The Melancholic Childhood
Causes and Consequences of Malnutrition on Psychosocial competencies. Evidence from Indian Adolescents

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Abstract

Using data from Young Lives longitudinal study, the objective of this paper is to present evidence about the relationship between early childhood environmental shocks and their psychosocial well-being. I examine whether there is a relationship between child malnutrition and psychosocial competencies where I measure both long-term (HAZ) and short-term (WAZ) malnutrition. The psychosocial competencies that I study are: aspiration, self-esteem and self-efficacy, which all are crucial and a determinant to future outcomes such as children’s schooling performance and labour market outcome. It is argued that malnutrition is not only an element to extinguish the hunger but act as an instrument to keep children’s enthusiastic mind and development circle in accordance with the expected child growth rate reference. The environmental shock is captured in an unconventional way, I use of the objective (community level) and subjective (household level) drought measurement. In addition, I employ weather data at district level from Global Climate database as a robustness check. Until today, there are still very few studies in the economic literature which tries to capture the channels which malnutrition can affect early psychosocial child development. In contrast to previous studies where the strong positive correlation between malnutrition and psychosocial competencies are well established, this paper tries to study the direct and indirect mechanism of child malnutrition on psychosocial competencies. To identify causal effects, I exploit rainfall as an instrument for malnutrition. The rationality of employing rainfall as an instrument relies upon the fact that it provide a measurement of health productivity shock by prevalence of infectious diseases, which is associated in urban and rural area with poor public health infrastructure and level of hygiene. The empirical evidence reveals that drought experienced in utero has detrimental effects on children’s psychosocial competencies, not surprisingly on children’s level of aspiration. It further give some evidence that girls living in rural area have in higher degree lower self-efficacy and self-esteem. In a nutshell, this paper studies the impact of early environmental shock on psychosocial childhood environment. The evidence shown in this paper speculate that public policies aimed at reducing vulnerability to negative weather shock experienced in early age may result into improved psychosocial health, yielding a higher human capital accumulation in rain-dependent agrarian economies.

Keywords: Psychosocial competences, Malnutrition, Early Climatic Shock, Child Health, India.
JEL classification: I14, I15, I25, Q31, Q51

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1 Introduction

In this paper, I ask whether malnutrition affects children’s non-cognitive competencies (psychosocial competencies or socio-emotional) such as; aspiration, self-efficacy and self-esteem (also known as agency or mastery) in Andhra Pradesh, India. The crucial role of malnutrition has received considerable attention in many fields. In the economic literature there is, however, little consensus concerning the impact of malnutrition on children’s non-cognitive competencies, I will henceforth refer to as psychosocial competencies. The objective is to study whether children’s malnutrition matter for their psychosocial competencies. In addition, looking closely on the concept of malnutrition to understand what are the elements that causes malnutrition and its consequences on psychosocial competencies. The concept of malnutrition is just one dimension of poverty. The contribution of this paper is to use Young Lives (throughout I refer to this survey as the YL) longitudinal panel data together with attractive source of exogenous variation on malnutrition.

The dataset used provides an accurate link between children’s accumulative malnutrition path from the time of conception until the survey baseline year 2002, when the children are the age of 8, born in year 1994. This can be compared to most other studies on malnutrition where dataset on child malnutrition is cross sectional where linking children across time is not available (see e.g.). This implies that I can rely on a relatively low level of attrition level. I, further, have access to a rich set of information on children, household and family outcomes as well as community and district level information. Moreover, I can address the issue whether child malnutrition affects psychosocial competencies differently depending on discrepancies in geographic units relying on the information on precipitation level. The challenge, however, lies in finding a credible exogenous variation in malnutrition. In recent years, many well renominated economist have taken advantage of natural experiments that are quasi-stochastic by nature to identify exogenous variation in early environmental conditions.

This paper exploit the plausibly exogenous source of variation in precipitation level to examine the

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1 In the field of psychology evidence is mainly provided through . While in sociology, the children’s psychosocial competencies are seen from the perspective of the

2 Malnutrition describes a nutritional status of an individual having a deficiency, imbalance of nutrients which results in adverse effects on body composition. The deviation from adequate and optimal nutritional input in infants and children and in adulthood is commonly referred to as being undernourished. Both malnutrition and undernutrition are commonly used synonymously, as is not the case in this paper. In addition to its deteriorate effect on such as muscle and bone, cardiovascular and respiratory, gastrointestinal, immunity and tissue repair, endocrine, reductive adaptation and re-feeding syndrom it also has physical consequences and psychosocial effects, such as apathy, depression, anxiety and self-neglect (Shetty, 2006), (Saunders et al., 2011) and (Macallan, 2005).

3 The definition of poverty is complex and multi dimensional. In this study, I will merely observe one dimension of poverty, i.e. malnutrition. Further, it is important to note that there is large complementary body of research by sociologists and development psychologists among others that is frequently cited in economic studies and often uses similar methods to study children’s psychosocial competencies. In economic term, a person is poor when she does not have enough money to purchase the food that is required for basic subsistence.

4 To briefly mention some of the events applied as exogenous variation are such as; famine (Almond, 2006), civil or armed conflicts (Tranchant et al., 2014), exposure to radioactive emission (Almond et al., 2009), ramadan fasting (Almond and Mazumder, 2011) and government intervention such as iodine supplementation (Field et al., 2009), hookworm and malaria eradication programs and extreme climatic shocks (Miguel and Kremer, 2004), have all been used to capture the causal relationship between early life condition (utero) and adulthood life outcomes.
effect of malnutrition to drought shock (in parlance a deficient rainfall) on psychosocial competencies outcomes of children in Andhra Pradesh. By applying exogenous shocks "caused by conditions outside the control of the mother" (Janet Currier 2009) to provide compelling observational evidence on the general importance of prenatal development, which can impact both subsequent health capital and skill formation (Flavio Cunha and James Heckman 2007). Consequently, the exogenous variation story, in this paper lies in the endogenous variable; children’s malnutrition which potentially can have an impact on child outcomes via two independent channels, namely, $i$) malnutrition could potentially have a direct effect on the outcomes of psychosocial competencies and $ii$) malnutrition could affect xx which in turn could affect children’s psychosocial outcomes. To begin with, I employ a subjective and objective drought measurement to instrument malnutrition to capture the casual impact. As a second step, I do several robustness checks where I use occurrence level of precipitation from the time when the child was born in year 1994 until wave 2 of YL dataset, year 2006, that is I restrict the sample population to those children who are present across wave I and II in the (YL) dataset and analyse the outcome for the gender differences separately. I then argue that drought is as good as randomly assigned (quasi-experimental) given the geographical location of the child. Further, I also check for in the year before birth, so called in utero exposure to drought and in the year of birth along with three interaction terms; gender, total shock and yearly exposure until children reach age of 8. To illuminate and clarify the quasi-experimental argument of how drought can be associated with malnutrition, and consequently children’s psychosocial competencies, I lay out a simplified story.

In India despite the fruitful economic growth, the rural households and children are left behind. The overall well-being of the children is largely being neglected or said it differently, it rest unresolved. There are reasons to believe why this rest unresolved. Because of this imbalance, rural households still relies largely on autarki, they are exposed to extremely high levels of income risk that not even risk coping mechanisms can eliminate (Dercon 2002; Townsend 1995). Consequently, they face substantial fluctuations in their purchasing power over real goods and services as well as shocks to the disease environment, during children’s crucial years of human capital accumulation. There are two main types of shocks that can affect children in the first years of life and in utero which can have consequences for their acquisition of psychosocial skills in later years, income and disease shocks. This implies, households existing on agricultural production are much more vulnerable to climatic shocks relative to other households and level of income is in higher degree volatile due to erratic monsoon rainfall since agriculture is predominately rain-fed in India. In recent years, droughts and other climatic shock has been a common phenomena in India. The dependency condition on rainfall makes the rural households to become much

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5 The subjectivity and objectivity defines how individuals in this paper, household’s are perceived

6 There is large variation of how a households in rural communities acquire purchasing power. The most common way is still labor earnings, home production and wealth of all kinds.
more vulnerable indicating a negative rainfall in a given year will response to an income shock resulting into reduction in agricultural production as well as food insecurity which in turn may affect the maternal and fetal nutrition.\footnote{There is ample evidence from developing countries that validates that household income have a large impact on the nutritional input on children, see \cite{1}, \cite{2}, \cite{3}. First, the climatic shocks, along with price shocks and parental employment shocks, could lead to unexpected negative income shocks, which will reduce children’s food consumption (and thus reduce child growth) in utero and in early childhood, and may also reduce parental time and the quality of that time due to increases in parental working hours and reductions on parental health. Second, climatic shocks and environmental fluctuations could also worsen the disease environment through increased water contamination or vector borne illnesses, which could directly impair child’s health and thus slow their physical and neurological development. Noteworthy, the nutritional status is associated beyond only food availability, other various contributors are equally important such as diet quality, sanitation, water supplies, breastfeeding practices and treatment of childhood diarrhoea, vaccination and vitamin A supplementation. In a broader context, children’s nutrition is both cause and consequence of health conditions, household income and living standards.} In YL dataset, households are in larger extent living in rural area. As a result, households living in districts where climatic shocks are likely to occur such as heavily rain fall or drought are more prone to be adversely affected. At present, the consequences of climatic shock in diverse fields are discussed at different scientific forums \cite{4} where the main objective is to decrease the number of adverse incidents in the livelihoods.

Psychosocial competencies are receiving increasing attention in the study of child inequality and poverty in developing economies. The emerging consensus in children’s psychosocial competencies are still on search for understanding the channels through which malnutrition affect the children’s psychosocial competencies. Today, one of the elements on the agenda, is to invest in early lives of disadvantaged children and their psychosocial competencies which will promote adequately social mobility. The demand for understanding the psychosocial behavior aspect of human capital was born in the work by \cite{5} who emphasized the crucial role to augment the human capital formation with psychosocial competencies. All of the mentioned elements make child health important to comprehend not only due to future prospects in terms of learning skills, well-being and labour market outcome but because one need to end the poor child health in order to break the cycle of poverty. When a child face difficulties already in early state, beyond household budget constraint such as insufficient of quality time spent by parents with their children and the parenting resources allocated into early child development \cite{6}. Consequently, from an economic perspective children have a crucial role as assets and to become economic productive individuals to contribute to economic well-being. Thus, children have a key role in formation of human capital accumulation. The human capital production function gives us tools to analyse the basic needs, in terms of resources a household should posses to be able to produce qualitative health outcome. Health is a stock variable which cumulates over the first period of the life cycle. Looking from the economic perspective, health is not purely an investment objective, instead it is maximizing the individuals potential over the life cycle. Therefore, when a child is not given the proper amount of nutrition and care needed, the development can be damaged in early stage of

\footnote{For more reference in this topic see e.g.}
their life by neglected or inadequate health, translating into lower attainment and weaker achievement across the development trajectories. As a result, the first stage of a life are widely recognised as a crucial period for human development in which negative experiences and/or deprivation, particularly in regards to nutrition input can have long term adverse consequences.

This paper adds to a large literature that has evaluated how early shocks to nutritional availability or health, induced by adverse climatic or political events, can affect health and economic outcomes in both childhood and adulthood. Particularly closely related paper is the work of Dercona and Sanchez (2013), who demonstrate the direct association of malnutrition on psychosocial competencies. However, another paper which employs similar method show that adverse climatic shocks in early childhood lead to worse economic outcomes for adults in Indonesia (). A third paper, analysis how children’s cognitive abilities are affected by climatic shocks in the YL context.

At a conceptual level, child poverty is in both absolute and relative terms omnipresent where malnutrition is just one dimension of the multidimensional perspective of child poverty. This is mainly because it has long been established that poverty in itself poses a major threat to children’s survival and physical health, especially in early childhood. This can be prevented by improved services and awareness within households. Among many research papers (), () and () show that improvement in health services and awareness of health impact has led to significant reductions in infant and child mortality and morbidity in many parts of the world in recent decades. Theses studies have had a wide audience in the policy community. Nevertheless, poverty remains an important cause and consequence of poor health in many population, creating a vicious cycle that many poor households find difficult if not impossible to break. Poor children are more prone to the effects of illness, diseases and malnutrition. In addition poor children have a higher risk of injury due to their insecure work and living environments.

This paper unfolds in the following way. Section 2 reviews recent evidence from economics and psychology that documents the importance of psychosocial competencies. Thus, in the next section, I place this study in the context of previous literature. This is followed by section 3, which sets out the analytical framework, followed by description of data employed. After describing the data available to me, I consider attrition bias in the sample, the endogeneity of malnutrition and lay out explicitly the causal mechanism. Having satisfactorily addressed these concerns, I present the paper’s core empirical findings in section 5. While section 6 presents robustness checks. A final section summarizes the findings and provides recommendations for future research. Before proceeding, a few comments are needed on the scope of the paper. First, it does not address the issue of long term effect of psychosocial competencies of children on the labor market. Instead, this study attempt to offer some suggestive evidence on the casual effect of malnutrition on children’s psychosocial competencies, with the caveat begin a small study
in a very specific socioeconomic context in India. Nonetheless, my results does reveal that (write one sentence evidence). Supplementary results are gathered in an online appendix.
2 Background on Children’s Psychosocial Competencies and Malnutrition

The Determinants of Psychosocial Competencies and Child Health

During the past decade we have experienced ground breaking evidence on how to demolish low prevalence of child health in developing economies, where malnutrition has been the main focus in children’s health. Social scientist are in accordance with the complexity of determinants of child health and it’s impact on economic outcomes. Noticeable from the past is that we have experienced large improvement rate in children’s overall health, mainly the large drop in child mortality and morbidity. In the educational psychology literature it is common to quantify the process in which psychosocial skills contributes to cognitive development. Whereas, in the recent evidence from economic literature documents the importance of multiple abilities in explaining a diverse array of economic outcomes and in determining socioeconomic success. The theoretical modelling of human capital formation captures well determinants of child health. I will here discuss what is suggested in the child health literature. There are at least four mechanisms that affect child health which ultimately have an impact on children’s psychosocial competencies. I will hereto briefly discuss the four aspects.

The first aspect concerns how parental schooling influences the child health. It is well documented in the literature that discrepancies between educated and non-educated households in developing economies show large effect on health. Among the earliest and most influential works by (Grossman, 1972), shows that education is an important determinant of health disparities. Given the evidence that schooling remains important instrument for the households decision making, which considerably influence parental value and cognitive skills. These elements affects their ability to acquire and understand health knowledge which affect the overall household health, nutritional and food inputs. The educational link is quite explicit and crucial to understand since, many of the decision making process in health are still made in higher proportion by women. Hitherto, only focus on the cognitive aspect of parental education has been on debate, however, the recent literature in economics show the importance of personality traits and cognition in affecting educational choices. Hence, parental value and what they aspire to their children, have

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9 Until today, research has mainly focused on the cognitive aspect of childhood such as test score and mother’s investment behaviour during pre and postnatal care.

10 A child at time \( t \) is characterized by a vector of capabilities or skills, as the following equation illustrates;

\[ \theta_t = [\theta^C_t, \theta^N_t, \theta^H_t] \]

where \( \theta^C_t \) is a vector of cognitive abilities (e.g IQ) at age \( t \), \( \theta^N_t \) is a vector of noncognitive abilities at age \( t \) (e.g., patience, self-control, temperament, risk aversion and neuroticism) and \( \theta^H_t \) is a vector of health shocks for mental and physical health at age \( t \).  

11 An excellent overview by (Glewwe, 2002) debate the essential aspect of educational input in developing economies.

12 For more references see; (Grossman, 1976), (Grossman, 1977) and Grossman (2003).
considerable influence on child health and how children perceive their future economic pay-off. *Second* aspect study the local health environment which influences child health through household health and nutritional inputs. The general definition of local health environment includes all community characteristics that have direct affects on the health of child, such as access to schools, hospitals and sanitation such as access to clean water and latrines. These factors are exogenous to households, nevertheless, the last two factors have large adverse impact on overall health. In India, despite the fruitful economic growth with emerging of middle income class, access to clean water and open defecation is still the main cause of negative healthy externalities, particularly in remote, rural area. The *third* aspect that influence child health is household asset which directly has an impact on household income which affect child health. A household with high household income is more able to make rational decisions and seek better information. The asset or wealth is further an indicator of households purchasing power. In this paper, I have constructed wealth index which act as a measurement for household income disparity in Andhra Pradesh. Finally, the *fourth* aspect looks at the child health endowments consisting of all components of the child’s genetic inheritance that may have implications for the health outcome(s). ([Currie, 2011](#)) documents the health at conception and birth and its impact on child outcome beyond the outdated distinction between "nature and nurture". The author review systematically the most crucial aspect of health at birth, one main point stands out; in order to ameliorate children’s health, mothers cannot be left out in the policy decision making. The endowments at birth and genes are another factors that are crucial. In economic literature, child health is measured by height or weight. Height is in fact an important predictor of future outcomes, it is also strongly heritable, implying that the height of children tends to resemble the height of their parents. Nevertheless, a child that has experienced a deprivation can still catch up the height curve by improving the health and nutritional conditions. The height of a child measures the accumulative experience since birth, thus it captures an early childhood experience of deprivation. Despite rather negative proliferation given here above, recent research give evidence on what mothers can do and how families can be supplemented to improve the outcomes of their children. These four mechanism are well documented, yet they still remain as a puzzle and act largely as an explanatory factor for many of the health outcomes. More recent review of the literature incorporate exogenous variations to capture the determinants of child health such as weather, environmental or price shocks to health. However, there are very few looking at how children’s health affect psychosocial competencies.

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13 See Appendix A for more detail.
14 ([Tarozzi and Mahajan, 2007](#), [Case and Paxson, 2008b](#), [Case and Paxson, 2008a](#), [Deaton and Arora, 2009](#), [Jayachandran and Kuziemko, 2011](#) and [Jayachandran and Pande, 2015](#)) offers more detailed overviews of elements that have been shown to influence height and weight and of policies that have been shown to be effective in catching up or ameliorating the long-term consequences of low height and low birth weight. ([Almond and Currie, 2011](#)), the fetal origins hypothesis is debated.
Why is Psychosocial Competencies important?

A related and relevant question is why psychosocial competencies are important and does it matter. i.e. in addition to cognitive skills such as the instrumental acquisition as numeracy and literacy, scientific knowledge and ability to critically thinking skills? An emerging body of research has established a parallel crucial role of non cognitive skills such as personality, social and emotional traits are important to understand how to promote successful lives. These elements of health capital are affected through choices made by the households. One of the important aspect for understanding the factors that affect the evolution of non cognitive skills is by gaining understanding of how to promote successful lives in early stage of children. Having said that, schools are in larger extend able to provide other types of skills than cognitive; social skills and internalized values that can help children navigate better in the adult world. In order to understand the dilemma between cognitive and non-cognitive competencies, whether they are mutually exclusive or inclusive, it is necessary to briefly understand the aspect of cognitive skills in the recent literature and why the need for nurturing non-cognitive skills. Firstly, the crucial role of cognitive skills are today firmly established in explaining outcomes such as test score, labor market success, decreasing participation rate in crime related activity among young adults (See e.g (Cunha et al. 2006), (Heckman 2006), (Heckman et al. 2006), (Cunha and Heckman 2008), (Currie 2001a), (Kautz et al. 2014)) (For more comprehensive understanding of cognitive research in Western economies, see references (Currie 2001b), (Cunha and Heckman 2008), (Currie 2009) and (Kautz et al. 2014)). The cognitive and non cognitive skill aspect as an augmenting effect in the human capital production function is investigated in (Cunha and Heckman 2009). The paper formulates and estimates the technology of capability formation of the evolution of children’s cognitive and non cognitive skills as determined by parental investments at different stages of the life cycle of children. The model’s main argument to create productive and successful life of children is to identify, first and foremost, the desired outcome. The impact of cognitive and non cognitive skills on the outcome, depends largely, to varying degrees on outcomes itself. Hence, the success in children’s life depends on the investment, the desired target outcome and the nature of the adversity of child’s early years. While these arguments are proven to be well established in the economic literature, it is quite tedious to prove the non-linear specifications of technology without measurement error causing econometric challenges. In (Flavio Cunha 2010), the author’s relax the assumption of linearity in technology between early and late investments in producing adult skills. Summing up, cognitive skills take quite conventional path to impart only one side of the human capital and the estimation challenges are somewhat manageable.

15 The model, which was initially developed by (Heckman 2007) and (Cunha and Heckman 2007), rationalizes a large body of evidence in economics, psychology and neuroscience.

16 The authors identifies a more general non-linear technology by extending the linearity assumption. The linearity assumption relies on perfect substitutability across time space of child health investment.
Meanwhile, in developing countries, the psychosocial skills are not well documented mainly due to data restrictions. Nevertheless, the few studies that tries to understand the impact of socio-emotional skills are albeit estimating the trivial association between outcome of interest and the influencing factors. Glewwe (2002) makes an arguably well literature review on the role of cognitive and non-cognitive skills in the context of developing economies. In comparison to Western economies, the psychosocial skills in developing economies manifest mainly through adverse shocks in early childhood such as weather or price shock on agriculture production. Despite the fact that psychosocial skills are relatively new, few of the prevalent studies shows that psychosocial skills merit a core consideration in different strands of scholarships. Psychosocial skills matters because of the simplest reason; it represent valuable capital with respect to both institutional outcomes and broader development of individuals, that is recognizing the intrinsic value of certain behavioural skills and their relevance for building cognitive skills. As mentioned above, psychosocial skills matter for their own sake, and they matter indirectly, (i.e. they correlate with other individual and societal outcomes, such as academic performance, labour productivity and earnings.)

In our society, the goal of public education should be to nurture emotional, social and democratic citizenship skills such as self-confidence, self-efficacy, self-esteem, respect for others, aspiration, ability to build consensus and willingness to tolerate alternative opinions. The natural follow up question is how to nurture the psychosocial skills? The economic literature suggest at least three mechanism by which high quality nurture might affect psychosocial competencies. The enhancing factors related to psychosocial skills are early childhood education, health, and school environment including teaching characteristics. The children’s environment such as family and contextual characteristics (social class, poverty, housing, culture among other factors) have a large impact on psychosocial skills. Fletcher and Wolfe (2016) articulate that the environmental aspect of human development is well encountered, starting from the prenatal period throughout the early childhood years. Moreover, the evidence shows that the differences in psychosocial scores can be illustrated by the role of environment. Frequently, the socioeconomic status or social class are used as the mediating variable to understand the effects of other mechanism that affect skills acquisition, whether it is parenting behaviour, access to higher level of early childhood care, parent’s level of aspiration for their child which is correlated to their own work habits and intellectual interests presented in household (Coneus et al., 2012).

17 In the early work by Marshall (1890) stated that without incorporating the aspect of psychosocial skills the true values of human productivity is not well understood. According to Marshall, the most valuable of all capital is that invested in human beings; and of that capital the most precious part is the result of the care and influence of the mother. Marshall’s conception of human capital is much more inclusive than that of contemporary formulation. He thought it was possible to build “character” and “moral” which likely resulted into uplift of the poor. Further, many societies and organizations have focused on developing personal traits that are perceived to be desirable in their children (e.g., ancient Sparta, Communist Russia and Nazi Germany).
Does Malnutrition Affect Psychosocial Competencies?

The negative association between malnutrition and psychosocial competencies has been documented in studies going back only recently. Consequently, the mechanisms that underlie this relationship are still not well understood. The existing evidence on channels linking malnutrition and psychosocial competencies comes mainly from medical research; siblings and twin studies; studies of shocks to the early-life environment, which offer the possibility of examining outcomes through the lens of natural experiments; and observational studies. Further, biological channels have also been identified as an influential factor on both malnutrition and psychosocial competencies over a broad range of the population. It is, however, unclear precisely how genetic and environmental factors interact in operating these biological channels. Evidence on the role of genetics in explaining the correlation between malnutrition and psychosocial competencies comes from a number of studies(). The gene endowments together with health at birth, mother’s health at birth as well as conception and fetal development impacts the child’s future health. Given that any of the elements have an adverse affect on child health, in terms of malnourishment which in turn will influence child’s self-esteem, level of aspiration and self-efficacy. As discussed here above, previous contribution attempts to distinguish the role of environment and socio-economic status as determinants of psychosocial competences. While more recent work tries to disentangle the gap in malnutrition. (Leight et al., 2014), analyse the impact of early childhood shocks, proxied by rainfall in poor, rural province in China, on the impact of cognitive and psychosocial skills overtime. The results are somewhat promising; likelihood to reverse the negative impact of cognitive skills on early deprivation condition (due to weather shocks) on households. Hence, there is a motivational incentive to make the necessary investments that are required for children to catch-up. However, study gives very little evidence of the association between early weather shocks on psychosocial skills at any age. While the studies by (Dercon and Singh, 2013) and (Dercona and Sanchez, 2013) applies YL survey data across four developing economies to capture an association between malnutrition and children’s psychosocial competencies, where malnutrition is measured by height-for-age and weight-for-age z-score. The study shows a positive, robust relationship, though, it is unable to show the indirect relationship that captures the channels through which malnutrition can affect psychosocial competencies. While, (Dercona and Sanchez, 2013) tries to understand the impact of nutrition on children’s level of aspiration and self-efficacy. The main contribution, is however to emphasize on the gender bias across time in the four countries studied. They find considerable heterogeneity across countries and ages, for example in India findings show some evidence on “institutionalized” gender bias against girls in education which indicates that poor psychosocial competencies could be a channel for continuing gender bias through poorer labour market outcomes. Yet, unlike the three studies just discussed, (Krishnan and Krutikova, 2013) shows
strong explanatory power on self-esteem and self-efficacy from an intervention conducted in Urban India\textsuperscript{18}. Although the result is only suggestive, it indicates that intervention has been effective in reaching out to deprived children in urban India to increase psychosocial skills. This does not necessarily imply that the intervention rewards children in ways other than increasing their skills; since the psychosocial competencies cover only some aspect of skills, other skills may be picked up by years of schooling or other institutional setting of the child. Also many of the children included in the intervention are pro-poor which certainly causes additional problems.

Child health literature in developing economies are mainly concerned about household’s access to nutrition overtime such as calorie intake or iron deficiency, implying that households are vulnerable towards adverse food or price shock. (Chong et al., 2016) investigates iron deficiency on schooling attainment and level of aspiration in Peru. The study argue that iron supplementation significantly increases students level of aspiration.

Connecting Malnutrition, Psychosocial competencies and Child Health

This paper attempt to examine the casual mechanism from psychosocial competencies of children in early childhood, at the age of 12 to malnutrition and eventually to child health. Although to my understanding there are papers that studies the aspect of malnutrition on children’s psychosocial competencies, to my knowledge this is the first one to systematically look at this questions empirically with survey data, previous work have mainly looked into part of the causal chain as discussed in the previous subsections. Several papers show empirically that in settings with high prevalence of malnourished children are found in societies with high social inequalities which is the case of India where majority of the population are not affected by the economic growth. I hope to advance this body of work by deriving a number of quite specific testable predictions in the relationship between malnutrition and psychosocial competencies hypothesis and then using them to empirically separate the causal chain that I suggest from the alternative hypotheses.

\textsuperscript{18} The intervention is called \textit{The Akansha intervention}, implemented by a NGO which goes under the same name as the intervention, active in Bombay, India. It has been active the past 18 years with objective of raising awareness and improve psychosocial competencies among disadvantaged children. The program includes 10 level, taught daily for three hours after school. The first 7 levels are to give children tools to build up solid psychosocial skills, while the last 3 levels are mainly devoted to prepare for a job and build up life skills.
3 Conceptual Framework

3.1 Motivating Theory

Theoretically there are two broad reasons why drought on malnutrition may affect children’s psychosocial competencies. In this section, I briefly discuss them. The underlying economic framework rest on (Grossman [1972]), (Grossman [2003]) and (Maccini and Yang [2009]). The link between malnutrition and psychosocial competencies are still in its infancy. Although, it is the cognitive competencies that has mainly been investigated in the literature, and only quite recently have focused turned to augment human capital with psychosocial competencies. Let us start from a simplistic health production function, pioneered by Grossman where $H_t$ is a function of an initial health endowment $H_0$, vector of health inputs $I_1...I_t$, time-invariant demographic characteristics $X$ such as age, birth order, gender, caste belonging, caregivers level of education, socio-economic status, and community characteristics such as availability and access to village infrastructures $V_0,...V_t$ as well as the disease environments $D_0,...D_t$.

$$H_t = h(H_0, I_1,...I_t,...,X,V_0,...V_t; D_0,...D_t) \quad (1)$$

Looking at the first component, the initial health endowment $H_0$ which tells us the story about the intrauterine environment. According to Baker’s fetal origin hypothesis, one’s health conditions in adult life can be traced back to the changes in conditions during the time of conception and during pregnancy. Consequently, this assumption requires a modification in equation 1 by augmenting $H_{t-1}$. Now, equation 2 set out the relationship between in utero conditions and childhood health status accordingly:

$$H_t = h(H_{t-1}, H_0, I_1,...I_t,...,X,V_0,...V_t; D_0,...D_t) \quad (2)$$

where $H_{t-1}$ captures the in utero conditions. The $H_{t-1}$ has two channels through which its impact can be traced on to $H_t$: the direct impact on $H_t$ but it can also affect the current health status indirectly, namely through the initial health conditions $H_0$. Adverse impact in utero conditions may affect birth weight of children or other health conditions at birth, as well as genetic components $G$ might play a crucial role in determining $H_0$. Furthermore, environmental circumstances $E_0$ such as village infrastructures $V_0$ and diseases environments $D_0$ can also play a role on $H_t$. Therefore the initial health endowment $H_0$ will depend on the following elements:

19 Evidently, previous literature in this subject is large, yet, how psychosocial competencies is affected by climatic shock is still narrow, hence, increasing understanding is crucial to disentangle the economic consequences of climate change. In addition, we have still very few evidence on which policies that best reduces the effects of climate change in relation to health.

20 Traditionally, health aspect of micro level changes such as school outcomes of children where contemporary society places great value on standardized achievement tests to shift and sort people, to evaluate schools and to assess the performance of nations to associate to economic growth.
\[ H_0 = k(H_{t-1}(E_{t-1}), G, E_0, V_0, D_0) \] (3)

Now that I have set up the channels that affect current health status with help of equations \([1](#) to [3](#)\), let me now establish a full conceptual framework where the aspect of climate change is incorporated in a systematic way. I start by argue that early life experience of weather shocks can affect the current health status \(H_t\) through \(H_{t-1}\) and \(H_0\). The essence of these testable predictions can be captured by two distinct mechanisms. Firstly, through income and food price effects and secondly via disease environment in the community where the households reside. Before, I start look into the intricate links between these, it should be apparent that small cultivators and workers comprise a significant proportion of the poor in developing countries. That being said, India is not an exception, its rural population is still mainly living out of agriculture and self-supporting households are still common across India.

Let me commence with the first claim, the income and food price channel, as known agriculture production requires water supply whereas India relies mostly on rain-fed water supply. This implies that erratic or deficient rainfall will have a negative impact on rural livelihoods due to crop failure and the agriculture income is derived from crop sales. Clearly, an increase in agricultural productivity directly increases the household income of small cultivators. Therefore, when households experience crop failure, the income declines which creates a vicious circle that affect the maternal and fetal nutrition through reduced household purchasing power. Moreover, consumption is also affected by rising food prices because crop failure will also induce a higher food prices as there will be food shortage due to harvest failure which results into negative income effect. In addition, credit constraints limit household’s ability to smooth consumption over time, making health vulnerable to economic shocks. The second claim concerns the potential impact that the disease environment \((D)\) in communities have on child nutrition and health. Despite the evidence of negative correlation between health of child and the disease environment, the evidence of drought on disease environment is ambiguous. A drought shock can be both a negative and a positive effect where a negative effect exist when household’s availability and quality of drinking water is adversely affected. In this situation, households are without any power to prevent or ameliorate the child’s health. While the positive effect appears from the reduction of water-borne diseases \([21](#)\). Thereof, drought shock will have a negative impact on nutritional status through the disease channel. There is an intimate connection between these two effects, on one hand the combined impact of negative income effect and negative disease effect due to drought on child health is unambiguous, while the impact resulting from the interaction of negative income effect and positive disease effect will have on health outcomes.

\[ \text{On the contrary an excess rainfall will lead to diarrheal diseases but also vector-born diseases such as malaria and dengue.} \]

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is not solid. Nevertheless, there is evidence suggesting that income effect on health dominate the disease
effect during drought shocks. This is the essential argument underpinning the belief that drought shocks
can have a negative impact on children’s psychosocial competencies through its effect of child health.
4 Data and Descriptive Evidence

The paper uses the best available longitudinal data of children living in low income countries. This enable me to investigate the psychosocial competencies of young children by exploiting a negative exogenous climatic shock on child nutrition in Andhra Pradesh, India. Using the longitudinal data, I look at the effects of weather shocks in terms of droughts on nutrition and its response on young children’s psychosocial outcome. The Young Lives longitudinal panel data of children and households is the main dataset employed to draw estimation and results. In addition, I use of precipitation level data from the Global Climate Database of University of Delaware (UDEL) [Willmott and Matsuura 2012] to check numerous specifications and robustness tests. The following subsections describe the data employed in detail and provide some descriptive statistics of the sample and the study area to easily comprehend the mechanism that I intend to show in the following sections.

4.1 Data overview - Young Lives Study

My analysis is based on Young Lives study, a national cohort panel study on poverty and child well-being conducted in Ethiopia, India (Andra Pradesh), Peru and Vietnam. In the younger cohort, YL follows 2,000 children in each country from age 6-17.9 month until they are 15 years old and in the older cohort, YL follows 1,000 children in each country from age 15 year until they have reached their early adulthood of 22 years of age where they might even have their own family. The caregiver (often the biological parents of the child) and when the child is old enough, both the caregiver and the child are interviewed every three to four years with a quantitative survey. In my analysis, I employ only samples on the older cohort from the first two waves. The first wave I was conducted in year 2002 at age of 8 years and the subsequent wave II followed year 2006/07 at about age 12. The YL is a cohort study of large scale household survey of all children and their primary caregiver, interspersed with more in-depth interviews, group work and case studies with a sub-sample of the children, and their peers, their caregivers, teachers and community representatives. The YL gives rich wealth of information, not only the households material and social circumstances, but also their perspectives on their lives and their aspirations for the future. The YL survey adopts a so called sentinel site surveillance system. It consists of a multi-stage, purposive and random sampling to select the two cohorts of children. This methodology randomised households within a study site while the sites themselves were chosen on the basis of predetermined criteria. To ensure the sustainability of the study, and for resurveying purposes, a number of well-defined sites were

\[22\] The sample size for the older cohort is 50 percent smaller than the younger cohort, however, this will not cause any statistical problem for the estimation procedure.

\[23\] The third wave was collected in year 2009, the fourth wave was collected year 2013 when then YL children were about 19 year of age. The raw data of the fourth wave of YL was released end of April 2016. The fifth, last round of YL is currently in process of collecting the data. The YL study also followed an younger cohort of children initially surveyed at age of 6-12 months in 2002 and followed through the 2008/07, 2009/10 and 2015/16 rounds of the panel study.
chosen. The survey is divided into three sections: a child questionnaire, a household questionnaire and a community questionnaire which are to be completed for each sentinel site at every data collection round.

The children and their households are enrolled in the sample during a total period of 15 years through a two-stage process. In each country, 20 sentinel sites are chosen, within each sentinel site, approximately 100 children aged 6-17.9 months and 50 children aged 7.5 years and their households will be randomly selected through the enrolment procedure. The enrolment visit is the first visit by the field research assistant (FRA) to the households and the form is designed to find whether there is an eligible child in the household and to identify the primary caregiver of the child which is usually the child’s mother. The household questionnaire includes elements of location information, household composition, pregnancy, delivery and breastfeeding, child care, child health, caregivers background, caregivers psychosocial well-being, livelihoods and time allocation, economic changes, socio-economic status, social capital, tracking details and anthropometry. The community questionnaire, unlike the child or the household survey is intended to act as a cross-validation of information between multiple qualified informants to get the most accurate information about the characteristics of the environment in which the children live. This implies that the community level survey do not reflect the opinion of inhabitants but tries to collect and corroborate the information collected. Therefore, a selection of informants with key position in the community were interviewed. These key informants was municipal/commune leaders, government officials, village headmen, child health nurses, headmasters, leaders of women’s groups and religious leaders. Thus, the community level data only gives relevant variables to understand the context of living environment of YL household and children.

As described thoroughly in this section, it is understandable that YL is uniquely positioned to contribute a strong understanding of contemporary child inequalities and their impact on children’s lives. The longitudinal dataset gives opportunity to follow the same child’s key moments during their childhood. Thus, it is a powerful dataset which allows me to track changes over the life course, as well as looking for causes and consequences of events or circumstances. In addition, dynamic relationships and possibilities to elicit heterogeneity among the subjects adds to the large benefits of working with panel

24 Special trainees were responsible for collection of anthropometry so called anthropometrics for measuring length and weight of the index child. I use of the World Health Organizations definition for constructing the measures of weight-for-age and height-for-age z-score standard deviation. The z-score measurement is among the most used to measure child health in empirical works. For more detail about the measurement see Appendix B.2

25 The community level survey collects informations in the following areas: general characteristics of the locality, social environment, access to services, economy, local prices and access to services relevant for children such as educational and health services. Overall, the specific areas are the same across waves, but can deviate for certain waves in some of the areas.

26 Charles Dickinson (May 30, 1780-1806) novel Oliver Twist in which the author, in a brilliant way illustrates the children’s position in the society, the value and emotional struggle the young children undergo and their venue into the future life is nearly predetermined by birth. In the same perspective as Dickinson, the YL dataset is making it possible to quantifying the children’s value, hence, adding value to the policy research forums. In a color full way the children’s lives and their well-being in the 21st century can be illustrated.
data since dynamic relationship can only be studied with repeated observations, consequently, one has to think carefully about how to define the subjects. Likewise, the main concern with panel data is the level of attrition, fortunately, the YL dataset has circumvented the problem of attrition level\textsuperscript{27}. In order to test my hypothesis I will mainly need to study the older cohort. Therefore, to conduct my analysis I have merged all three questionnaires of the first two waves into one dataset so that I follow every child from the start of the baseline year 2002 until the second wave when the children are at the age of 12 years old, year 2006. Thus, all children and their household characteristics as well as the community in which they live are accurately captured in the final dataset merged with the dataset on level of precipitation.

### 4.2 Sample descriptives

Table 6 provides summary statistics for the sample showing data on basic child characteristics, as well as parental and socioeconomic characteristics. In child characteristics, I have included gender, age\textsuperscript{28} (in completed months), first language, cast belonging and religion. Since, all of the mentioned characteristics are time-invariant variables, they are taken as fixed as from wave I in the survey, exception of, child’s first language was collected from wave II. Therefore, most missing values in this variable are explained by level of attrition. Further, the household and community characteristics are included to capture the children’s environmental context.

**Child malnutrition** Beside the child characteristics, I have child health and nutritional variables consisting of anthropometric information\textsuperscript{29} and constructed measures for malnutrition. The key variable of interest is anthropometric information which includes z-scores\textsuperscript{30} for WAZ and HAZ which indicates whether children inhibit chronic malnutrition. These two measurements are the most common to employ to illustrate child health status in low income countries. In most empirical works, evidence of child health is referred to use the WHO reference table in order to make appropriate comparisons across children’s health. A z-score of 0 is the median in the reference population. While, a z-score of -1 indicates that the child is 1 standard deviation below the reference-population median for his or her gender and age. If a child has a z-score of -2, it is considered to have long-term health problem, called stunted\textsuperscript{31}.

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\textsuperscript{27} In YL, the level of attrition is relatively low due to efforts made by FRA’s when the YL program was implemented. The field worker were told to give solid background information about the YL study to all participants concerning the importance of remaining in the study throughout all 15 years.

\textsuperscript{28} Age in months is estimated by taking age of the child in days, that is, date of interview minus date of birth and dividing this number by 365/12, the number of days per month. The final number is rounded up to one decimal point.

\textsuperscript{29} The validity of anthropometric reference is debatable, nevertheless, until today there are no alternative measurements which describes more accurately early childhood growth in low income countries. The mentioned measurements are well established in the field of epidemiology and became to be recognized in economics late 1980’s.

\textsuperscript{30} The z-scores were estimated using WHO reference table. For each combination of gender and age in months, the WHO provides the distribution of these measures for a reference population of children from Brazil, Ghana, India, Norway, Oman and the United States without health or environmental constraints to growth and who were given recommended nutrition and health inputs (WHO Multi centre Growth Reference Study Group, 2006).

\textsuperscript{31} Stunting is the definition of long-term health status of the child. A child with z-score of $< -2$ SD of HAZ is stunted and severe stunting $< -3$ SD.
wasted and underweight is the short-term health status measured by WAZ [32]. Stunted and wasted are terminology used by epidemiologist to capture health status of a child. Since HAZ yields long-term and WAZ yields short-term health status of the child, I am able to observe the cumulative nutritional impact of the child. This reveals child’s historical nutritional input path overtime. The average HAZ for Andhra Pradesh is -1.541 and average WAZ is -1.975, indicating that children in Andhra Pradesh experience nutritional deficiency both in short and long term. The average height is 140.64 cm while average weight is 32 kg [33]. Since health is a stock variable i.e. cumulative variable, naturally it implies that the WAZ is a short term measure giving information about children’s wasting status. While HAZ is the long term health status consequently it can easily trace the children’s past nutritional intake. The longitudinal set up gives me an opportunity to predict children’s past health environment much narrowly. In my estimation (see 4), I include HAZ and WAZ from wave I when children are at the age of 7 to 8. Figure illustrates histograms with corresponding raw scores for short and long term malnutrition. It confirms previous evidence that on average Indian children are wasted and stunted [34].

Measurements of psychosocial competencies I follow similar structures as Dercona and Sanchez [2013] and Dercona and Krishnan [2009] to construct indicators to approximate children’s psychosocial competencies. The three dimensions studied is this paper are survey-based indicators of self-efficacy, self-esteem and (educational) aspiration acting as a proxy for upward mobility. Table 1 show the statements and corresponding raw average scores used to construct each of the outcome indicators. For the analysis, I have based on what children answered to the statements, created individual average scores on self-efficacy and self-esteem, see Table 2 for an overview. The average scores relies upon the degree of agreement for each of the statements, measured on a 4-point Likert scale that ranges from strong agreement to strong disagreement. The average educational aspiration is 13 which corresponds to post-secondary level studies. The histograms over psychosocial competencies are standardized to have mean 0 and variance 1 in each of the personality traits. The concepts of self-efficacy and self-esteem has extensively been studied in psychology, less in economic field. [35] Self-esteem is considered to reveal an individual’s overall evaluation of her own worth. While, self-efficacy on the other hand, is correlated to an individual’s sense of agency or ability to conduct her own life. In psychology, this is related to how

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32 Wasting is when child has <-2 SD and severe underweight <- 3 SD.
33 Following references emphasize in what degree Indian children are lacking behind in nutritional development (), () , (). To get a sense for discrepancy in weight and height, on average a child in Europe, at the same age 7 to 8 is taller (xxx) and heavier (xxx)
34 I elaborate with WAZ in my estimations to study whether the short-term health is also affected by drought.
35 In the field of psychology, it is stated that both self-efficacy and self-esteem are important indicators for child foundation. It is crucial to master your own self in order to fully become a well oriented citizen. For example according to [Alsaker and Kroger 2008], the concept of self-esteem refers to how one evaluates oneself, including the degree of self-worth one holds in a given context. [Bandura 1993] describes that low level of self-efficacy can produce depression and anxiety. This holds from the fact that individual are partly product of their environment. Therefore, belief on one’s self-efficacy have power to shape the course of children’s lives through influencing choices of activities and environment. These concepts broadly captures the development trajectory during adolescent life.
individuals perceive their effort, whether the achievements are purely luck or intervention of others. The last psychosocial measurement is aspiration which capture individual’s endeavour to a goal. Contrary to (Dercona and Sanchez, 2013), I treat this variable as upward mobility which generates a better understanding to the context this paper is aiming to cover. (Chong et al., 2016) provides evidence that improvements in health can lead to improvements in aspiration for future mobility. Thus, if health affect level of aspiration, then a malnourished child will evidently have a lower upward mobility. Therefore, how profound the mechanism of children’s capacity to form and set goals for the future is, largely influenced by the level of poverty. Indeed, increasing number of studies in developing country incorporate psychological elements such as level of hope for escaping poverty and happiness of children. As claimed in previous section, malnutrition is only of dimension of the poverty. Consequently, positive psychological attributes on different socioeconomic outcomes are crucial to understand child aspiration because its plays an important role in their human capital investment decisions. In YL sample, level of aspiration is captured by asking children what level of education she/he intend to achieve. The answer corresponds to years of education, i.e. the highest grade of education that the child hopes to complete (Glewwe et al., 2017).

The two bar charts illustrate, how many percent of the households and communities that experienced drought during the past four years. Households seem to have reported fewer occurrences of drought than what community level key people acknowledged. This indicates that individual households and community level define drought differently. Approximately 68 percent reported that drought was one of the most important events in the last four years and 38 percent stated that drought had an impact on the YL child. According to the subjective drought, 44 percent of the reported drought affected the household under interrogation and some other households in the village. About 30 percent responded that drought affected all households in the village. Thus, there is a discrepancy in how people perceive weather shocks. At the community level, the local authority asked the government of help, mostly they received money but it was far from being enough.

**Coping strategy** The coping strategy refers to climatic shock variable. I want to observe the nature of household’s mechanism to cope with drought.

**Sever illness** This variable indicates whether the mother have been severe ill in the last four years?

### 4.3 Climatic Shocks and Instruments for Child Malnutrition

In addition to childhood and household variables, the individual questionnaire also provides with range of negative economic, physical and social events that might have affected household members in the last four years, between wave I and wave II. I use of drought events occurred in communities where children
lives. The self-reported drought events were collected both at household and community level for each YL child. The response from both parties are denoted as subjective and objective drought measurement, respectively. Although the shocks can be multiple, I have mainly focused on drought in Andhra Pradesh in order to capture the consequences of drought on households well-being, as it is part of my hypothesis. The main advantage of having both subjective and objective measurement for drought is the question of validation. Further, among all types of natural disaster, drought is the most reported across households and communities.

The second main data source is weather data and relies on the Global Climate (GC) database which combines a series of gridded temperature and precipitation dataset. The data is expressed in gridded monthly time series for year between 1970-2007. The GC database provides a relatively detailed global land surface temperature climatology with high spatial resolution than other comparable datasets. The data is expressed in monthly standard deviations from the historical mean at a 0.5 arc degree level, corresponding to an area equal to 52 km$^2$. The GC database follow the YL data, i.e the study period wave I and wave II. The data points covers each of the six districts in the three regional Andhra Pradesh and state capital Hyderabad. The district precipitation level amount is recorded monthly where precipitation refers to the amount of rain in millilitre per acre. I create a drought measure to verify the self-reported drought shock from households (subjective) and community level (objective) from YL data. I calculate the long term average value using the monthly rainfall data from 1970-2007 for each districts.

Based on this definition, a year will be defined as a drought year if the long term average rainfall is less than the average rainfall between year 2002-2006, such as the following set up:

$$\sum_{i=1970}^{2007} \sum_{j=1}^{12} Y_{ij} < \frac{\sum_{i=2002}^{2006} \sum_{j=1}^{12} Y_{ij}}{4}$$

In addition, I extract in three various way drought shock measurements which I intend to incorporate as robustness validity checks. The first measurement for drought, follows the definition of a drought year as a year in which monsoon rainfall, the rain between months June-September, falls below 75% of it’s long-term average value according to Indian Meteorological Department. The long-term average value is calculated using the monthly rainfall data from 1970-2007 for each districts. Based on this definition, I define a year as a "drought year" if the monsoon rainfall is less than 75% of the district’s long-term average rainfall. In equation $??$, the drought year ($D$) is a dummy variable equal to 1 if rainfall is less than 75%, and 0 otherwise. This can be denoted as follows:

$$\sum_{i=1970}^{2007} \sum_{j=6}^{9} < 0.75 \cdot \frac{\sum_{i=1970}^{2007} \sum_{j=1}^{9} Y_{ij}}{48}$$

In Wave II - the subjective measurement was extracted from the question that was posed to the households across districts in Andhra Pradesh. The question is the following: Have you experienced drought in the last four years? This question implies whether households experienced drought since wave I in year 2002. At the community level, the objective drought measurement was extracted in the same way as the subjective drought measurement. The question posed is: in the last four years, has any natural disaster happened in this locality? Following options were given; volcanic eruption, cyclone/tornado/hurricane, drought, avalanche/mud slide, earthquake.

The village level data points are not available for reasons of confidentiality of young lives children.
Further, I extend the monsoon rainfall as explained here above with monsoon rainfall that deviates at least one standard deviation from the district’s long-term Parthasarathy et al. (1994). Lastly, I define a drought shock when monsoon rainfall falls below the 20th percentile of the districts’ historical monsoon rainfall Shah and Steinberg (2013). Notwithstanding, in my analysis I use of yearly level of shocks and interaction terms. The climatic shocks are built in a logical sequence. For illustration study the timeline in figure 6. The utero shock is when child is still a fetus, 0-11 months, this is to capture nutritional impact through mother as well as prenatal care. I construct shock variable for every year starting from utero shocks, after birth months 12-24 (year 1 shock) and so on. The purpose of have yearly shocks injected into the model is to control for the yearly shock and to study whether the shocks that occurred in time $t - 1$ is more damaging than shocks that occurred in early childhood $t$ period. This reasoning will certainly lead me to capture the equation promptly. Moreover, I interact total shock and gender variables. The total shock variable captures the children’s critical period, that is before age two of the infant and measures the early shock exposed to the children. While the gender variable is interacted with total shock which is intended to show whether girls are disproportionately vulnerable to early childhood shocks.
5 Empirical Framework

My goal is to investigate whether prevalence of child inequality in psychosocial competencies is determined by nutritional inputs, I intend to study how children’s psychosocial competencies is affected by malnutrition in different geographical units experiencing climatic shock across Andhra Pradesh. I combine the panel data on child anthropometrics, psychosocial competencies and other socioeconomic variables provided by the YL dataset with the rainfall dataset. This will enable me to estimate the effect of malnutrition on children’s psychosocial competencies. The analysis is divided in two steps which makes the identification strategy clean. I will start by illustrating a simple intuition behind the direct effect of malnutrition and drought on psychosocial competencies. This will eventually provide me with a useful set of benchmark estimates that I will use to compare with the impact of the interaction between malnutrition and drought and between severe illness and drought. Hence, the main hypotheses that this paper provides is to test whether there is a mechanism linking child malnutrition to psychosocial competencies. In this line, my aim is to comprehend in depth and capture the indirect effect of malnutrition by instrumenting drought with malnutrition in Andhra Pradesh. I argue that, in communities with high prevalence of rainfall will experience adversely by a climatic shock. Consequently, children in those districts are more likely to experience shortage or lack of nutritional input for a certain period. This claim is observed in the accumulative malnutrition measurements. Consequently, as the HAZ captures child’s past nutritional input production function, the impact of indirect effect will be captured by this channel.

5.1 Direct effect of malnutrition and drought on children’s psychosocial competencies

The structural equation that I wish to estimate is as follows:

\[
PSY_{ihd,t} = \beta_1 \text{Malnutrition}_{ihd,t-1} + \beta_2 I_{hd} + \beta_3 X_{ihd,t} + \epsilon_{ihd,t} \tag{4}
\]

where \(PSY_{ihd,t}\) is the outcome variable, psychosocial competencies of child \(i\), in household \(h\), in district \(d\) at time \(t\). \(\text{Malnutrition}_{ihd,t}\) is the HAZ and WAZ of all children included in the sample. \(I_{hd}\) is binary variable indicating 1 if the mother in household \(h\) in district \(d\) have had severe illness in the last four years before the survey round 1, in year 2002, 0 otherwise. Severe illness is an idiosyncratic household shock and one of the most common shock experienced by households in developing countries. In fact, there is a valid reason to believe that the relationship between severe illness and drought is expected to be positive. First and foremost, it is expected that severe illness have an adverse impact
on household resources by exacerbating their material poverty, assets and weakening their bargaining position. Secondly, the drought amplifies the illness even further by its impact on the household well-being such as physical and moral resources of the households. Thus, both shocks create an insecurity and a simultaneous vulnerability on households health status. This, implies that non-inclusion of the variable would probably give me an overestimation of the effect of drought which is not desirable if it can be avoided. \( \beta_3 X_{ihd,t} \) is a vector of relevant child, household and district levels characteristics which are considered to be predetermined in the model and \( \epsilon_{ihd,t} \) is an i.i.d error term.

The theoretical literature on this subject predicts that \( \beta_1 > 0 \), which signals whether children are malnourished in wave I, hence signed to have lower psychosocial competencies relative their peers. As established in previous section, drought have a cumulative effect on both child nutritional input and on the outcome variables. The assumption behind this model is that I am identifying the effect of malnutrition conditional on observable individual and household controls from wave I when children are 8 years old. I am imposing the standard error to be clustered at district level when estimating equation 4 to correct for the fact that the errors are not i.i.d. More to, the fact that I am observing the same child repeatedly helps me to rule out cross-sectional confounders that could correlate with malnutrition and explain psychosocial outcomes. Throughout the paper, I estimate equation 4 by OLS as a baseline and reference for comparing other estimates, always including malnutrition. For several reasons that will be made clear in the later sections, malnutrition can be expected to correlate with important characteristics of drought, either observable or unobservable, that can have a direct impact on the outcomes of interest. A strong concern in estimating equation 4 by OLS is thus, that it may yield biased estimates of the effects of malnutrition. In particular, the risk of picking up reverse causation is likely. Without, the ability to quantify the relative importance of these effects, OLS estimates yield limited information about the causal effect of malnutrition on psychosocial competencies. Because it is not expected to produce consistent estimate of the coefficient of child malnutrition as malnutrition is endogenous because from equation 4 it is assumed to be associated with children’s psychosocial competencies and other unobservable that are subsumed in the error term. To overcome this issues related to omitted variables and to consistently estimate parameters, I propose an identification strategy exploiting rainfall data. The remainder of the section describes how I construct drought shock and presents the instrumental variables strategy in more detail.

\footnote{Severe illness and injury in household have both direct costs for prevention care and cure, as well as opportunity cost in terms of lost income. Yet, the lion’s share of the cost of illness is lost income and not care expenditures. Further, timing and duration, frequency of illness also affect its impact. Small farms and households are experiencing illness during the slack agricultural season are better off than during peak season because it leads to heavy loss of income associated with reduced labour supply and productivity which can result into costly private informal coping mechanism such as informal borrowing, selling assets, transfers from their families and social support networks. De Weerdt and Dercon (2006) and Paul Gertler (2002) studies the impact of severe illness on household resources. The results indicate that...}
5.2 Identification Strategy and challenges

As mentioned previously, the consensus about climatic shock and its impact on child health status is divided among researchers. Nonetheless, it is agreed that drought is more vulnerable to marginalized populations. Given these facts, estimating the equation using OLS would not be enough to retrieve the causal impact of growing up in districts with high prevalence of drought on children’s psychosocial competencies. These estimations will have high tendency to overestimate the true impact of drought if children in drought affected districts are poorer, even without being exposed to drought. In order to disentangle and address this potential endogeneity bias problem, I instrument malnutrition with presence of climatic shock (drought) across districts in Andhra Pradesh. The regression differs from the structural model because of the correlation between the error term and the endogenous variable, producing inconsistency in the structural equation. The endogeneity concern arising in is mainly, though not exclusively due to imprecise measurement of child’s height, age and gender, or due to genetic and environmental factors that affect height but is independent from child’s nutritional intake. With this in mind, as known the instrument variable requires three conditions to be satisfied; the instrument should be as good as randomly assigned, the instrument must be able to explain a sizeable variation of the endogenous variable and it must influence the outcome variables (i.e. psychosocial competencies) only by its effect on the endogenous variable (malnutrition). This implies that exclusion restriction assumption can potentially be violated if there are other channels through which malnutrition might affect psychosocial competencies, rather than its interaction with climatic shock. I argue that drought shock is as good as quasi-random because it can be considered as natural experiments. The assumption of relevance condition that the instrument should be associated with malnutrition. The rationality behind employing drought as instrument for malnutrition is based on the evidence that weather deviations from the norm are associated to changes in the prevalence of infectious diseases in areas which results into malnourishment i.e. stunting and wasting, this often so in poor, rural areas. This channel isolate the direct measure of health productivity shocks which captures child’s nutritional status from the time of conception. Consequently, this becomes more explicit as climatic shocks impact on the productivity of nutritional inputs by affecting the extent of absorption of nutrients from the body. The link between weather variation and disease prevalence is expected to be the case in all areas with poor health infrastructure and level

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39 The wealthy can recover losses in one year, but poor people, who have no money, will never recover.
40 The technique of IV is the standard prescription for correcting cases as the one that I experience, hence a solution for rebuilding the structural parameters. This requires me to find instrumental variables that are correlated with the endogenous variable but uncorrelated with the error term, given the feasibility, the IV regression will yield consistent estimate of \( \beta \) \( \text{cov (shock, malnutrition)} \neq 0 \)
of hygiene. Lastly, the exclusion restriction assumption\textsuperscript{42} can be violated if there are other channels through which malnutrition might affect children’s psychosocial competencies, rather than the drought shock. For instance, income channel whereas weather variation is negatively associated to agricultural productivity hence rural income. I address these two concerns by; first incorporating household income proxied with wealth index. Second, I control for the local economy environment such as local prices and crops. Moreover, I demonstrate by employing an external weather data as a robustness check. By using shocks that occurred in different time period of children, I am able to isolate exogenous variation in shocks that is solely related to malnutrition see figure\textsuperscript{6}. A typical complication in studies that uses climatic shocks as instrument for some endogenous variable is that climate can have simultaneous impact on many variables. However, in this paper, it will not violate the exclusion restriction and invalidate the use of the climatic shocks as instruments. Given that these three conditions are fulfilled, the IV produces an asymptotically unbiased estimate wherein I am better off than evidence produced by equation\textsuperscript{4}.

Endogeneity and IV approach

The empirical economics literature often uses weather data as source of exogenous variation in income for developing countries, motivated by the idea that level of precipitation has direct effect on agricultural yields. In order to consistently estimate $\beta$ in equation\textsuperscript{4} I instrument for malnutrition using weather data where I adapt various definitions for drought along the children’s timeline in figure\textsuperscript{6} from the time of conception to middle childhood (8 years old) and to early adolescent (12 years old). I exploit shocks in utero for the simple reason that it captures the nutrition level of mother and during in utero period. This claim will assure whether Baker’s fetal hypothesis holds true or not. Moreover, I check for yearly shock until children are of age 5 and gender interaction terms, total shocks. The direct effects of drought and malnutrition are established in the reduced form equation.

$$\text{Malnutrition}_{ihd,t} = \gamma_1 \text{Shocks}_{ihd} + \gamma_2 I_{hd} + \gamma_3 X_{ihd,t} + \epsilon_{ihd,t}$$  \hspace{1cm} (5)

where $\text{Malnutrition}_{ihd,t}$ is the HAZ and WAZ, estimated separately for child $i$ living in household $h$ in district $d$. $\text{Shocks}_{ihd}$ is shocks experienced by children in the different time scale as explained earlier. Because drought shocks are constructed to capture stochastic variation with respect to fixed district characteristics, the coefficient of interest $\gamma_1$, is estimated without bias\textsuperscript{44}.

\textsuperscript{42} $\text{cov} (\text{shock}, \epsilon) = 0$
\textsuperscript{43} This implication is tested here below
6 Empirical Evidence

Before investigating the link between the instrument and malnutrition, I verify the story from the direct effect, thereafter I lay out the mechanisms that tries to capture the causal effect. My approach is predicted on the notion that the malnutrition produce children to have lower psychosocial competencies.

6.1 Direct Effect

Here I present the direct effect of malnutrition on psychosocial competencies estimated by OLS. The specification includes a battery of control variables of demographic and socioeconomic time-varying covariates of children and households from the YL data. Table ?? and ?? presents the results from the specification in equation 4. It summarizes the direct relationship between malnutrition, both the short-term and long-term and psychosocial competencies among early adolescent children. To keep the presentation simple, the coefficients of Aspiration, Self-esteem and Self-efficacy are given in columns (1), (2) and (3), respectively. Since psychosocial competencies and malnutrition are standardized variables with mean 0 and variance 1, this indicates that marginal effects can be interpreted in terms of proportion of the standard deviation of the outcomes explained by WAZ and HAZ. Consequently, the short-term health status of children in Table ?? indicates that an increase of one standard deviation of child malnutrition measured by WAZ will increase the level of aspiration by 5.5%, but with no statistical power. Therefore, the gender differences are emphasized; girls have lower level of aspiration compared to boys irrespective of the time dimension in the health status. To certain degree this implication is not surprising, the fact that girls show lower level of aspiration in a patriarchal society where boys have a higher market value because money transfers are in higher degree invested in early development of boys. Further, YL sample is pro-rural where traditions and norms are still kept in shape without questioning its impact.

When controlling for caregivers level of education, the evidence comply to what we tend to assume, that a child’s level of aspiration is in high degree influenced by their surrounding. In YL sample, caregivers with secondary level of education have a positive impact on early adolescents compared to caregivers with none or lower level of education. Not surprisingly, wealth have positive and statistically significant impact on children’s level of aspiration. The aspiration is the ability to set up goals, achievements and fulfilsments in life, therefore, the results are not astonishing that children living in households with higher education and wealth on average are better off to also for themselves create a higher aspiration level. So, the household environment plays a crucial role in how child develops her psychosocial competencies. Thus, household size have a negative impact on children’s self-esteem, children in households more than 13 family members are neglected. They do not get the level of attention needed which amplifies into lower
self-esteem. Moreover, children living in Rayalaseem and Telangana show a lower self-esteem compared to their peers from Costal Andhra. Costal Andhra have a higher wealth then other two regions. The third psychosocial competencies, self-efficacy show somewhat interesting result. Contrary to self-esteem, the impact of caregivers’ level of education on children’s self-efficacy have a counter-intuitive results. The higher the level of education in the household and therefore, on average higher wealth, the lower is the children’s self-efficacy. The result can be a reflection of a two-way path. Children from a relatively higher level of education in the household, aspire higher level of education for themselves. At the same time, they show a lower degree of self-efficacy. These two elements seem to contradict each other, in fact, they are not. The lower self-efficacy presents from the lack of faith in a specific action, hence, not lack of faith in your self. Further, children living in rural area have relatively lower self-efficacy compared to children in urban area.

Is there a discrepancy in children’s short and long-term health status on psychosocial competencies? The results report quite similar results to short-term health status. Both short and long-term health status have a positive effect on early adolescents level of aspiration; one standard deviation increase in HAZ, increases children’s level of aspiration by 9.6% and is statistically different from zero at 1 % level. Arguably, the result predicts the same patterns as in the conventional literature in economics about human capital that malnourished children have lower cognitive skills. This capitalize a vicious cycle, if my "window" of aspiration is determined solely by individuals who populate by low aspired individual, the more likely am I also to comply to the norm. This indicates that children’s environment is an element that have a positive effect for the development of aspiration. Therefore, an internal environment such as caregivers level of education and wealth status of the households are factors that are likely to have positive impact because caregivers with higher education are also more likely to have higher level of aspiration which will create a positive spillover effect. Further, irrespective of health status (i.e whether its short or long-term) gender plays a role in the creation of aspiration, girls have a lower level of aspiration compared to boys. Living in a family with numerous member has a negative impact on self-esteem; as the number of family member increases, the self-esteem of the child decreases whereas the number of family member crowd out the expected positive input that increasing number of family member have (i.e. help within the family such as taking care of the siblings, farming and monetary contribution to the household.) to the cost of well-being of the child.44 On the contrary self-efficacy show slightly different and unexpected results. The age of the child have a positive influence on its self-efficacy. One plausible explanation for this can be that self-efficacy is the belief of children’s capacity to shape their aspiration.

\[
\frac{d(\text{Self - esteem})}{d(\text{family})} > 0, \quad \frac{d^2(\text{Self - esteem})}{d(\text{family})^2} < 0
\]

44
and career trajectories. Thus, very few children are able to shape their future in young age, notably children from pro-poor and pro-rural households. Astonishingly, the internal environment, caregivers level of education and wealth which have a positive effect on the level of aspiration but have a negative effect on self-efficacy. A potential disagreement or fail to interpret correctly the result can be due to the fact that self-efficacy is one’s own system of belief over their cognitive functioning. This is seemingly counter-intuitive influenced by .... Although this result is not conclusive due to the limited number of observations exposed to the underlying questions for extracting the self-efficacy index, the internal environment appears to have a negative impact on self-efficacy.

Self-efficacy is also influenced by child’s age which indicates that as the child ages, it is more likely that child’s awareness toward the future prospect is more developed and skins through by seeking a need to develop skills where her own self is rapidly in the center of awareness. Rural adolescents show lower self-efficacy compared to their peers living in urban area. Rural adolescents are time constrained and less exposed to the modern society, thus more likely to be outsiders and their future aspect and vision is short-lived.

6.2 Mechanism

Because of reverse causality and omitted variable problems, OLS estimates of (equation 4) are unlikely to uncover the causal effect of malnutrition on psychosocial competencies. I now outline a source of exogenous variation in malnutrition that may help me to estimate accurately these causal effects.

6.2.1 First stage results

Table ?? and ?? documents the first stage results where short and long-term malnutrition is instrumented with drought shock. To see how controlling for drought shock affect malnutrition, column (2) and (3) reports subjective and objective drought respectively. The estimation is composed with same covariates as in the direct effect. The results are in line with my expectations - children’s health deteriorate more in response to an additional drought shock. Table ?? show results for long-term health status of children. In terms of magnitude, the estimates show that health of children aggravates by 19.8 % given that they have been exposed to drought shock. This is consistent with the theory that climate have an adverse effect on children’s malnutrition. The result is only true for subjective drought, for objective drought, the coefficient is not statistically different from zero. It implies that households who self-reported to have experienced drought the last four years have experienced adverse impact on malnourishment. This indicate that climate change have an adverse and statistically significant effect on child health. The coefficient of child’s age have a negative and statistically significant effect at 5% level.
indicating malnourishment is correlated to child’s age. This results are in line with previous evidence [46] Table ?? displays the result for short-term health status. Notably, neither of the drought shocks are statistically significant. Nevertheless, the coefficient of control variables Rayalaseema region and rural site demonstrate negative and statistically significant effect at 1% and 5% level, respectively. This result suggests that children in rural and Rayalaseem are more likely to be malnourished and thus face a larger catching up time. Their psychosocial health status during early adolescent might be negatively affected by the early childhood exposure to the lack of nutrition. Not surprisingly, the wealth coefficient report positive and statistically significant at the 5% level. Access to wealth give households higher purchasing power thus less constrained to health expenditures and therefore can provide children with higher nutritional care. The result in column (3) produce similar results as in column (2).

6.2.2 Does Drought Affect Early Adolescents Psychosocial Competencies - Second Stage Results

The IV approach has its limitations. First, as in any instrumental variable strategy, we must convince that the instruments are legitimate. The IV solution is to isolate variation in the endogenous variable malnutrition and the variable which does the isolating is the instrumental variable which is the drought shock. The good thing is that we just need some of the variation in malnutrition. Intuitively, conditional on covariates, 2SLS retains only the variation in HAZ that is generated by quasi-experimental variation, that is conducted by the instrument. My main concern has all along been to estimate the returns to exogenous changes in the level of malnourishment. In the sample, I have identified two groups where one group of household have reported to have been exposed to drought while other group have no exposure to drought which does not directly determine children’s psychosocial competencies, though does affect the level of malnourishment and therefore indirectly affect my outcome, psychosocial competencies. Consequently, the IV estimate is the difference in average psychosocial competencies across the two groups divided by the difference in children’s average level of malnourishment across the two groups. The Tables xx-xx reports the result of intrinsic interest, those from the reduced form equation. Among the three psychosocial competencies studied, self-efficacy is the only competence that is affected by subjective drought, self-reported by the households whether they have experienced drought in the past four years. The coefficient show a positive and statistically significant level at 5 %. The result is intuitive, on average children that are malnourished, possess lower level of self-efficacy. Elaborating further the result, the self-efficacy component in early adolescents are fragile to stunting. Therefore, this study confirm, in addition to what previous literature have established that stunted children have lower school

46 See
attainment, that social problem is also a consequence of malnourishment in early childhood. 47

Although, the level of aspiration and self-esteem show right direction in coefficients, they are, yet not statistically significance. This can be a result of insufficiency in the sample. Overall the 2SLS coefficient estimates and the standard errors are larger than the corresponding OLS coefficient estimates. This suggests that the observed association between malnutrition and early adolescents psychosocial competencies are not driven by omitted variables such as family background and other characteristics that are not observed in the model but that might potentially affect the outcome variables through the chosen instrument. 48

6.2.3 What type of x change matters?

6.2.4 Implications for malnutrition

6.3 Validity and Robustness Checks

To validate the identifying assumption, I extract the exogenous variation, drought shock from GC database in a year-wise sequence from the time of conception until children are in their early adolescent. Specifically, I replace \( \gamma_1 \text{Shocks}_{ihd} \) in equation 4 with the set of year-wise dummy variable which equals to 1 if \( n \) year have experienced drought shock, otherwise equal 0.

Early Shocks and Psychosocial competencies

Measuring psychosocial competencies is, of course, non-trivial challenge, and it is possible that the failure to detect a significant effect partially or primarily reflects mismeasurement.

Heterogeneous Effects by Gender

Table xx study heterogeneity in the reduced form effects for in utero shocks by gender for the set of psychosocial competencies outcomes; aspiration, self-efficacy and self-esteem. The equation estimated is as follows;

Heterogeneous Effects by Land Endowment

7 Caveats and Conclusions

47 The results is consistent with many theories such as parental investment, parental information, sorting and peer effects, household credit constraints, preference formation and genetics.

48 The estimation was also made for the short-term malnutrition, however, none of the results were statistically significant. The reduced form equation was also employed on the objective drought measurement which is self-report of drought occurrence at community level. None of the results of drought measurement on psychosocial competencies were statistically significant.
References


Appendix A

A.1 Supplementary figures and tables

Study area - Andhra Pradesh

Figure 1: Andhra Pradesh (AP) is a state in South east of India. Its distinguishing features can be categorized into three agro-climatic regions; Coastal Andhra, Rayalseema and Telangan where YL dataset captures the interregional variations. Its sub-ecological zones across the communities are described mainly by coastal and inland plan. The state is divided into 23 administrative districts that are subdivided into a number of mandals. When I employ the "community", it refers to mandal or panchyat. Generally there are approximately between 20 and 40 villages in each mandal. In total, there are 1,125 mandals and 27,000 villages in Andhra Pradesh. Villages are normally composed of a main village site with a small number (two to five) associated hamlets. This paper focuses on Andhra Pradesh and Telangana. The two regions were united until June 2014, after Telangana, the north-western part of Andhra Pradesh bifurcated to form a new state and accounted a population of over 84 million in 2011, both together accounted for the fifth largest population in India. In the last years the Indian government have implemented various instruments to reduce the child poverty in order to achieve better environment and well-being to its population. In the 1990’s the government of AP initiated several reform process for fiscal and institutional restructuring with aim of decreasing the prevailing poverty. Therefore, it is particularly interesting to capture the progress toward demolishing the level of poverty. In comparison to other states, Andhra Pradesh is largely better developed, in terms of economic, educational and health outcome. In this paper, the aim is to understand the causes and consequences of malnutrition on psychosocial competencies among YL children. I am, further studying the variation in rainfall across districts in Andhra Pradesh to see whether it is likely to have an impact (positive or negative) on children’s capability to shape a functional characteristics of their psychosocial skills.
A.2 Child, Household and Community Characteristics

Histograms of Psychosocial Competencies

Figure 2: Histograms of psychosocial competencies when YL children are age of 12 years old. All measurement indices are standardized to have mean 0 and variance 1 in each of the personality traits; Aspiration, Self-esteem and Self-efficacy.

Table 1: Psychosocial statements with raw scores

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Statement</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-esteem</td>
<td>I feel proud to show my friends or other visitors where I live</td>
<td>1.30 (.652)</td>
</tr>
<tr>
<td></td>
<td>I am ashamed of my clothes&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.67 (.760)</td>
</tr>
<tr>
<td></td>
<td>I feel proud of the job done by the head of household</td>
<td>1.33 (.687)</td>
</tr>
<tr>
<td></td>
<td>I am often embarrassed because I do not have the right books, pencils or other equipment for school&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.28 (1.09)</td>
</tr>
<tr>
<td></td>
<td>I am proud of my achievements at school</td>
<td>1.52 (.767)</td>
</tr>
<tr>
<td></td>
<td>I am worried that I don’t have the correct uniform</td>
<td>3.53 (0.915)</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>If I try hard I can improve my situation in life</td>
<td>1.14 (.421)</td>
</tr>
<tr>
<td></td>
<td>Other people in my family make all the decisions&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.68 (.957)</td>
</tr>
<tr>
<td></td>
<td>About how I spend my time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I like to make plans for my future studies and work</td>
<td>1.46 (.781)</td>
</tr>
<tr>
<td></td>
<td>If I study hard at school I will be rewarded by a better job in future</td>
<td>1.20 (.536)</td>
</tr>
<tr>
<td>Educational aspiration (Upward mobility)</td>
<td>Imagine you had no constrains and could stay at school as long as you liked, what level of formal education would you like to complete?</td>
<td>13.06 (1.67)</td>
</tr>
</tbody>
</table>

Note: The score indicates the extent to which the respondent agrees with each statement. Mean score is on a scale from 1 to 4 (1 - strongly disagree, 2 - disagree, 3 - agree, 4 - strongly agree). The reversed score is presented for the negative statements, indicated by <sup>a</sup>. Standard error in brackets. <sup>a</sup> indicates negative statements.
Table 2: Measurements of Psychosocial traits

<table>
<thead>
<tr>
<th>Psychosocial index</th>
<th>Mean</th>
<th>Std</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Aspiration (Upward mobility)</td>
<td>13.067</td>
<td>(1.675)</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>1.351</td>
<td>(0.107)</td>
</tr>
<tr>
<td>Self-esteem</td>
<td>2.445</td>
<td>(0.384)</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on the YL dataset - Wave II (2009). The mean indicates the mean of total sum of psychosocial statements for each competencies. See Table [1] for detailed computational sequence for each psychosocial index.

Anthropometric Measurement

The nutrition data use the z-score transformations proposed by the WHO 2005 conventions; in principle comparability across settings is possible.

Figure 3: The histogram shows the density of short-term (weight-for-age z-score) and long-term (height-for-age z-score) malnutrition for YL children in year 2002, wave 1. The immediate observation from the histogram is that the sample have children with very high wasting and stunting.

Table 3: Descriptive statistics for HAZ and WAZ

<table>
<thead>
<tr>
<th>Gender</th>
<th>All children</th>
<th>Girls</th>
<th>Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Height-for-age</td>
<td>1.526 (1.057)</td>
<td>-1.596 (1.013)</td>
</tr>
<tr>
<td></td>
<td>Stunted (%)</td>
<td>17%</td>
<td>17%</td>
</tr>
<tr>
<td></td>
<td>Weight-for-age</td>
<td>-1.886 (0.965)</td>
<td>-1.939 (1.039)</td>
</tr>
<tr>
<td></td>
<td>Wasted (%)</td>
<td>23%</td>
<td>28%</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on the YL dataset. Notes: Based on children aged 7-8 years old. Stunted refers to children whose height-for-age z-scores were below -2 standard deviation of the international reference group of children the same age. The equal definition applies to weight-for-age z-score.
Table 4: Wealth and Nutritional Status

<table>
<thead>
<tr>
<th>Indicators of poverty</th>
<th>Mean (SE)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative poverty (%)</td>
<td>.418 (.215)</td>
<td>733</td>
</tr>
<tr>
<td>Wealth Index for Wave I</td>
<td>.418 (.215)</td>
<td>733</td>
</tr>
<tr>
<td>Wealth Index for Wave II</td>
<td>.464 (.197)</td>
<td>917</td>
</tr>
</tbody>
</table>

Nutritional status

- Percentage of stunted children
  - 7-8 years (Wave I): 35.33% (259, 733)
  - 11-12 years (Wave II): 34.76% (316, 909)

Source: Authors’ calculations based on the YL dataset. Percentage of stunted children are children with height-for-age z-score is smaller than 2 standard deviations.

Table 5: Nutritional Indicators across Drought and Non-drought affected Districts

<table>
<thead>
<tr>
<th>Height-for-age z-score</th>
<th>Weight-for-age z-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A: Statistics in 2002 (Children 8 year old)</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>Children living in:</td>
<td></td>
</tr>
<tr>
<td>Drought - affected Districts</td>
<td>-1.621 (1.020)</td>
</tr>
<tr>
<td>Non Drought affected Districts</td>
<td>-1.539 (1.040)</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on the YL dataset. The objective drought measurement was applied to calculate average nutritional status.

Figure 4: Height of Young Lives children and WHO growth norms for Andhra Pradesh. The chart plots real height centimetres for girls and boys separated by urban and rural Andhra Pradesh against the WHO growth norm standard.
Table 6: Demographic Summary Statistics

<table>
<thead>
<tr>
<th>Sample Characteristics</th>
<th>Mean (Std.dev)</th>
<th>Min</th>
<th>Max</th>
<th>Obs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>12.368 (0.340)</td>
<td>11.57</td>
<td>13.14</td>
<td>902</td>
</tr>
<tr>
<td>Height-for-age Z (wave I)</td>
<td>-1.607 (1.045)</td>
<td>-5.60</td>
<td>2.01</td>
<td>733</td>
</tr>
<tr>
<td>Weight-for-age Z (wave I)</td>
<td>-1.974 (1.057)</td>
<td>-5.05</td>
<td>2.35</td>
<td>733</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>141.368 (7.551)</td>
<td>101.20</td>
<td>172.20</td>
<td>902</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>31.544 (6.491)</td>
<td>15.60</td>
<td>62.20</td>
<td>902</td>
</tr>
<tr>
<td>BMI (calculated BMI = weight/height^2)</td>
<td>-1.485 (1.226)</td>
<td>-5.37</td>
<td>3.04</td>
<td>902</td>
</tr>
<tr>
<td><strong>Household Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caregivers age</td>
<td>34.804 (6.235)</td>
<td>20</td>
<td>74</td>
<td>901</td>
</tr>
<tr>
<td>Caregivers education</td>
<td>1.494 (1.789)</td>
<td>1</td>
<td>3</td>
<td>900</td>
</tr>
<tr>
<td>Mothers age</td>
<td>34.600 (5.632)</td>
<td>24</td>
<td>64</td>
<td>889</td>
</tr>
<tr>
<td>Mothers level of education</td>
<td>2.277 (3.819)</td>
<td>0</td>
<td>15</td>
<td>867</td>
</tr>
<tr>
<td>Fathers age</td>
<td>40.695 (6.285)</td>
<td>28</td>
<td>70</td>
<td>860</td>
</tr>
<tr>
<td>Fathers level of education</td>
<td>3.959 (4.921)</td>
<td>0</td>
<td>15</td>
<td>811</td>
</tr>
<tr>
<td>Age of household head</td>
<td>42.414 (9.619)</td>
<td>24</td>
<td>94</td>
<td>902</td>
</tr>
<tr>
<td>Household heads level of education</td>
<td>3.836 (5.122)</td>
<td>0</td>
<td>28</td>
<td>898</td>
</tr>
<tr>
<td>Household size (members in the family)</td>
<td>5.214 (1.840)</td>
<td>2</td>
<td>22</td>
<td>902</td>
</tr>
<tr>
<td>Housing quality index</td>
<td>.548 (.275)</td>
<td>.015</td>
<td>1</td>
<td>902</td>
</tr>
<tr>
<td>Consumer durables index</td>
<td>.232 (.197)</td>
<td>0</td>
<td>.89</td>
<td>902</td>
</tr>
<tr>
<td>Access to electricity</td>
<td>.895 (.302)</td>
<td>0</td>
<td>1</td>
<td>902</td>
</tr>
<tr>
<td>Drinking quality</td>
<td>.950 (.216)</td>
<td>0</td>
<td>1</td>
<td>902</td>
</tr>
<tr>
<td>Sanitation quality</td>
<td>.338 (.473)</td>
<td>0</td>
<td>1</td>
<td>902</td>
</tr>
<tr>
<td>Cooking fuel quality</td>
<td>.262 (.440)</td>
<td>0</td>
<td>1</td>
<td>902</td>
</tr>
<tr>
<td>Housing services index</td>
<td>.611 (.250)</td>
<td>0</td>
<td>1</td>
<td>902</td>
</tr>
<tr>
<td>Wealth index</td>
<td>.464 (.197)</td>
<td>.007</td>
<td>.92</td>
<td>902</td>
</tr>
</tbody>
</table>

Notes: Author’s calculations based on the YL dataset. Data drawn from Wave I and II of the Young Lives survey for Andhra Pradesh, India. The sample includes older children who are present in both waves. The 2002 and 2006 waves account for 73% and 92% of the observations, respectively. Standard errors are in parentheses.
Appendix B

B.1 Construction of Wealth Index

The wealth index is intended to be the primary instrument to measure socioeconomic status of the households. It draws on work undertaken by the World Bank and Macro International that developed a wealth index cited in the UNICEF Multiple Indicator Cluster Surveys. The YL’s wealth index is the simple average of the three indices: Housing Quality Index (HQ), Consumer Durables Index (CD) and Services Index (SI). Each of the indices are just a simple means of variables that are in a 0-1 range. Hence, the wealth index can take a value between 0 and 1, whereby a higher wealth index indicates a higher socioeconomic status.

Housing Quality Index

- HQ1 - Rooms per person. Number of rooms divided by the number of household members. The HQ1 variable is set to take a maximum value of unity. Ratios higher than 1 are recoded accordingly.
- HQ2 - Floor quality. The variable has the value 1 if the floor is made of a finished material (cement, tile or laminated material); 0 otherwise.
- HQ3 - Roof Quality. The variable has the value of 1 if the roof is made of iron, concrete tiles or slates; 0 otherwise.

Consumer Durables Index

- Constructed from simple means of the following variables; ownership of (i) radio, (ii) bicycle, (iii) motorbike or scooter, (v) motorised vehicle or truck, (vi) landline telephone, and (vii) a modern bed or a table.

Services Index

- S1 - Electricity, takes the value of 1 if the household has access to electricity; 0 otherwise
- S2 - Water, takes the value of 1 if the household’s source of drinking water is piped into dwelling or yard; 0 otherwise.
- S3 - Toilet, takes the value of 1 if the household has access to its own pit latrine or flush toilet; 0 otherwise
- S4 - Cooking fuel, takes the value of 1 if the household uses electricity, gas or kerosene as cooking fuel; 0 otherwise.
B.3 Construction of Psychosocial competencies

The psychosocial competencies are created accordingly educational psychology, intended to capture childrens dimensions of what she or he believe is possible to achieve in life. The YL implemented and worked with other disciplinary to understand the complexity of these dimensions. Hence, before implementing the survey on psychosocial, the YL team went through several piloting sessions before the final survey. In my work, as previously mentioned, I follow similar to Dercona and Sanchez (2013) and Dercona and Krishnan (2009) to create the psychosocial competencies. The way the authors shape the measurement is among the commonly used procedure to extract emotional and happiness instruments in psychology. In the YL survey, the psychosocial trait questions are based on how much the child or the caregiver agrees or disagrees with a number of statements. The degree of agreement or disagreement is a measurement on a 4-point Likert scale that ranges from strong agreement to strong disagreement. The answers to the statements were, consequently used to construct the individual average scores on aspiration, self-efficacy and self-esteem. Here below, I have stated all the items which are included in each of the three psychosocial trait dimensions.

To make the questions more comprehensible to understand, I have used of three explorative analysis that I apply to extract maximum information from the items on YLs’ childrens’ psychosocial competencies before constructing the three dimensions; aspiration, self-esteem and self-efficacy. For aspiration, there is no need to apply any of these methods because there is only one item to capture this dimension. Further, the aspiration gives the average educational achievement the YL child would like to see her or himself pursuit. However, the other two psychosocial traits have 5 and 9 items respectively. For an overview of the psychosocial traits, I have chosen to apply principal component analysis (PCA), factor analysis and Cronbach’s alpha analysis before constructing a valid indices from each psychosocial dimensions. Briefly, the PCA considers the total variance in the data and transforms the original variables into a smaller set of linear combination of the variables. The total variance is explained by each factor is the eigenvalue.

While the factor analysis is very similar to PCA, yet it provides me with elements not analysed in PCA which is valuable to validate the measurement before building the psychosocial indices. The factor analysis groups similar variables into several dimensions. In order to achieve with grouping, the information in the data is reduced by reducing the number of dimensions of the observations. This process makes the data more comprehensible to read because the analysis is intent to discover the latent variables through the observed variables.

Lastly, Cronbach’s alpha is a tool used for dichotomous and continuously scored variables which estimate the reliability i.e. the internal consistency reliability. It is not a statistical test, rather a coefficient of reliability. The reliability assumption of this tool relies upon the assumption which is worth to mention; the unidimensionality, that all items measure on a single dimension. However, a high degree of alpha does not necessarily indicate a high degree of internal consistency nor that the measure is unidimensional. In fact, it can be due to several reasons such as There are several formula for Cronbach’s alpha, nevertheless, I am applying of the most insight full and most accessible one (see here below the formula). Formula \( \alpha = \frac{k \bar{r}}{1 + (k - 1) \bar{r}} \) is standardized on correlation.

\[ \alpha = \frac{k \bar{r}}{1 + (k - 1) \bar{r}} \]  

where \( k \) is the number of indicator, or items (ex. in self-efficacy the YL survey have 5 items on a 4-point Likert scale while self-esteem have 9 items.) \( \bar{r} \) is the mean inter-indicator correlation (the average correlation between the items)
B. 3.1 Educational aspiration

**Educational aspiration** (1 item)
1. Imagine you had no constraints and could stay at school as long as you liked, what level of formal education would you like to complete?

B. 3.2 Self-efficacy

**Self-esteem** (includes 9 items)
1. I feel proud to show my friends or other visitors where I live.
2. I am ashamed of my clothes.
3. I feel proud of the job done by the head of household.
4. I am often embarrassed because I do not have the right books, pencils or other equipment for school.
5. I am proud of my achievements at school.
6. I am embarrassed by/ashamed of the work I have to do.
7. I am ashamed of my shoes.
8. I am worried that I don’t have the correct uniform.
9. The job I do makes me feel proud.

The PCA for Self-efficacy.

B. 3.3 Self-esteem

**Self-efficacy** (includes 5 items)
1. It I try hard I can improve my situation in life.
2. Other people in my family make all the decisions about how I spend my time.
3. I like to make plans for my future studies and work.
4. If I study hard at school I will be rewarded by a better job in future.
5. I have no choice about the work I do “ I must work.

The Table below describes the correlation matrix across the three psychosocial competencies. It gives a general description of the relationship between three indices which is valuable for understanding their magnitude and interrelation.

**Table 7: Correlation between psychosocial competencies**

<table>
<thead>
<tr>
<th>Psychosocial competencies</th>
<th>HAZ</th>
<th>WAZ</th>
<th>Wealth</th>
<th>Illness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspiration</td>
<td>0.108</td>
<td>0.128</td>
<td>0.167</td>
<td>0.002</td>
</tr>
<tr>
<td>Self-esteem</td>
<td>0.073</td>
<td>0.114</td>
<td>0.093</td>
<td>0.023</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>0.002</td>
<td>0.08</td>
<td>-0.067</td>
<td>-0.044</td>
</tr>
</tbody>
</table>

Source: Author’s calculations based on Young Lives Survey dataset. Correlation study over psychosocial competencies and main explanatory variable.
Appendix C

C.1 Drought measurements from Young Lives Study

Here below, illustrations and explanations are given about drought measurement extracted from YL dataset.

Figure 5: Bar chart over subjective and objective drought measurements, given in percentage of the given binary answer during interrogation of households and communities.

Table 8: Who was affected by drought (Subjective)

<table>
<thead>
<tr>
<th>Who was affected by drought</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only affected my household</td>
<td>38</td>
<td>13.92</td>
</tr>
<tr>
<td>Affected my household and some other in this village</td>
<td>120</td>
<td>43.96</td>
</tr>
<tr>
<td>Affected all household in this village</td>
<td>83</td>
<td>30.40</td>
</tr>
<tr>
<td>Affected this village and other village</td>
<td>32</td>
<td>11.72</td>
</tr>
</tbody>
</table>

Source: Authors’ calculation based on the YL dataset - Wave II (2006). Household’s self-reported drought measurement

Table 9: Correlation Study over Drought and Child Malnutrition

<table>
<thead>
<tr>
<th></th>
<th>WAZ</th>
<th>HAZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought subjective</td>
<td>-0.114</td>
<td>-0.146</td>
</tr>
<tr>
<td>Drought objective</td>
<td>-0.067</td>
<td>-0.036</td>
</tr>
</tbody>
</table>

Source: Author’s calculations based on Young Lives Survey dataset. Correlation study between child malnutrition and drought measurement
Table 10: Exposure of Rural Households to Drought in Andhra Pradesh, year 2002-2006

<table>
<thead>
<tr>
<th>District</th>
<th>% of households who suffered from drought (Household survey)</th>
<th>Household only</th>
<th>Household and others in villages</th>
<th>All households in villages</th>
<th>Village and beyond</th>
<th>% of rural villages which suffered from drought (Community survey)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% of households who suffered from drought (Household survey)</td>
<td>Household only</td>
<td>Household and others in villages</td>
<td>All households in villages</td>
<td>Village and beyond</td>
<td>% of rural villages which suffered from drought (Community survey)</td>
</tr>
<tr>
<td></td>
<td>% of households who suffered from drought (Household survey)</td>
<td>Household only</td>
<td>Household and others in villages</td>
<td>All households in villages</td>
<td>Village and beyond</td>
<td>% of rural villages which suffered from drought (Community survey)</td>
</tr>
<tr>
<td>Region: Coastal Andhra</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Godavari</td>
<td>1%</td>
<td>5%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>Srikakulam</td>
<td>12%</td>
<td>42%</td>
<td>8%</td>
<td>5%</td>
<td>9%</td>
<td>22%</td>
</tr>
<tr>
<td>Region: Rayalaseem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kadapa</td>
<td>5%</td>
<td>0%</td>
<td>5%</td>
<td>8%</td>
<td>0%</td>
<td>10%</td>
</tr>
<tr>
<td>Anantapur</td>
<td>46%</td>
<td>21%</td>
<td>60%</td>
<td>54%</td>
<td>0%</td>
<td>23%</td>
</tr>
<tr>
<td>Region: Telangana</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Karimnagar</td>
<td>5%</td>
<td>0%</td>
<td>5%</td>
<td>8%</td>
<td>0%</td>
<td>7%</td>
</tr>
<tr>
<td>Mahboobnagar</td>
<td>29%</td>
<td>24%</td>
<td>17%</td>
<td>85%</td>
<td>0%</td>
<td>20%</td>
</tr>
<tr>
<td>Region: State Capital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyderabad</td>
<td>2%</td>
<td>8%</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>6%</td>
</tr>
<tr>
<td>Whole sample</td>
<td>30%</td>
<td>14%</td>
<td>44%</td>
<td>30%</td>
<td>12%</td>
<td>46%</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations from YL dataset. Statistics on households are based on rural households with a YL child of the older cohort and that have not moved between 2002-2006.
C.2 Climatic shock as instrument variable - further explained

The weather data covers six districts in Andhra Pradesh: West Godavari, Srikakulam, Anantapur, Kadapa, Karimnagar, Mababubnagar and the state capital, Hyderabad across 1970 to 2006. The climatic shocks are extracted from different time across the whole time period. As illustrated, each of the shocks are assumed to have an impact on YL child’s life in retrospective.
Figure 6: Timeline over shocks
Appendix D

D.1 Estimation Results

Does malnutrition affect Psychosocial competencies?