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Ramona Molitor "Testing the Fetal Origins Hypothesis: The Case of Rainfall Shocks in India"

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Summary

Problem statement und motivation

Prevalence of malnourished children in India is among the highest in the world. According to the Hunger and Malnutrition (HUNGaMA] Survey Report (2011) compiled and published by Naandi Foundation, 42% of children under five years of age in India are moderately or severely malnourished[1], a figure that is nearly double of that of Sub-Saharan Africa. Despite some progress in recent years, India is most likely going to miss the 2015 target of reducing child malnutrition to 28.6% as part of the Millennium Development Goals (MDGS). Child health plays a crucial role in human capital development. Better nutrition and, thus, better health in early childhood improves not only health later in life, but also educational outcomes (among others Cunha and Heckman 2007, Behrman and Rosenzweig 2004, Black et al. 2007). The risk of malnutrition is especially high for children in rural areas, for children belonging to Scheduled Castes or Tribes (SC/ STs), for children from low-income families, and for children whose mothers have less or no schooling (Naandi Foundation 2011). For policymakers, it is important to understand not only the consequences of poor child health but also the causes.

Child malnutrition starts early in life with low birth weight being an important risk factor that indicates impaired in-utero health. An assessment of in-utero development can, thus, serve as an important link in understanding one channel of child malnutrition.

That the in-utero environment plays a crucial role for human development was first stipulated by the British physician and epidemiologist David I. Barker in the beginning of the 1990s. Originally, he postulated that nutritional deprivation of pregnant women impacts the fetus and leads to impaired fetal development with long lasting consequences that continue to

[1] As defined by the World Health Organization [WHO], moderate and severe malnutrition [also referred to as undernutrition] is defined as having a weight-for-age z-score below -2 and -3, respectively. Weight-for-age is a standardised measure that compares a child's weight with that of healthy children of the same age, living under conditions likely to favour achievement of their full genetic growth potential. In other words, weight-for-age captures how much a child's weight deviates from an international standard of same aged, healthy children.

persist after birth and even through adulthood (Barker 1990, Barker 1995). To put it in another way, the body's memories of early undernutrition become translated into pathology explaining the development of a number of diseases in later life. Barker denoted this fetal programming as the *fetal origins hypothesis*, a thesis that has gained much attention in the medical literature ever since. Nowadays, the *fetal origins hypothesis* is used as a general term to describe how in-utero shocks translate into early and later life.

It was not until the influential seminal work by Almond (2006) that the role of the in-utero environment has become an important research topic in economics as well. A growing empirical literature confirms a negative relationship between unfavourable circumstances experienced in-utero and the prevalence of low birth weight and human capital accumulation[2]. A key challenge in the empirical analysis is the assessment of a causal relationship. Methodologically, new studies take advantage of natural experiments that induce exogenous variations of in utero conditions over time and groups. Examples of these are famines (Almond et al. 2010, Neelson and Stratmann 2011), pandemics (Almond 2006, Kelly 2011), hot temperatures (Deschénes et al. 2009), and exposure to radioactive emission (Almond 2009).

Methodology

In my Master thesis I complement the previous research by measuring the causal effect of in-utero rainfall shocks in an agrarian economy with repeated occurrences of these shocks over time and with variation of the intensity at the geographical level. More precisely, I quantify effect of rainfall deficiency in India experienced in utero on health of children between 0 and 5 years and on educational outcomes later in life. The use of rainfall is originated in the characteristics of the Indian context; monsoon rainfall constitutes a critical feature of the rural and on agriculture depending Indian economy and has been observed to be historically volatile[3]. Since agriculture is predominantly rain-fed, droughts cause harvest failure, put families under severe financial stress, and affect in return food availability. Females and, thus, pregnant women and their unborn children are particularly vulnerable in times of food shortages due to unfavourable household reallocations (Behrman 1988, Behrman and Doalalikar 1990). In principle, there is insurance available to protect against this type of risk, but the uptake of such insurance is quite low in rural India (Cole et al. 2013)[4].

My data comes from three distinct data sets. Information on children is drawn from the District Level Household Survey [DLHS-2) and the Indian Human Development Survey (IHDS]. While the DLHS-2 is similar to the often used National Family Health Survey, it is five times larger and provides me with a final sample size of over 250,000 children. The IHDS data is much smaller but contains an additional range of important variables. District level rainfall data is available monthly; it enables me to identify periods of drought based on year-to-year monsoon rainfall variation within districts which I argue is exogenous.

[2] In my thesis, I set up an economic model based on Almond and Currie (2011) to show theoretically why in utero shocks can affect health of children and educational outcomes later in life.

[3] That rainfall is highly correlated with income in India has been recognized in several studies (among others Jacoby and Skoufias 1998, Jayachandran 2006).

[4] I am not the first to test the fetal origins hypothesis using rainfall shock in this type of setting. There are two closely related studies that come to mixed results regarding the role of the womb (Maccini and Yang 2010; Shah and Steinberg 2013). While both papers focus on the more long-term effects or educational outcomes, I address also health outcomes of children aged 0 to 5 and put emphasize on an important channel through which the previous findings can be explained.

Results

My findings suggest medium to long-term effects of in-utero shocks on nutritional status of children between 0-5 years. Hemoglobin level of girls under age 5, who experienced a drought in-utero, is about 0.18 g/dl lower compared to girls who were not exposed to this shock; thus, increasing the risk for anemia. Weight is reduced by about half a kilogram which translates into a decrease on weight-for-age z-scores of about 0.1 standard deviations for girls and boys exposed to a drought in-utero. Boys are also about 1.2 cm smaller compared to boys that did not experience a shock in the womb. Height and weight regressions for women between 15-49 years indicate that the anthropometric effects of droughts persist until adulthood. The schooling outcomes provide further evidence that in-utero drought exposure has lasting effects. My results also indicate that drought in the year of birth is an important predictor of health, a finding similar to previous studies.[5]

I also discuss the internal validity of my findings. Using different definitions to define droughts, I can show that my results are not sensitive to the way I define the rainfall shock Moreover, I address serial correlation in the rainfall data, selective fertility, migration patterns, and discuss potential consequences of selective mortality.

Even though I focus on in-utero shocks in my thesis, I do not imply that droughts have no effect on nutritional status in other periods of life. However, my findings suggest that the time in the womb is a sensitive period for human development which is in line with Barker's *fetal origins hypothesis*. For policy makers, the implication of my findings points towards a stronger focus on policies that improve maternal and fetal health, especially given the high variability of rainfall in India, and thus the repeated occurrence of droughts within the country.

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[5] I also study the effect of excess rainfall which may cause harvest failure and destruction of physical capital through flooding. The results, however, I quite inconclusive which is most likely due to the difficulty of measuring flood solely based on rainfall and without information on streams and vaporization.

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