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Childhood shocks, safety nets and cognitive skills: panel data evidence from rural Ethiopia

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ABSTRACT

A growing body of evidence emphasizes that shocks in early childhood can have irreversible effects on long-term child welfare and poverty. A number of studies have investigated the effects of shocks on child nutrition and health. However, evidence on the effects of shocks in early childhood on child cognition, particularly when measured after the early childhood window during preschool and beyond, is scarce. Given its history of recurring natural and economic shocks, Ethiopia presents a compelling context in which to seek a better understanding of this question. Using child-level panel data from rural areas of Ethiopia, this paper analyzes effects of both economic and non-economic shocks on child cognition skills measured after the early childhood age window.

The identification strategy for the study exploits the timing of shocks that occurred between the two periods in which cognitive scores of children were measured - between 2006, when the children in the study were between 4 and 6 years old, and 2009, when they were between 7.0 and 9.6 years old. Using difference-in-differences analysis and controlling for child, household, and village-level baseline characteristics, we find that exposure to these shocks significantly decreased child cognitive skills. Specifically, exposure to drought reduced child cognitive skills by 0.18 standard deviations, while food price inflation undercut cognitive skills by more than one standard deviations (0.98 due to cereals price inflation and 0.47 due to inflation in meat prices). Divorce contributes to a reduction in child cognitive abilities by another 0.39 standard deviations. On the other hand, the safety net program put in place in 2005 to protect households from the economic effects of such shocks mitigated the reduction in cognitive skills by 0.18 standard deviations. These results are in line with comparable studies from similar contexts and suggest that policies that aim at mitigating these shocks are crucial for child welfare and for future human capital development. The results also suggests that social safety nets, if well designed and implemented, can help check the long-lasting detrimental effects of shocks experienced during early childhood.

Keywords: Shock, safety nets, cognitive skill, children, difference-in-differences, Ethiopia

1. INTRODUCTION

Ethiopia has a long history of natural disasters that include droughts, floods, crop pests, and localized rain failures that at times have turned into humanitarian crises with long term social and economic repercussions (Pankhurst 1986, Dercon and Porter 2010). While Ethiopia has registered impressive economic growth in the last two decades, more than 80 percent of its population still subsists on rain-fed agriculture. This means that a single drought, if left unchecked, can lead to a crisis of significant proportions, such as the one in 1984-85. The welfare effects of such shocks on poor rural households are often exacerbated by economic stresses subsequent to the humanitarian crisis, including food price inflation (Durevall, Loening, and Birru 2010) and distress sales of assets (Berhane et al. 2011). These effects of such disasters, including income losses and consumption fluctuations, are well recognized and documented. What is less recognized is the lasting effects of such disasters on communities, particularly on long-term outcomes, such as human capital development (Dercon and Porter 2014).

A growing body of literature points to the long lasting adverse consequences of economic (e.g., droughts and food price inflation) and non-economic (e.g., divorce and family separation) shocks, particularly on child welfare outcomes (mainly, nutrition, health and cognition) and, hence, on future human capital development, as these shocks hit disproportionately harder on children than on adults (Alderman, Hoddinott, and Kinsey 2006; Dercon 2008; Dercon and Porter 2014; Meng and Qian 2009). Dercon and Porter (2014) report individuals affected by the 1984-85 Ethiopian famine who were below the age of 36 months were found later as young adults aged 17-25 years to be at least 3 cm shorter than expected. Rosales (2014) found that Ecuadorian children, who were exposed during pregnancy to food shocks arising from the 1997-98 El Nino, were more likely to have been born with a low birth weight and, five to seven years after the shock, to be shorter in stature and more anemic and to score lower in vocabulary tests. Yamano, Alderman, and Christiaensen (2005) examining the effect of shocks and food aid on the growth of children aged 6-54 months in Ethiopia for the period 1995-6 find that crop damage reduced child growth substantially - reducing child growth by about 0.9 cm growth over a six-month interval when half of their crop area is damaged – while food aid was found to have positive effects on child growth. Estimating the impact of the 1998-2000 Ecuadorian economic crisis on early childhood cognitive outcomes, Hidrobo (2011) finds one year of exposure to the crisis between birth and five years of age significantly decreased vocabulary test scores in children by an average of 2.4 points, which constitutes a 3 percent reduction in vocabulary test scores compared to the baseline for every year of exposure to the crisis.

Many of these studies focus on the effects of shocks on health and nutrition outcomes during early childhood. The importance of early age parental inputs on the formation of cognitive skills and the critical role cognitive skills play in determining success in later years of life is now firmly established (see, e.g., Cunha and Heckman 2007). Early childhood interventions are important to cognitive skills through their effects on health and nutrition, as brain development and laying down of the foundations for cognitive and socio-emotional skills take place at this stage of life. Undernourished children are observed to have poorer cognitive skills in adulthood, are less likely to complete school, and are less productive economically. There is evidence documenting chronic undernutrition during this window can lead to irreversible neurological damage that adversely affects schooling and economic productivity in adulthood (see, e.g., Hoddinott et al. 2013). Specifically, an impairment in physical growth in the first two years of life is never fully recovered (Alderman and Walker 2014) and slow growing children experience poorer psychomotor development and interact less frequently with their environment (Grantham-McGregor et al. 2007; Yamano, Alderman, and Christiaensen 2005). For example, Hoddinott et al. (2013) find that a reduction in height-for-age by one standard deviation increases the likelihood of being poorer by 10 percentage points at adulthood.

These findings have far-reaching implications in that the long-term development costs of under-investment in children at early stages of life, such as by not taking action to mitigate the impact on children of transitory income shocks, can be substantial. As a result, many policies and interventions tend to focus on food supplementation and child intellectual stimulation in the earliest years of life. However, the period after infancy "through to the age for initiating preschool and beyond" is more important for cognitive development (Lundberg and Wuermli 2012). The effect of shocks on cognition and socio-emotional skills during this latter period takes a different path than directly through health and nutrition – these effects work directly through depressing parental roles in caring and in stimulating their children intellectually and through compromising parental choices on child investments.

However, the evidence of the effect of childhood shocks experienced by somewhat older pre-school children on the development of their cognitive skills is scarce, particularly in the context of poor countries like Ethiopia. Our study is aimed at filling this evidence gap. This study examines the impacts of economic (e.g., drought and food price inflation) and non-economic (e.g., divorce) shocks on the cognitive skills of children at preschool age and beyond. These children were first observed when they were between the ages of 4 and 6 years in 2006 and then observed again when they were between the ages of 7 and 9.6 years in 2009. The shocks considered include those experienced between 2006 and 2009 and those experienced in 2002 when the children studied were between 0 and 2 years old.

This study particularly focuses on the impact on child cognitive skills of experiencing drought, food price inflation, or divorce shocks. We use a unique, child-level panel data set from Ethiopia, the Young Lives panel data that was developed over the period 2002 to 2009 in three rounds (2002, 2006, and 2009).[1] Our study is motivated by a number of events that occurred in Ethiopia in the period covered by these panel surveys. First, in 2002/03, a major drought hit Ethiopia that adversely impacted the food security of millions of households and left them vulnerable to shocks in subsequent years. Second, Ethiopia experienced a dramatic food price rise starting in 2007, such that by 2008 the country experienced one of the highest increases in food prices globally. This price rise particularly affected millions of poor rural households in areas where food production is deficient. Third, the effects of the major drought and food price rise were further exacerbated by localized rain failures in some parts of the country that occurred in the aftermath of these crises. Fourth, the 2002-03 drought resulted in the government of Ethiopia drastically changing its food-aid policy – mainly in the way emergency aid is channeled to those in need in the country. In 2005, Ethiopia designed one of the largest social safety nets in Africa - known as the Productive Safety Net Programme (PSNP). The PSNP shifted food aid transfers from being purely emergency-based to a social safety net program that targeted chronically food insecure households in drought prone areas. The PSNP made food or cash transfers to food insecure households on the basis of daily wages provided to households whose members worked on local public works. It also made direct transfers to labor-constrained food insecure households in the same areas.

Understanding the direction and magnitude of the impact of these overlapping events on many child outcomes is by no means straightforward. To our knowledge, no study has evaluated the effects of such a set of shocks on child cognitive outcomes comprehensively. We specifically study the impact of experiencing droughts, food price shocks, and other

[1] Young Lives is a 15-year study of childhood poverty in four developing countries, Ethiopia, India, Peru and Vietnam. It tracks two cohorts of children, a younger (children born in 2001/2) and an older cohort (children born in 1994/5), in each country until 2016 to investigate the changing nature of childhood poverty through quantitative and participatory qualitative research, linked to policy analysis. Young Lives Project - Ethiopia is a collaborative research project between researchers based at the University of Oxford, Save the Children Ethiopia, and the Ethiopia Development Research Institute. For further details on the Young Lives data used for this paper, see http://www.younglives.org.uk/ and http://younglives-ethiopia.org/.

household specific shocks e.g., divorce, between 2006 and 2008 on the cognitive achievement of children. The timing of our data collection relative to each of these events allows us to identify clean impact estimates, while controlling for a number of household and child level baseline characteristics that would otherwise confound those estimates. We use difference-in-differences methods to estimate the impact of shocks that occurred between 2006 and 2009 and control for early age potential unobserved heterogeneities using village, household, and child level covariates observed in 2002. We account for potential endogeneity due to selection into the PSNP using matching, combining the matching method with difference-in-differences method.

We find that children from households that experienced shocks scored significantly lower cognitive achievements than children of the same age from households that did not experience these shocks. The cognitive scores of children who experienced drought and parental divorce shocks decreased by 0.18 and 0.39 standard deviations, respectively. Additionally, exposure to (average) cereal and meat price rises decreased cognitive scores by 0.98 and 0.47 standard deviations, respectively. These results are robust even after controlling for a range of baseline household, child, and village level characteristics that might affect cognitive development at a later age. We also find that participation in the PSNP has a positive and significant effect on child cognitive scores. Compared to children from non-participating households, children from the PSNP participant households exhibited 0.18 standard deviations higher cognitive scores, suggesting that PSNP has some impact in reversing the detrimental effect of shocks. This finding is important given that the PSNP does not specifically target children. Furthermore, our findings provide additional evidence of the significance of recurring shocks on child cognitive skills. These results are robust to different specifications and largely in line with similar studies from other contexts. The implications are far-reaching: it is important to put carefully designed child safeguards in place before shocks hit so that the prolonged effects of shocks well into the next generation are prevented. These results also underline the importance for cognitive skill development of investments for older pre-school children are as important as those for younger children.

The remainder of the paper is organized as follows. Section 2 discusses shocks and child growth in rural Ethiopia. Section 3 describes the data and key variables used. Section 4 presents the theoretical framework, empirical strategy, and estimation implemented. Section 5 discusses our estimation results, and section 6 concludes.

2. SHOCKS, SAFETY NETS AND CHILD GROWTH IN RURAL ETHIOPIA

With a population of close to 90 million, Ethiopia is the second most populous country in Africa. Over the past 20 years, Ethiopia has registered impressive economic growth and has one of highest urbanization rates in Africa. Yet, more than 80 percent of its population still resides in rural areas mostly relying on rain-fed smallholder agriculture. Production is prone to the vagaries of frequent droughts, often resulting in reductions in household income and immediate consumption gaps. Persistent droughts coupled with other unfavorable economic shocks, such as the global food price increases, have often left rural households vulnerable, including to the impact of considerably smaller subsequent shocks. Despite the impressive economic growth and the reduction in the headcount poverty rate[2], the rural population in Ethiopia still remains vulnerable to shocks and the vicious circle of poverty. Some argue that much of this poverty can be explained by recurring shocks (e.g., Chuta 2014).

Poor rural households in Ethiopia face both area-wide, covariate shocks, such as drought and crop failure, and more idiosyncratic household-level shocks, such as the illness, the death of household members, or divorce (Woldehanna 2010). All such shocks are of significant concern for poor households, with their children being among the worst affected. Shocks can cause child poverty to persist, with negative future consequences. As social assistance programs in the country do not systematically target children, any shocks are likely to have strong negative effects on children, in particular (Woldehanna 2010, Hoddinott 2014), with far-reaching implications for the long-term human capital development of the country.

Of equal importance, Ethiopia is among the developing countries identified as being particularly vulnerable to the effects of global food price shocks (World Bank 2008). Rising food prices have direct adverse impacts on poor households, since food constitutes a relatively large share of the consumption basket of poor households. An average household in Ethiopia spends more than two-thirds of its income on food (Berhane et al. 2012). Among households defined as poor in Ethiopia, only 8 percent were found to be net-sellers of food (i.e., sell more food than what they purchased to consume) in 2000/01 (World Bank 2008). Ethiopia experienced sharp food prices increases in 2008. Food price inflation in Ethiopia was 81 percent in September 2008, one of the highest rates in the world. Management of this crisis reduced Ethiopia's national

[2] Headcount poverty fell from 38.7 per cent in 2004/5 to 29.6 per cent in 2010/11 (MOFED 2012).

reserves to US $ 900 million, the equivalent of 1.2 months of national imports (International Monetary Fund 2009). This was further exacerbated by the failure of the small rains (*Belg*) in 2007/08 (World Bank 2008). Some studies suggested that 60 percent of households in Ethiopia were under chronic food insecurity during this period. The prevalence of stunted and wasted children in Ethiopia were at their highest during the peak of the food price hikes (Uraguchi 2009).

Owing to these shocks and related food insecurity problems (and exacerbated by poor feeding practices), in terms of nutritional status and well-being, children in rural Ethiopia stand among the most disadvantaged in the world. The Ethiopia Demographic and Health Survey (EDHS) for 2011 reports that only four percent of children age 6-23 months are fed according to recommended practices (EDHS, 2011). Moreover, early-age complementary foods are not introduced in a timely fashion. Childhood illness is also rampant. For example, 44 percent of children age 6-59 months are anaemic (EDHS, 2011). The combined effect of these problems results in Ethiopia having among the highest stunting (44 percent), underweight (29 percent) and wasting (10 percent) prevalence rates globally among children under five years of age as observed in 2011 (EDHS, 2011)[3]. Parental literacy rates also are low in Ethiopia. According to the EDHS 2011, only 38 percent of women (age 15-49) and 65 percent of men (age 15-59) are literate. In addition, 51 percent of women and 33 percent of men in the same age group have no formal education (EDHS 2011). As a result, awareness about parental inputs for optimal child cognitive development is limited. In the absence of appropriate information transmission mechanisms in rural areas, such awareness deficiency is expected to be worse in rural areas than in urban contexts. All of these factors synergistically interfere with optimal overall child growth and mental development.

Until recently, food aid has been a common intervention to alleviate the adverse effects of shocks and food insecurity in Ethiopia, often motivated by explicit reference to its beneficial effect on child malnutrition (Yamano, Alderman, and Christiaensen 2005). Starting from 2005, however, the Government of Ethiopia and a consortium of donors has implemented a safety net program, the Productive Safety Net Program (PSNP), that provides transfers to food-insecure households through public works and direct support. The public works component pays daily wages for unskilled labor either in cash or in kind.

Although PSNP does not directly target children, some observers expect that the transfers will help mitigate some of the malnutrition problems that arise when droughts hit. The results of program evaluations to date are mixed in this regard, however. Using a four-round panel data set collected to evaluate the PSNP, Hoddinott et al. (2014) find no clear association between PSNP transfers and the child anthropometric outcomes of height-for-age (stunting) and weight-for-height (wasting). In contrast, Debela, Shively, and Holden (2014) analyzed a smaller sample of beneficiaries coming from one of the regions in which the PSNP has been operational and find that the program improved weight-for-height z-scores. In line with this latter finding, Goyal and Porter (2014), using the same Young Lives Ethiopia data as that used in the present study, find a positive and significant effect of the PSNP on height-for-age z-scores. Our study also provides evidence on the effect of the PSNP program, not on nutritional indicators, but on child cognitive outcomes in the face of economic and non-economic shocks.

3. DATA AND DESCRIPTION OF KEY VARIABLES AND MEASURES

3.1. Data

The data used in this study comes from the three round panel data set developed by the Young Lives Project (YLP) from surveys conducted in 2002, 2006 and 2009 in five major regions of Ethiopia. YLP Ethiopia tracked two age cohorts of 3,000 children over the three rounds. These are 2,000 children born in 2001-02 (the younger cohort) and 1,000 children born in 1994-95 (the older cohort). The two cohorts were re-surveyed in 2006 and 2009, with a relatively low attrition rate of 2.17 percent over the three survey rounds.

The YLP survey was implemented using a multi-stage sampling procedure. The survey was carried out in the four major regions, Amhara, Oromia, SNNPR, and Tigray, and in Addis Ababa. These survey strata account for about 96 percent of the total population of Ethiopia and 97 percent of children aged 18 months and below. Twenty *woredas* (districts) were selected in which to carry out the survey. One community was selected in each *woreda*, and from each selected community, around 100 households with at least one child born between 2001 and 2002 were chosen randomly (for details, see Outes-Leon and

[3] It is important to note that Ethiopia has made significant improvements in these nutrition outcomes in recent years. Between 2000 and 2011, stunting prevalence declined by 26 percent (from 58 percent in 2000 to 44 percent in 2011), indicating a substantial improvement in chronic malnutrition. Wasting prevalence has also declined by 32 percent (from 41 percent in 2000 to 29 percent in 2011), but wasting remained stable (around 10-12 percent) over the 11 years considered.

Sanchez 2008). It should be noted that the study over-sampled poor households in each region. The survey collected child, household, and community level information through appropriate questionnaires.

We only used data from the younger cohort for this study, because this data contains early childhood information on children. This information is essential for identifying the effects of early childhood shocks on cognitive achievements observed at a later age (i.e., when the young cohort was aged between 52 and 76 months in 2006 and between 90 and 116 months in 2009). We excluded children from urban areas because, compared to rural areas, weather shocks are likely to have a different sets of effects in urban centers due to differences in access to food markets, prices, and other socio-familial safety nets. In addition, the PSNP was designed for rural households.[4]

3.2. Description of key variables and measures

The outcome variable in our analysis is the cognitive achievement of children. We use the Peabody Picture Vocabulary Test (PPVT), which is an international proxy for cognitive ability first developed in 1959 and improved in subsequent years (Dunn and Dunn, 1997). The PPVT is a test of receptive vocabulary and seeks to measure a child's learning ability and, to some extent, to predict future individual skills (Duncan et al. 2007, Le 2009). The PPVT is widely used to measure cognitive development and achievement of children (Desai, Chase-Lansdale, and Michael 1989; Baydar and Brooks-Gunn, 1991; Blau and Grossberg, 1992; Rosenzweig and Wolpin, 1994; Outes-Leon, Porter, and Sanchez 2011). Children were given four pictures and were asked to select the one that best represented the meaning of a word presented to them orally by the enumerator. The number and the level of difficulty of questions in PPVT differed according to the child's age. The tests used were norm-referenced (Cueto et al. 2009). The YLP survey administered the standard PPVT for the younger cohort of children during the last two survey rounds in 2006 and 2009 when the children were between 4 and 9.6 years old.

The main variables of interest for this study are exposure to shocks and PSNP participation between 2006 and 2009. We use self-reported household shocks, including drought and divorce, as proxy for household shocks experienced by the child. We also use changes in community level food prices between 2006 and 2009 to measure the effect of food price hikes during 2007/08. Regarding PSNP, a household is considered as PSNP participant if the household has been participating either in the public work or the direct support component of PSNP between 2006 and 2009.

Table 3.1 provides descriptive statistics for the outcome, PPVT score, as well as all controls that were used in the empirical specification. The PPVT score is standardized to a mean of 0 with a standard deviation of 1.0. These results show that, in the period between 2006 and 2009, about 51 percent of the households reported drought shocks, while only 3 percent were affected by divorce. Food prices increased considerably within the 2006 and 2009 period. Approximately 47 percent of the households in our sample are PSNP participants.

Appendix Figures A1 and A2 compare the cumulative density function of the standardized PPVT score for the drought and divorce shock-affected and for households not affected by those shocks, respectively. The PPVT score distribution for children from the shock-affected households has shifted to the left, dominated by the scores of children from households that were not affected by these shocks. This suggests that the shocks adversely affected the cognitive development of children affected by them. Appendix Figure A3 compares the cumulative density function of the standardized PPVT score for PSNP participants and non-participants. The cumulative density function for the PSNP participants has shifted to the right, dominating the score for the PSNP non-participants. This suggests that participation in the PSNP improves the cognitive development of children in PSNP participating households.

4. METHODOLOGY

4.1. Theoretical framework

A large literature studying early childhood development examines the role of parental investments on children's health, nutrition, and cognition. These studies conceptualize a child's cognitive achievement as a cumulative process of knowledge acquisition through a history of inputs applied by parents and schools (Todd and Wolpin 2003; 2007; Glewwe and Miguel 2008). These inputs from parents and school are applied to the child's growth and combined with the child's innate genetic endowment, which is determined at conception (Porath 1967; Leibowitz 1974). Following Hoddinott and Kinsey (2001),

[4] In the younger cohort data, 66 urban households participated in PSNP between 2006 and 2009. Our subsequent results were robust to the inclusion of these urban households in particular and all households in the other urban sites in general.

Table 3.1—Descriptive statistics of variables used in analysis

Variable	Obs..	Mean	Std. Dev.	Min	Max
PPVT score (SDs), 2006	1104	-0.01	0.98	-1.58	4.84
PPVT score (SDs), 2009	1135	0.00	1.00	-1.05	3.71
Drought, 2006-09 (=1 if HH affected by drought shock between 2006 and 2009)	1138	0.51	0.50	0	1
Drought, 2002-06 (=1 if HH affected by drought shock between 2002 and 2006)	1138	0.44	0.50	0	1
Divorce, 2006-09 (=1 if HH affected by divorce shock between 2006 and 2009)	1138	0.03	0.17	0	1
Change in cereals prices (ETB[5] per kg), 2006-09	1138	3.06	0.72	2.46	4.28
Change in milk and egg prices (ETB per liter and piece, respectively), 2006-09	1138	11.92	1.42	10.38	14.05
Change in meat prices (ETB per kg), 2006-09	1138	14.33	1.85	11.16	15.75
PSNP participation, 2006-09 (=1 if household participated in PSNP between 2006 and 2009)	1138	0.47	0.50	0	1
Age of child (month), 2006	1138	62.24	3.87	52.80	75.37
Age of child (month), 2009	1138	98.60	3.85	89.83	115.93
Sex of child (=1 if male)	1122	0.53	0.50	0	1
HAZ of child, 2006	1138	-1.63	1.10	-5.57	3.64
HAZ of child, 2009	1135	-1.38	1.04	-5.23	2.59
Highest grade child completed, 2009	1126	0.68	0.63	0	2
Child enrolled in preschool (yes=1)	1138	0.03	0.18	0	1
Health problems child reported to have had from birth to age one year	1138	1.38	1.87	0	10
Age of caregiver, years	1135	27.90	6.91	10	61
Caregiver completed fifth grade (yes=1)	1138	0.09	0.28	0	1
Age of household head, years	1138	41.17	10.75	17	86
Head completed fifth grade (yes=1)	1138	0.20	0.40	0	1
Number of male adult members in household, 2006	1138	1.28	0.74	0	6
Number of male adult members in household, 2009	1138	1.53	0.97	0	7
Number of female adult members in household, 2006	1138	1.34	0.63	0	5
Number of female adult members in household, 2009	1138	1.56	0.87	0	9
Per adult daily consumption expenditure in ETB, 2006	1138	3.78	2.44	0.34	25.05
Per adult daily consumption expenditure in ETB, 2009	1138	7.30	4.43	1.43	52.75
Household owns land, 2006 (yes =1)	1136	0.97	0.16	0	1
Household owns land, 2009 (yes=1)	1136	0.97	0.18	0	1
Village access to health center (yes=1)	1119	0.42	0.49	0	1
Village access to primary school in less than 1 km distance (yes=1)	1119	0.50	0.50	0	1
Village access to all-weather road (yes=1)	1119	0.50	0.50	0	1

Note: PPVT is the Peabody Picture Vocabulary Test standardized to a mean of zero and a standard deviation (SD) of 1.0.
Source: Authors' calculations from Young Lives Data

Dercon and Hoddinott (2005), and Yamano, Alderman, and Christiaensen (2005), we model cognitive achievement as a knowledge acquisition production process. As outlined in Yamano, Alderman, and Christiaensen (2005), in a general utility framework defined over consumption, child nutrition, and cognitive development, including preference shifters, *N*; parents are assumed to maximize utility from their own consumption and from investing in their child's nutrition and cognition, subject to an inter-temporal budget constraint and cognition production function.[6] Since the extent to which child cognitive achievement can grow between t and $t+1$ is affected by the level of cognitive achievement at t, child i's growth in Cognitive Achievement (CA), can be written as:

$$CA_{it+1} – CA_{it} = g(CA_{it}, M_{it} (y_{it}, N) X_{it}, \alpha_i, e_{it}) \quad (1)$$

Where CA_{it} is child *i*'s initial cognitive achievement at period *t* and CA_{it+1} is the cognitive achievement at period *t+1.* M_{it} represents parental investment in child growth at period *t*, which is a function of flow of incomes y_{it} in period *t* and parents' preference shifters *N*. X_{it} represents the vector of observed characteristics at child, household, and community level; and α_i denotes unobserved individual (including endowed mental capacity ('ability') of child *i*), household, and community level characteristics determining cognitive achievement.[7] e_{it} is a random error term, and *g* is the functional operator. Equation (1) is a general formulation of the determinants of child cognitive development in period *t+1* and has two terms, an initial

[5] ETB stands for the Ethiopian currency, the Birr (1.00 USD = 9.02 ETB in 2006)

[6] We rule out income from child labor since we focus only on early age children. However, parents may see discounted future flow of income from their children in the form of direct labor contribution to the household, working off-farm, or through transfers.

[7] Since our sample contains one child per household and to simplify notation, we drop the household identifier and assume one child per household.

cognitive achievement level and parent or caregiver investments on child cognitive development, which depends on household income.

Following Yamano, Alderman, and Christiaensen (2005), we define household income, y_{it}, as a function of household characteristics, X_{it}, such as education, gender, and access to productive assets (e.g., land and labor); household- (e.g., divorce) and community-level shocks (e.g., drought, price), $Shock_{it}$, and safety nets and income transfers to the household (e.g., through the PSNP), $PSNP_{it}$; therefore, y_{it} can be written as:

$$y_{it} = f(Shock_{it}, PSNP_{it}, X_{it}, \alpha_i, e_{it}) \quad (2)$$

By substituting equation (2) into equation (1), child *i*'s cognitive achievement at time *t* becomes:

$$CA_{it} = g(CA_{it-1}, Shock_{it}, PSNP_{it}, M_{it}, X_{it}, \alpha_i, e_{it}, N) \quad (3)$$

Equation (3) roughly provides the structural relationship between cognition development and its inputs[8]. Note that parental inputs are endogenous to income and preference shifters[9]. Income in turn is dependent on income shocks, mainly weather and price shocks. Transitory drought shocks and shocks related to divorce or death of key family member are reported between 2006 and 2009. The major price inflation shock also hit between 2007 and 2009 following the global price hikes in the same period. While the effect of droughts on consumption is definitively negative, the effect of a price rise on rural households' incomes cannot be determined *a priori* and depends on whether the household is a net-buyer or a net-seller in the food market. Clearly, the impact of these shocks on child's cognition development will depend on households' ability to cope with these shocks as well as on child-specific parental preferences, which maybe endogenous to child performance on cognition. On the other hand, our households come from areas where the PSNP operates. The PSNP is designed to help households mitigate shocks. Households with access to the PSNP are expected to have better capacity to smooth their food consumption gaps during negative income shock periods.

4.2. Empirical strategy and estimation

In this section, we outline the empirical strategy and estimation method that was implemented. Assuming additively separable linear relationships, from equation (3) we derive an estimable equation for cognitive achievement (where *z* refers to baseline characteristics):

$$CA_{it} = \alpha_0 + \beta_1 z_{it-1} + \beta_2 Shocks_{it} + \beta_3 PSNP_{it} + \beta_4 M_{it} + \beta_5 X_{it} + \alpha_1 + e_{it} \quad (4)$$

The main objective is to investigate if observed economic and non-economic shocks that occurred early in 2002 and those that occurred between 2006 and 2009 have an effect on cognitive achievement. There are two ways through which this mechanism can work. First, drought shocks can affect family income through reduction of crop yields. Likewise, high inflation dwindles income by wiping out purchasing power. The reduction in family income in turn exposes children to malnutrition or even chronic undernutrition, which is often the result of dangerous synergistic effects of continued inadequate food intake together with repeated infections[10]. Malnutrition or chronic undernutrition in turn leads to irreversible neurological damage, which adversely affects cognitive development (Hoddinott et al. 2013). Note that since we do not observe our test score at baseline (because our cohort was too young to administer the test score), we proxy for baseline cognitive achievement using the child's health and education history at the baseline.[11] Second, drought, price rises, and other household-level shocks can have direct and persistent effect on cognitive achievement other than through nutrition. It is likely that a shock in one period crowds out expenditure on cognitive-related inputs in the next period through reduction in savings, the household is forced to sell assets as a result of the event, or simply that the shocks emotionally depress parents and influence their preferences regarding investments in their children.

A key concern in estimating equation (4) using OLS is the potential endogeneity, largely due to unobserved child, parent, or household-specific factors, affecting both parental investments on child and cognitive outcomes. Moreover, since the caring ability of parents, the qualities of the home environment, and a child's innate ability are unobserved and may be

[8] For detailed discussion of a more complete structure model, see Cunha and Heckman (2007).

[9] In our empirical estimation, we control for observed parental inputs, but the unobserved effects are treated together with other unobservable effects, α_i.

[10] "Over a protracted period of time, the child's body fails to receive sufficient nutrients – calories and micronutrients to grow and/or the need to fight repeated infections diverts energy that otherwise would be used for child growth." Hoddinott et al. 2014.

[11] In the subsequent estimation we add controls like child's health condition at infancy, proxied by the number of health problems the child had from birth to age one, and preschool enrolment history, proxied by whether the child was enrolled in preschool.

correlated with the error term, OLS estimations of equation (4) are likely to be biased. One instance of the parental preference change is that some parents may have strong investment preference for healthy and relatively bright children. Todd and Wolpin (2007) summarize a number of approaches used to tackle the endogeneity problem, which, in the absence of panel data, often involves the use of instrumental variables. With panel data, the unobserved child, household, and home environment level effects can be wiped out by using differencing or variants of the fixed-effects panel data method (Wooldridge 2002; Todd and Wolpin 2003, 2007). That is, if multiple observations on achievement outcomes and on inputs for a given child at different ages are available, equation (4) can be estimated fairly consistently using difference-in-differences (DID) methods (Wooldridge 2002, 283; Todd and Wolpin 2007)[12].

DID can be implemented either by using differencing or in a regression framework. There are two attractions of implementing DID in a regression framework in our case (see Angrist and Pischke 2009, 222-240). First, the timing of our main variable of interest, mainly the main drought and prices shocks, are observed between 2006 and 2009, for which the regression framework becomes convenient.[13] Second, the regression framework has the extra advantage of allowing us to include baseline characteristics that enable us to control for initial conditions, early shocks, and potentially time-varying variables. Alternatively, this may be implemented in a DID framework by including the baseline characteristics after first-differencing takes place. However, doing so introduces serial correlation (Wooldridge 2002:283). The regression framework enables us to overcome this serial correlation problem by providing the extra advantage of calculating standard errors automatically (Angrist and Pischke 2009:237). We thus estimate DID in the regression framework, while also using the baseline information to control for initial heterogeneities and time-varying unobservable:

$$CA_{it} = \alpha_0 + \alpha_1 Year + \beta_1 z_{i,t-1} + \beta_2 Shocks_i + \beta_3\, Shocks_i * Year + \beta_4 X_{it} + e_i \qquad (5)$$

Where cognitive achievement, CA_{it}, is measured by the PPVT scores in 2006 and 2009; $z_{i,t-1}$ represents a vector of baseline and time-varying characteristics; *Year* refers to the second period (2009); X_{it} is a vector of variables observed in the two periods; e_i is the error term composed of both time-constant and time-varying components. α_0 is the intercept, and α_1, β_1, β_2, β_3, and β_4 are parameters to estimate.

An attraction in estimating equation (5) that takes into account changes in PPVT scores over time is that the estimates show whether a child has advanced in terms of her skill levels over time (Boo 2009). This equation cancels out the unobserved time-invariant omitted variables, such as child ability, parental preferences, community characteristics and school quality, and it also controls for individual and parental level characteristics that might affect outcomes at a later stage. The main parameter of interest in equation (5) is β_3, which indicates the effect of shocks on the cognitive achievement of children affected by shocks against those that were not affected. We also include the PSNP in equation (5) to control for its potential effect in reversing shocks. However we are not directly interpreting the estimates for PSNP in this equation, because it might be endogenous to our outcome variable. By definition, the PSNP targeted food insecure households, in which case the assumption $E(PSNP_{ijt}, \mu_{ij}) = 0$ would fail to hold. To overcome this problem, the DID model in equation (5) is estimated on matched households. Households are matched based on their observable baseline characteristics just before the start of the PSNP, and we estimate model (6) on the matched sample[14].

$$CA_{it} = \alpha_0 + \alpha_1 Year + \beta_1 z_{i,t-1} + \beta_2 Shocks_i + \beta_3\, PSNP * Year + \beta_4 X_{it} + e_i \qquad (6)$$

As in equation (5), we include shock and the other characteristics in equation (6), but our main parameter of interest now is β_3. It indicates the impact of participation in the PSNP on cognitive test scores against those that did not participate in the PSNP, once we control for the observable baseline characteristics using matching. As in Hoddinott et al. (2014), we assume selection into the PSNP is largely based on observable characteristics.

[12] This works under the assumption that the child's genetic endowment is time-invariant and independent of age.

[13] Note that our aim is to identify the effect of the shocks and PSNP that occurred between 2006 and 2009 and reported in 2009, while the cognitive measure, PPVT, is reported in 2006 and 2009.

[14] The first stage probit regression results for the propensity score matching of PSNP enrolment are presented in Appendix Table A2.

5. ESTIMATION RESULTS

The results for the impact of economic and other shocks on the cognitive test scores of the children from the DID model specification in equation (5) are reported in Table 5.1. Columns 1 to 4 report the results with different sets of controls.[15] In column 1, we include child-level characteristics. Column 2 adds household and village-level covariates. Column 3 further improves the specification by including additional controls to account for initial heterogeneities, including enrollment in preschool, sickness at infancy, and other parental factors. Column 4 presents the result for the full DID model, including participation in PSNP.

Table 5.1 shows statistically significant negative impacts of the experience of the economic and non-economic shocks on cognitive test score of children. (Full results of the model are reported in Appendix Table A1.) Results of the full specification of the model in column 4 show that, compared to those that were not affected, drought and divorce shocks decreased child cognitive score by 0.18 and 0.39 standard deviations, respectively. Also, an increase in average cereal and meat prices by one ETB per kilogram during the period considered decreased child cognitive score by 0.98 and 0.47 standard deviations, respectively. Average prices of milk and eggs also suggest similar trends, but are not statistically significant. As described in Section 3, the impact of the rise in food prices on cognitive test scores depends on whether the household is a net-buyer or a net-seller of food. These results are plausible, given our sample comes from relatively poorer rural areas that are likely to be significantly affected by such food price rises. These estimates are consistent and robust to the inclusion of controls for household and village-level characteristics, initial conditions, and PSNP participation.

Child and household-level controls presented in column 4 also show expected results. Specifically, child, caregiver, and household head education has a statistically significant positive effect on child cognitive test scores. A one-year increase in child schooling increases cognitive test score by 0.39 standard deviations. Children with caregivers and household heads that have completed at least fifth grade also exhibited a higher test score by 0.20 and 0.26 standard deviations, respectively. Access to health centers and primary schools is also important with statistically significant positive effects on the score. Children living in villages with access to health centers and a primary school with a distance of less than 1 km realized 0.19 and 0.14 standard deviation higher cognitive test scores, respectively.

In addition, pre-school enrolment has a statistically significant positive effect on child cognitive test scores, while sickness and drought in a child's early years have a statistically significant negative effect on the score. Children who were enrolled in preschool exhibit a 0.37 standard deviations higher score on average than those that were not enrolled. A one unit increase in the number of health problems during infancy decreases the score by 0.03 standard deviations. Further, we note that, in addition to the drought shocks that were experienced during and after the preschool age (i.e., between 2006 and 2009), shocks that occurred during early childhood (i.e., between 2002 and 2006) also have had significant negative effects on cognitive test scores measured in 2006 and 2009. We find that, keeping other things constant, children that were exposed to drought shocks during the early childhood window experienced additional reductions in cognitive test scores of 0.12 standard deviations. This is roughly equivalent to the effect of drought experienced later at preschool age and beyond (i.e., between 2006 and 2009).

[15] These include child-level controls, such as child's age, sex, and highest grade completed (years of schooling); household-level controls, such as caregiver's and household head's age and education (dummy that indicate if completed fifth grade), number of adult male household members, and number of adult female household members; village-level controls, such as dummies that indicate village access to a health center and village access to a primary school within 1 km distance; and controls for initial conditions, such as to indicate if the child being enrolled in preschool, number of health problems the child had from birth to age 1, dummy that indicate if household affected by drought shock between 2002 and 2006.

Table 5.1—Effect of drought, divorce, and food price shocks between 2006 and 2009 on cognitive test score measured in 2006 and 2009 for children born in 2001/2002, difference-in-differences regression estimation

Dependent variable: PPVT score (SD)	(1)	(2)	(3)	(4)
Drought, 2006-09 x Year_2009	-0.153**	-0.170**	-0.176**	-0.181**
	(0.076)	(0.077)	(0.078)	(0.078)
Divorce, 2006-09 x Year_2009	-0.296*	-0.385**	-0.385**	-0.392**
	(0.178)	(0.166)	(0.167)	(0.164)
Change in cereals prices, 2006-09 x Year_2009	-0.975***	-0.913***	-0.897***	-0.984***
	(0.243)	(0.247)	(0.248)	(0.254)
Change in milk and egg price, 2006-09 x Year_2009	-0.024	-0.009	0.000	-0.042
	(0.063)	(0.063)	(0.063)	(0.068)
Change in meat prices, 2006-09 x Year_2009	-0.501***	-0.438***	-0.424***	-0.466***
	(0.125)	(0.129)	(0.129)	(0.132)
PSNP participation, 2006-09 x Year_2009				0.178**
				(0.088)
Dummy for child being enrolled in preschool			0.375***	0.368**
			(0.142)	(0.143)
Number of health problems child had from birth to age one year			-0.028***	-0.029***
			(0.011)	(0.011)
Drought, 2002-06			-0.130***	-0.116**
			(0.049)	(0.049)
Number of obs.	2223	2182	2182	2182
R-squared	0.10	0.13	0.14	0.15
Child level controls	Yes	Yes	Yes	Yes
Household level controls	No	Yes	Yes	Yes
Village level controls	No	Yes	Yes	Yes

Note: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors are in parentheses.
PPVT is the Peabody Picture Vocabulary Test, with mean of zero and a standard deviation of 1.0.
Source: Authors' calculations from Young Lives Data

The impact of participation in the PSNP from the DID specification on a matched sample of participants and non-participants is reported in Table 5.2. (Full results of the model are reported in Appendix Table A3.) Matching enables us to control for program selection biases at baseline. It specifically helps us establish a proper non-participant comparison group that can be safely compared against our participant group so that we can compare mean differences between these two groups. As shown in equation (6), a DID regression framework similar to equation (5) is implemented on the matched samples. In Column 1 in Table 5.2, we include child-level characteristics. Column 2 adds household and village-level controls. Column 3 further adds the economic and non-economic shocks experienced. As presented in column 3, compared to non-participants, children that belong to households that participated in the PSNP between 2006 and 2009 realized 0.18 standard deviations higher cognitive test scores on average.

In other words, the PSNP had a statistically significant positive effect on cognitive test scores of children in these areas, even after controlling for initial selection effects into the PSNP and controlling for observed shocks in those households. This result is in contrast to those reported by Hoddinott et al. (2014), who found the PSNP not to have a significant effect on child anthropometric outcomes. However, it is important to note two important differences between these two studies. First, our data comes from a non-representative sample of villages who benefitted from the PSNP. Consequently, our results can be considered as derived from a sub-sample of the areas covered by the PSNP and cannot be taken to represent the wider impact of the PSNP reported in Hoddinott et al. (2014). Second, our study is focused on the effects of the PSNP as experienced during preschool on child cognitive skills later around preschool age and beyond. Hoddinott et al. (2014) focus on the effects of PSNP on early childhood health and nutrition measures.

Table 5.2—Impact of PSNP participation between 2006 and 2009 on cognitive test score measured in 2006 and 2009 for children born in 2001/2002, difference-in-differences regression on matched sample

Dependent variable: PPVT score (SD)	**(1)**	**(2)**	**(3)**
PSNP participation, 2006-09 x Year_2009	0.286***	0.210***	0.178**
	(0.076)	(0.077)	(0.087)
Drought, 2006-09 x Year_2009			-0.173**
			(0.078)
Divorce, 2006-09 x Year_2009			-0.390**
			(0.168)
Change in cereals prices, 2006-09 x Year_2009			-0.970***
			(0.252)
Change in milk and egg prices, 2006-09 x Year_2009			-0.038
			(0.068)
Change in meat prices, 2006-09 x Year_2009			-0.468***
			(0.131)
Number of obs.	2167	2130	2130
R-squared	0.07	0.12	0.14
Child level controls	Yes	Yes	Yes
Household level controls	No	Yes	Yes
Village level controls	No	Yes	Yes

Note: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors are in parentheses. PSNP is the Productive Safety Net Programme. PPVT is the Peabody Picture Vocabulary Test, standardized to a mean of zero and a standard deviation of 1.0.
Source: Authors' calculations from Young Lives Data

Consistent with the results presented in Table 5.1 above, all shocks continue to show significant negative effects even in the face of the PSNP and after controlling for initial selection effects into the PSNP. In addition the covariates for child, caregiver, and household head education continue to show significant positive effects on the score. As reported earlier, Village level characteristics such as access to primary schools also show significant positive effect. All of these indicate that results are consistent even after we account for potential confounding factors in program placement and households' selection into the program. Note also that we have controlled for nutritional differences at early age by including indicators for height-for-age measures in our regressions. We have however stayed away from interpreting these parameters as they might be biased due to endogeneity to our outcome variable.

6. CONCLUDING REMARKS AND POLICY IMPLICATIONS

An extensive literature shows economic and non-economic shocks define the way of life in developing countries. These shocks work in synergy with other problems of development. A growing body of literature reveals how shocks hit much harder on children than on any other member of community in poor rural areas like in Ethiopia, partly because it is harder to target children for social protection programs in such environments. Recent studies also demonstrate that, although early life shocks are very critical with lasting effects on later health and skill development, there can be other windows when the child can recover and improve, as far as cognition is concerned. Thus, shocks that hit in later after the early childhood period, such as during the preschool ages and beyond, can be critically detrimental, as these shocks may affect parental investment choices on their children. The primary focus of this paper has been to investigate the effect of both shocks that hit early on and those that hit later on child cognition skills measured during preschool and later. Given its history of shocks, Ethiopia presents an interesting context to try and understand this problem. The identification strategy in this study exploits the timing of shocks (mainly drought, divorce, and food price inflation) that occurred between two periods (2006 and 2009) in which cognitive test scores were measured for a cohort of children born in 2002 in rural Ethiopia. The estimation strategy controlled for child, household, and village level characteristics and initial conditions. It also took into account the effects of major, potentially time-varying factors as well as policy interventions, such as the PSNP, and also attempted to causally identify such impacts.

Our results show that experiencing drought, divorce, and price rise shocks affected child cognitive skills negatively in the period considered. These results are statistically significant and robust to different specifications. Drought and divorce shocks reduced child test scores by 0.18 and 0.39 standard deviations, respectively. Increases in food prices, specifically cereal and meat prices, also decreased the score substantially. An increase in average cereal and meat prices by one ETB per kilogram decreases the score by 0.98 and 0.47 standard deviations, respectively. Milk and egg price increases also suggest similar negative impacts, but are not statistically significant.

The Productive Safety Net Programme (PSNP) is an important policy intervention put in place by the Ethiopian government and its development partners to protect households from the adverse welfare effects of recurring droughts and to strengthen their post-drought resilience. It is an interesting policy question to investigate whether the PSNP actually helped households avoid adverse impacts on their welfare when shocks hit. The analysis also considered the impact of the safety net program on children's cognitive test score. The results indicate that PSNP participation has a 0.18 standard deviation positive impact on children's cognitive test score, a result that is statistically significant. This result is robust as the estimation combined two identification strategies – matching and difference-in-differences methods. Some studies have evaluated the impacts of the PSNP on other child outcomes, mainly nutrition and health, and found more mixed results on the impact of the program. To the best of our knowledge, our study is the first to specifically look at the impact of social safety nets on child cognitive skill in the face of shocks. The findings suggest that the PSNP has indeed protected households from reduced consumption and lower welfare after experiencing a shock, at least for the measure of the development of cognitive skills of young children in beneficiary households.

In summary, the results we obtained from using rigorous identification strategies and controlling for other confounding factors, suggest that economic shocks such as drought, food price rises and non-economic shocks, such as parental divorce, that negatively affect the socio-emotional growth, negatively impact child cognitive skill development, while the PSNP appears to play an important role in reversing these negative impacts. These results are in line with similar studies done in comparable contexts and suggest that economic and non-economic shocks, such as those considered here, are critically important for policies that aim to address child welfare needs, as well as human capital development. Specifically, this study complements the wealth of evidence on the lasting effects of shocks experienced during early childhood, but brings much needed additional evidence to the rarely available empirical evidence of the detrimental effect of shocks experienced even after early childhood, mainly during the later preschool years and beyond. The results strongly suggest that, even when children grow into their later preschool years and beyond, continued investment in child health and nutrition is as important for the development of their cognitive skills as such investments in early childhood.

The implications of this finding are far reaching: policies to address child welfare and ensure sustained growth and overall human development need to seriously consider continued investments in children in their late preschool years and beyond, in addition to the early childhood period. In other words, unlike for other early childhood nutrition and health deficiencies, early childhood shortfalls in cognitive skills can be improved by investments at later age, including during preschool and beyond. Such careful interventions would be required in contexts like rural Ethiopia where shocks are recurrent, child protection schemes are scarce and difficult to implement, pre-schooling is hardly available, and investments in socio-emotional interventions for young children are rare and frustrated by both economic and non-economic factors. This study suggests that social protection programs, if designed and implemented carefully, can enhance child cognitive development, protect child development outcomes, and improve child welfare.

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APPENDIX

Table A1—Full results: effect of drought, divorce, and food price shocks between 2006 and 2009 on cognitive test score measured in 2006 and 2009 for children born in 2001/2002, difference-in-differences regression estimation

Dependent variable: PPVT score (SD)	(1)	(2)	(3)	(4)
Drought, 2006-09 x Year_2009	-0.153**	-0.170**	-0.176**	-0.181**
	(0.076)	(0.077)	(0.078)	(0.078)
Divorce, 2006-09 x Year_2009	-0.296*	-0.385**	-0.385**	-0.392**
	(0.178)	(0.166)	(0.167)	(0.164)
Change in cereals prices, 2006-09 x Year_2009	-0.975***	-0.913***	-0.897***	-0.984***
	(0.243)	(0.247)	(0.248)	(0.254)
Change in milk and egg price, 2006-09 x Year_2009	-0.024	-0.009	0.000	-0.042
	(0.063)	(0.063)	(0.063)	(0.068)
Change in meat prices, 2006-09 x Year_2009	-0.501***	-0.438***	-0.424***	-0.466***
	(0.125)	(0.129)	(0.129)	(0.132)
PSNP participation, 2006-09 x Year_2009				0.178**
				(0.088)
Year_2009 (1 if the year is 2009)	10.082***	8.742***	8.405***	9.686***
	(3.076)	(3.139)	(3.145)	(3.244)
Drought, 2006-09 (0/1)	0.017	0.044	0.077	0.086
	(0.06)	(0.061)	(0.062)	(0.062)
Divorce, 2006-09 (0/1)	0.145	0.23	0.212	0.222
	(0.16)	(0.162)	(0.158)	(0.158)
Change in cereals prices, 2006-09	0.878***	1.001***	1.071***	1.166***
	(0.213)	(0.217)	(0.216)	(0.219)
Change in milk and egg prices, 2006-09	-0.120**	-0.061	-0.023	0.017
	(0.052)	(0.052)	(0.053)	(0.055)
Change in meat prices, 2006-09	0.263**	0.331***	0.379***	0.420***
	(0.111)	(0.112)	(0.112)	(0.113)
PSNP participation , 2006-09 (0/1)				-0.175**
				(0.068)
Age of child (in month)	0.004	0.005	0.004	0.005
	(0.006)	(0.006)	(0.006)	(0.006)
Sex of child (1 if male)	0.062	0.064	0.054	0.053
	(0.043)	(0.043)	(0.042)	(0.042)
Highest grade child completed	0.417***	0.416***	0.388***	0.390***
	(0.05)	(0.05)	(0.05)	(0.05)
Child enrolled in preschool (0/1)			0.375***	0.368**
			(0.142)	(0.143)
Number of health problems child had from birth to age one year			-0.028***	-0.029***
			(0.011)	(0.011)
Drought, 2002-06			-0.130***	-0.116**
			(0.049)	(0.049)
Age of caregiver		0.001	0.003	0.003
		(0.004)	(0.004)	(0.004)
Caregiver completed fifth grade		0.234***	0.205**	0.197**
		(0.085)	(0.083)	(0.083)
Age of household head		0.001	0.001	0.001
		(0.003)	(0.003)	(0.003)
Head completed fifth grade (0/1)		0.263***	0.256***	0.259***
		(0.063)	(0.062)	(0.062)
Number of male adult household members		0.008	0.01	0.008
		(0.028)	(0.028)	(0.028)
Number of female adult household members		0.034	0.03	0.031
		(0.033)	(0.033)	(0.033)
Village access to health center (0/1)		0.169**	0.206**	0.191**
		(0.079)	(0.08)	(0.08)

Village access to primary school in less than 1 km distance (0/1)		0.141***	0.118**	0.139***
		(0.051)	(0.052)	(0.053)
Constant	-5.349*	-7.727***	-8.982***	-10.284***
	(2.758)	(2.8)	(2.804)	(2.85)
Number of obs.	2223	2182	2182	2182
F-statistic	17.87***	14.66***	13.44***	12.72***
R-squared	0.10	0.13	0.14	0.15

Note: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors are in parentheses.
PPVT is the Peabody Picture Vocabulary Test, standardized to a mean of zero and a standard deviation of 1.0.
Source: Authors' calculations from Young Lives Data

Table A2—First stage probit regression (Propensity score) of PSNP enrollment

Independent variable	Coefficient	Standard Error
Household is male headed (0/1)	-0.074	0.144
Head’s age, years	-0.005	0.024
Head's age square	0.000	0.000
Head completed fifth grade (0/1)	0.222*	0.116
Number of male adult household members	-0.205**	0.099
Number of female adult household members	0.079	0.109
Household wealth-index	-2.374***	0.714
Land ownership (0/1)	-0.150	0.118
Annual consumption expenditure per adult, ETB	0.000	0.000
Shortage of food (0/1)	0.036	0.103
Death of livestock (0/1)	-0.063	0.103
Crop failure (0/1)	0.272**	0.106
Livestock stolen (0/1)	-0.202	0.289
Stolen crop (0/1)	-0.186	0.220
Death of livestock (0/1)	-0.218	0.173
Job loss (0/1)	0.041	0.157
Severe illness (0/1)	-0.182	0.134
Victim of crime (0/1)	0.386	0.256
Household divorce (0/1)	-0.904***	0.249
Rural site in Oromia (0/1)	-0.067	0.126
Rural site in SNNP (0/1)	-1.008***	0.128
Rural site in Tigray (0/1)	1.516***	0.149
Constant	0.758	0.558
Pseudo R-square	0.27	
Number of obs.	1136	

Note: * p<0.10, ** p<0.05, *** p<0.01. The region of common support is [.0577, .9789]
Source: Authors' calculations from Young Lives Data

Table A3—Full result: Impact of PSNP participation between 2006 and 2009 on cognitive test score measured in 2006 and 2009 for children born in 2001/2002, difference-in-differences regression on matched sample

Dependent variable: PPVT score (SD)	(1)	(2)	(3)
PSNP participation, 2006-09 x Year_2009	0.286***	0.210***	0.178**
	(0.076)	(0.077)	(0.087)
Drought, 2006-09 x Year_2009			-0.173**
			(0.078)
Divorce, 2006-09 x Year_2009			-0.390**
			(0.168)
Change in cereals prices, 2006-09 x Year_2009			-0.970***
			(0.252)
Change in milk and egg prices, 2006-09 x Year_2009			-0.038
			(0.068)
Change in meat prices, 2006-09 x Year_2009			-0.468***
			(0.131)

Year_2009 (0/1)	-0.448**	-0.673***	9.594***
	(0.22)	(0.22)	(3.233)
PSNP participation, 2006-09 (0/1)	-0.163***	-0.129**	-0.196***
	(0.059)	(0.059)	(0.068)
Drought, 2006-09 (0/1)			0.058
			(0.062)
Divorce, 2006-09 (0/1)			0.249
			(0.166)
Change in cereals prices, 2006-09			1.092***
			(0.219)
Change in milk and egg prices, 2006-09			-0.016
			(0.055)
Change in meat prices, 2006-09			0.370***
			(0.112)
Age of child (in month)	0.000	0.000	0.006
	(0.006)	(0.006)	(0.006)
Sex of child (1 if male)	0.064	0.061	0.071*
	(0.044)	(0.043)	(0.043)
Highest grade child completed	0.484***	0.437***	0.416***
	(0.045)	(0.046)	(0.049)
Age of caregiver, years		0.002	0.002
		(0.004)	(0.004)
Caregiver completed fifth grade (0/1)		0.184**	0.235***
		(0.084)	(0.083)
Age of household head, years		0.001	0.000
		(0.003)	(0.003)
Head completed fifth grade (0/1)		0.246***	0.247***
		(0.061)	(0.064)
Number of male adult household members		0.005	0.007
		(0.03)	(0.029)
Number of female adult household members		0.038	0.03
		(0.033)	(0.033)
Household daily consumption expenditure per adult, ETB		0.034***	
		(0.007)	
Village access to health center (0/1)		0.317***	0.108
		(0.063)	(0.077)
Village access to primary school in less than 1 km distance (0/1)		0.097**	0.181***
		(0.043)	(0.051)
Constant	0.059	-0.416	-9.054***
	(0.369)	(0.372)	(2.844)
Number of observations	2167	2130	2130
F-statistic	26.12***	16.64***	13.45***
R-squared	0.07	0.12	0.14

Note: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors are in parentheses. PSNP is the Productive Safety Net Programme. PPVT is the Peabody Picture Vocabulary Test, standardized to a mean of zero and a standard deviation of 1.0.
Source: Authors' calculations from Young Lives Data

Figure A1—Cumulative density function of Peabody Picture Vocabulary Test (PPVT) score (SDs) by drought shock

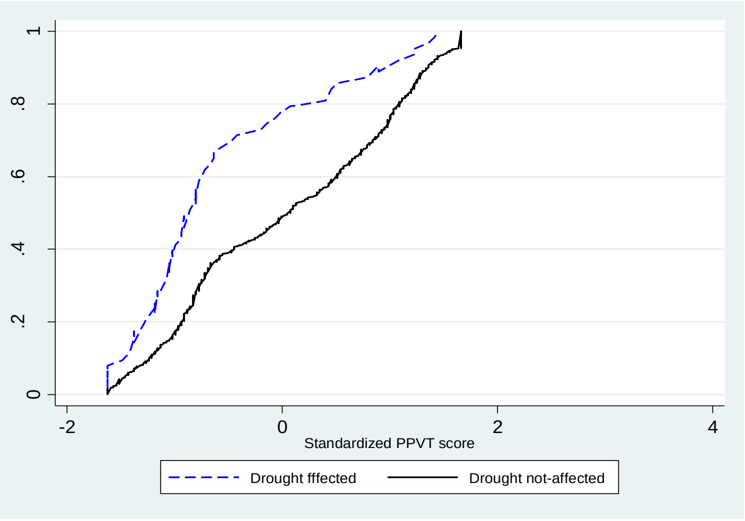


Figure A2—Cumulative density function of PPVT score (SDs) by divorce shock

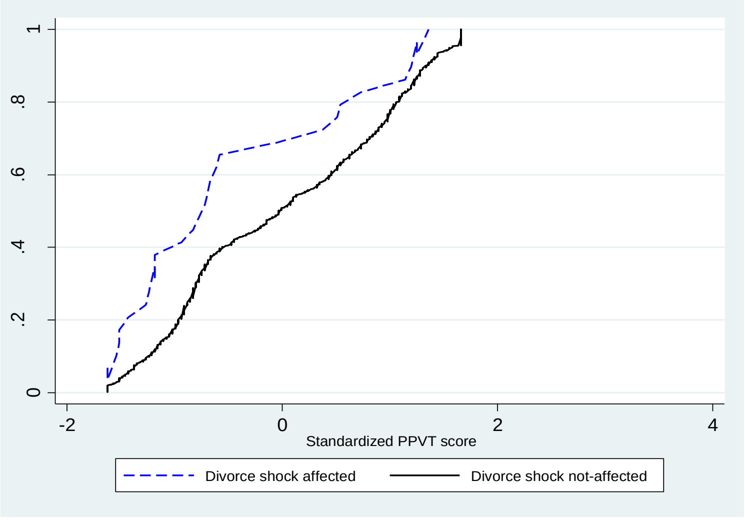
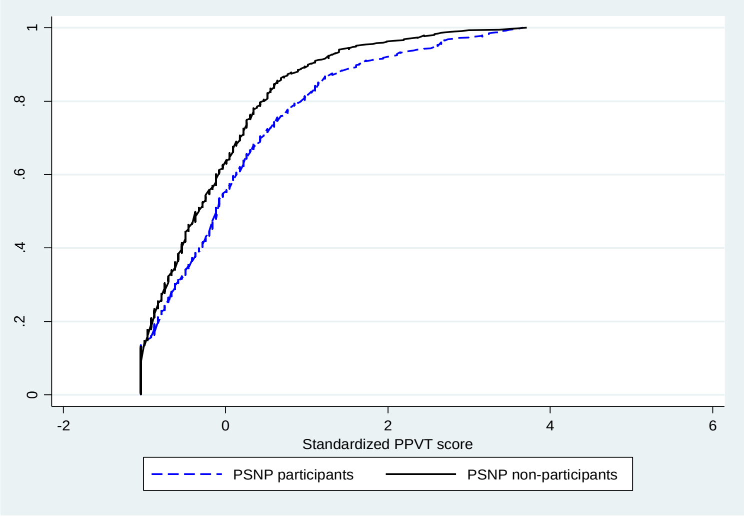


Figure A3—Cumulative density function of PPVT score (SDs) by PSNP participation status



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