***	0.46***	0.41***	0.17
	(0.10)	(0.11)	(0.12)	(0.13)	(0.12)	(0.62)
Collateral: log per capita durables	0.13	0.21	0.28	0.34*	0.27	0.26
	(0.15)	(0.17)	(0.17)	(0.18)	(0.17)	(0.18)
Shock * collateral	-0.03*	-0.035**	-0.035**	-0.036**	-0.034**	-0.032*
	(0.01)	(0.015)	(0.016)	(0.017)	(0.016)	(0.019)
Liquid wealth: log per capita cash					-0.13	-0.054
					(0.12)	(0.14)
Shock * Liquid wealth						-0.022
						(0.022)
Illiquid wealth: log p.c. physical assets					0.62	0.53
					(0.38)	(0.42)
Shock * Illiquid wealth						0.031
						(0.058)
Farm household						
Father's schooling: 1-6 years	-0.35	-0.80	-1.10	-1.36	-1.05	-1.06
	(1.61)	(1.75)	(1.72)	(1.69)	(1.72)	(1.72)
Father's schooling: 7 years	0.070	-0.013	-0.42	-0.63	-0.42	-0.44
	(1.61)	(1.80)	(1.78)	(1.75)	(1.78)	(1.78)
Father's schooling: 8+ years	-2.30	-3.01	-3.87	-4.16	-3.83	-3.88
	(2.26)	(2.65)	(2.61)	(2.56)	(2.61)	(2.61)
Mother's schooling: 1-6 years	0.40	0.035	-0.037	-0.18	-0.041	-0.050
	(1.34)	(1.41)	(1.39)	(1.36)	(1.39)	(1.39)
Mother's schooling: 7 years	1.53	1.38	1.48	1.43	1.43	1.42
	(1.40)	(1.49)	(1.47)	(1.44)	(1.47)	(1.47)
Mother's schooling: 8+ years	1.84	-1.66	-1.45	-1.84	-1.53	-1.54
	(3.38)	(4.20)	(4.15)	(4.07)	(4.14)	(4.15)
Observations	3839	3234	3234	3234	3234	3234
Number of households	636	517	517	517	517	517
R-squared	0.04	0.15	0.04	0.04	0.04	0.04

Notes: Standard errors are in parentheses. In column 1, standard errors are computed correcting for heteroskedasticity and correlation within household clusters. Fixed effects are computed at the household level. Hours include time spent on economic activities and household chores. *** indicates significance at 1%; ** at 5%; and, * at 10%. Other regressors included, but omitted from the table, are age and age squared and indicator variables for missing parental education, the season at time of interview, and the round of the interview.

Table 7: Hours Worked in the Last Week, Income Shocks, and Collateral: Robustness Checks

	(1)	(2)	(3)	(4)	(5)
Specification:	FE	FE	FE	FE	FE
	Ages 10-15	Ages 10-15	Ages 10-15	Ages 10-15	Ages 10-15
			Land restriction	Land restriction	Land restriction
Definition of shock:	Dummy for crop	Dummy for crop	Dummy for crop		
	share lost>.1	share lost>.1	share lost>.1	log(crop loss)	log(crop loss)
Definition of collateral:		Per capita durables	Per capita durables	Dummy for durables>0	Total durables
Shock	1.48**	2.47***	3.38***	0.34***	0.36***
	(0.75)	(0.96)	(1.06)	(0.12)	(0.12)
Collateral		0.10	0.18	1.42	0.15
		(0.15)	(0.17)	(1.25)	(0.14)
Collateral * shock		-0.28**	-0.33**	-0.24*	-0.03**
		(0.14)	(0.16)	(0.13)	(0.01)
log per capita cash		-0.13	-0.18	-0.18	-0.16
		(0.10)	(0.11)	(0.12)	(0.11)
log per capita physical		0.51*	0.64	0.61	0.43
		(0.30)	(0.38)	(0.38)	(0.38)
Household size					-0.83
					(0.22)
Father's schooling: 1-6 years	-0.35	-0.35	-0.78	-0.76	-1.13
	(1.61)	(1.61)	(1.75)	(1.75)	(1.74)
Father's schooling: 7 years	0.12	-0.01	-0.05	-0.01	
	(1.61)	(1.61)	(1.80)	(1.80)	(1.80)
Father's schooling: 8+ years	-2.19	-2.33	-2.96	-2.95	-3.48
	(2.26)	(2.26)	(2.65)	(2.65)	(2.65)
Mother's schooling: 1-6 years	0.45	0.40	0.06	0.071	0.15
	(1.34)	(1.33)	(1.41)	(1.41)	(1.41)
Mother's schooling: 7 years	1.58	1.53	1.36	1.35	1.46
	(1.40)	(1.40)	(1.49)	(1.49)	(1.49)
Mother's schooling: 8+ years	2.00	1.85	-1.89	-1.85	-1.86
	(3.38)	(3.38)	(4.20)	(4.20)	(4.19)
Observations	3839	3839	3234	3234	3234
Number of households	636	636	517	517	517
R-squared	0.04	0.04	0.04	0.04	0.05

Notes: Standard errors are in parentheses. Fixed effects are computed at the household level. Hours include time spent on economic activities and household chores. *** indicates significance at 1%; ** at 5%; and, * at 10%. Other regressors included, but omitted from the table, are age and age squared and indicator variables for missing parental education, the season at time of interview, and the round of the interview.

Table 8: Alternative Interpretations of the Shock-Collateral Effect

Dependent variable	(1) Any member of family with loan	(2) Child wages
Shock	0.022***	-2.14***
	(0.007)	(0.43)
Collateral	0.007***	
	(0.002)	
Collateral*shock	5.25e-04***	
	(1.98e-04)	
Liquid wealth: log pc cash	-0.027***	
	(0.002)	
Shock *Liquid wealth	0.001***	
	(2.48e-04)	
Illiquid wealth: log per capita physical assets	0.001	
	(0.004)	
Shock * Illiquid wealth	-0.003***	
	(6.39e-04)	
Sample size	3839	3846
R-squared	0.05	0.19

Notes: Specification (1) controls for wave, season, and household fixed effects, along with community-time dummies and household characteristics. Specification (2) is at the community level.