



Multidimensional human capital formation in a developing country: Health, cognition and locus of control in the Philippines



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ABSTRACT

Economic success depends on multiple human capital stocks whose production is interrelated and occurs over many life stages. Yet, much empirical work fails to account for human capital's multidimensional nature and limits its focus to specific childhood stages. Using longitudinal data from the Philippines, I estimate a model of multidimensional human capital formation from birth through adulthood where health, cognitive, and noncognitive dimensions are jointly produced. I examine during which developmental stages parental investment is most influential and address the endogeneity of investment using a policy function where investment depends on child characteristics, exogenous conditions at birth and local prices. Findings imply that not only will early human capital disparities persist into adulthood without early remediation but also that cognitive gains yielded from early remediation will be lost without complementary investment in adolescence. Findings further suggest that interventions will be undervalued if their multidimensional effects are not accounted for.

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1. Introduction

It is widely understood that accumulating higher levels of human capital is important for developing countries to promote sustainable economic growth and improve the well-being of their citizens. Individual economic productivity depends on multiple domains of human capital including education, health, and numerous noncognitive skills and traits.^{1,2} A series of randomized control trials and natural experiments demonstrate that early life human capital shocks can result in long-term disparities in skills and economic well-being that persist into adulthood.³ However, evidence is still surprisingly sparse on the mechanisms underlying the long-lasting influence of early childhood over the process of human capital development across the life course, particularly in developing countries. Consequently, little is understood about the dynamic relationship between parental inputs, environment and the joint evolution of different human capital domains across

different developmental stages. Thus, while this literature elucidates the importance of early life experiences, questions remain concerning whether or not there exist other stages of human development, such as adolescence, during which human capital formation is sensitive to shocks and/or interventions.⁴ Shedding light on these mechanisms is crucial to understanding the barriers that households and governments face in fostering human capital formation and what interventions are potentially most effective and efficient in the context of poverty.

The broad scope of adult outcomes affected by early childhood experiences suggests that human capital formation consists of numerous interrelated processes including physical, cognitive and socio-emotional development. Currently little empirical work examines the joint production of different human capital dimensions. Instead, most existing empirical work examines one-to-one relationships between some early childhood realization and some specific adult outcome. This is primarily due to the inherent difficulty of measuring various domains of human capital and their inputs as well as to a paucity of high quality longitudinal data containing these measures at different stages of development. The skill formation literature, pioneered in [Cuhna and Heckman](#)

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¹ Noncognitive skills encompass the psychological and socio-emotional status of an individual and include an extensive set of skills and characteristics such as personality, motivation, perseverance, self-control, time preference, self-esteem, and the ability to work with others.

² See [Brunello and Schlotter, 2011](#), [Glewwe and Kremer \(2006\)](#) and [Strauss and Thomas \(2008\)](#) for a good review of some of this literature.

³ For example see [Alderman et al. \(2006\)](#), [Almond and Currie \(2011\)](#), [Barker \(1998\)](#), [Blau and Currie \(2006\)](#) and [Dawson et al. \(2000\)](#).

⁴ [Agüero and Deolalikar \(2012\)](#) provide some evidence for the importance of adolescence in the production of health. They examine the impact of the 1994 Rwanda genocide on adult female height and find substantial negative effects from exposure both during early childhood and adolescence.

(2008), offers an empirical methodology for investigating human capital formation that explicitly accounts for its multidimensional nature and estimates how various skills are jointly produced over childhood. This methodology then allows for the examination of the interrelationships between the production of various human capital domains and how those relationships evolve through childhood and adolescence. Research in this literature largely focuses on the joint production of cognitive and noncognitive skills and predominantly comes from developed countries.

In this paper, I bring some of the ideas and methodologies developed in the skill formation literature to model human capital formation in a poor country context. Using a rich longitudinal data set from the Philippines, I estimate a model of human capital formation in which the production of health, cognitive, and noncognitive domains of human capital are interrelated and jointly determined. These data allow me to estimate this model across all stages of childhood, from *in utero* to adulthood.

If interdependencies exist between the production of different developmental skills and traits, then there are likely gains to be had from taking a more comprehensive approach to modeling human capital formation where multiple dimensions are produced jointly within a system, rather than looking at them in isolation of each other. This is especially important in a developing country context where human capital growth is essential to a country's economic development and where barriers to healthy child development can be substantial. Poverty is associated with many insults to child well-being including inadequate food, poor sanitation and poor hygiene, all leading to increased incidences of infection and stunted growth. Poverty is also associated with poor maternal education, increased maternal stress and depression, and inadequate stimulation in the home (Grantham-McGregor et al., 2007). These risk factors frequently occur together resulting in cumulative deficits in child development starting in infancy and increasing with age (Grantham-McGregor et al., 2007; Evans and English, 2002). Grantham-McGregor et al. (2007) estimate that more than 200 million children under five fail to reach their developmental potential due to poverty, poor health, and deficient care. The social, cultural, and economic context of poverty exposes disadvantaged children to multiple and cumulating risks affecting children's development through brain structure, brain development, brain function and associated behaviors (Walker et al., 2008). Understanding the process of human capital formation under these circumstances is essential in order to more fully comprehend the consequences of growing up in poverty and to allow policy makers to better target and evaluate programs designed to impact child well-being and human capital formation.

To date, only a few studies take a multidimensional approach to understanding human capital formation in developing countries. Helmers and Patnam (2011) use the skill formation framework of Cuhna and Heckman (2008) to estimate the joint production of cognitive and noncognitive skills for a sample of Indian children covering the ages 1–5 years old and 8–12 years old. Using that same data, Attanasio et al. (2015) similarly estimate the joint production of cognition and health for two cohorts of children: a younger cohort covering the ages of 1, 5 and 8 years old and an older cohort covering the ages of 9, 12 and 15 years old. Both Helmers and Patnam (2011) and Attanasio et al. (2015) find evidence for interrelationships between the development of the different human capital stocks investigated (between cognitive and noncognitive skills in the former and health and cognition in the latter). Their findings also emphasize the importance of early childhood investment to the accumulation of human capital, particularly health and cognition.

Research investigating the production of noncognitive traits in a developing country context is similarly limited. Using a sample of youth from rural China, Leight et al. (2015) estimate the effect of

climatic shocks in early childhood on the production of cognitive and noncognitive skills in adolescence and young adulthood.⁵ They find that shocks early in life impact cognitive production but have little to no impact on adult noncognitive skills.

Using the Cebu Longitudinal Health and Nutrition Survey (CLHNS), a rich longitudinal dataset from the Philippines, I add to this limited literature in a number of ways. First, I estimate the joint production of multiple human capital domains over a much longer period than previously done in a developing country context. The CLHNS follows a cohort of children and their mothers from the children's birth through adulthood. The index children and their mothers were surveyed when the mothers were pregnant and then bimonthly for the first two years of the children's lives. The surveys then continued to follow the children and their mothers when the children were 8, 11, 15 and 19 years of age. I am therefore able to estimate the joint evolution of multiple human capital stocks from *in utero* through childhood and adolescence and into young adulthood. Second, I add to the sparse literature on the formation of noncognitive dimensions of human capital in poor countries. This is the first paper to my knowledge that examines the interrelationship between adult noncognitive traits and other human capital domains in a developing country context. While Leight et al. (2015) investigate cognitive and noncognitive skill formation in China, their reduced form approach does not allow them to analyze the potential synergies between the production of these two human capital domains. For the sample of children surveyed in the CLHNS, I am able to estimate the joint production of four adult human capital stocks including health, cognition and two noncognitive traits—internal and external locus of control.

Specifically, using the dynamic factor approach first developed in Cuhna and Heckman (2008), I estimate the joint production of health and cognition through childhood and adolescence. In doing so I am able to explore existing complementarities in the production of these two human capital domains as well as the extent to which parental investment is able to influence this process at various stages of development. I address the endogeneity of parental investment in human capital formation following the method proposed in Cuhna (2010). This involves estimating a policy function in which parental investment is a function of a child's current health stock, maternal characteristics, family background, conditions at birth, and exogenous community-level food prices. In doing so, I am able to investigate the ages in which the production of health and cognitive ability are most sensitive to intervention as well as to how these two traits produce themselves and each other.

Finally, I estimate how health and cognition in adolescence jointly produce these traits in adulthood in addition to producing two specific noncognitive traits: external and internal locus of control. Locus of control (LOC) represents individuals' beliefs or attitudes about the control they are able to exert over their own lives. An internal LOC constitutes the extent individuals feel that the events of their life are the result of their own actions and can thus be determined by their own skills and behavior. In contrast, an external LOC is the extent that individuals feel that these events are beyond their control and are instead due to external factors. Therefore individuals with an external locus of control tend to believe that factors such as fate, luck, or chance are the main determinants of the outcomes they experience. Previous empirical work demonstrates that each of these four human capital domains—health, cognition, external LOC, and internal LOC—are important to adult economic success (Alderman et al., 2006;

⁵ The noncognitive traits Leight et al. (2015) investigate are internalizing and externalizing behaviors in childhood and adolescence and depression and self-esteem in young adulthood.

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