

The Effect of Drought on Health Outcomes and Health Expenditures in Rural Vietnam

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Summary. — This paper quantifies the short-term impact of drought on health conditions and health expenditures. Using panel data from rural Vietnam and rainfall data in an instrumental variable approach, the results suggest that populations face an increased risk of illness in the year they are exposed to drought. Households with reduced agricultural incomes and limited access to coping mechanisms seem particularly affected. Drought-related health shocks also cause financial burden for many households, with health expenditures increasing by 9–17% of total consumption. This paper contributes to a literature which so far has mostly focused on the long-term consequences of climate shocks.

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Extreme weather linked to climate change is increasing and will likely cause more disasters. Such disasters, especially those linked to drought, can be the most important cause of impoverishment, cancelling progress on poverty reduction. (Overseas Development Institute, 2013, p. vii).

1. INTRODUCTION

As the frequency of climate shocks increases rapidly across the world, researchers and policy makers alike recognize the enormous cost developing countries face from the damage done to infrastructure, crop production, and most importantly, human development and human lives (IPCC, 2012). In fact, for most countries weather shocks are the single most important cause that pushes households below the poverty line and keeps them there (World Bank, 2013). The second most important cause relates to health shocks, which are highly correlated with weather shocks such as floods and droughts. Given that climate shocks affect a wide range of socio-economic outcomes, understanding their precise effects is at the core of designing effective policies and institutions to mitigate their consequences (Skoufias, 2003).

Vietnam is among the countries most frequently affected by extreme weather. With a very long coastline in tropical South-East Asia, the country is prone to strong typhoons during the monsoon season. Rainfall patterns are very volatile and in 40 of the past 50 years, droughts have occurred in different extents and locations across Vietnam. Particularly in rural areas dependent on agriculture, sufficient rainfall is crucial for subsistence and income generation (Nguyen, 2011). In fact, despite Vietnam's impressive record on economic growth and poverty reduction, one out of five Vietnamese continues to live on less than 1.25 USD a day. In addition, many households earn barely more than the poverty line (World Bank, 2012). Weather shocks frequently affect poor and vulnerable households and push families into poverty, especially in rural parts of the country (Arouri, Nguyen, & Youssef, 2015; Klasen, Lechtenfeld, & Povel, 2015).

Most of the existing epidemiology and economics literature estimates the long-term effects of drought on health outcomes

during adult-life, i.e., after a decade and more.¹ While very different methods are used to identify droughts in historic data, it has been well established that lack of rainfall can have substantial health effects on children and adults later in life. Hodinott and Kinsey (2001), for instance, find that children aged 12–24 months lose 1.5–2 cm of growth in the aftermath of a drought where annual rainfall decreased by 20–30% compared to long-term average rainfall. Their evidence shows that poor households and girls are especially vulnerable. The catch-up growth of these children is limited causing this growth faltering to have a permanent effect. Yamano, Alderman, and Christiaensen (2005) reach similar conclusions in a study from Ethiopia conditional on the absence of food aid. Looking at child mortality in the aftermath of drought, Rose (1999) reports that during years with significantly more rainfall than the historic average the survival rates of girls increase relative to boys. A second, related strand of literature examines to what extent early-life rainfall has lasting effects on health, education, and socioeconomic outcomes during adulthood. Maccini and Yang (2009) find that higher rainfall (compared to a district's long-term average) during birth years has large positive effects on the adult outcomes of women, but not of men: Women born in years with higher rainfall (relative to the local norm) are taller, complete more schooling grades, and live in households scoring higher on an asset index. Schooling attainment appears to mediate the impact on adult women's socioeconomic status. Using longitudinal datasets from Zimbabwe and Tanzania, Alderman, Hodinott, and Kinsey (2006) and Alderman, Hoogeveen, and Rossi (2009) document that prolonged peri-

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ods of drought during the pre-school age have adverse effects on nutritional status and subsequent child growth as well as on lifetime earning capacity due to both delays in schooling and declines in total schooling, including years of education and delay in enrollment. In sum, children growing up during an extended drought episode can suffer from under-investments in schooling and earn lower incomes throughout their lives. With about 85% of rural households in Vietnam being farms and about two thirds growing rice, droughts can create intense pressure on the rural livelihoods.

The short-term health impacts of drought on health outcomes within one year are not as well established. In addition, the health-related economic costs of drought are largely unknown at the micro level. The literature from developing countries points to three primary channels through which drought can affect health outcomes and expenditures, namely food shortages, price effects, and scarcity of potable water (for a comprehensive literature review see [Kovats, Bouma, Hajat, Worrall, & Haines \(2003\)](#)). First, droughts tend to have detrimental effects on the quality and quantity of agricultural output. As a consequence, food shortages and lower income from agricultural sources can cause a substantial deterioration of nutritional intake among children and adults, leading to malnutrition and an impaired immune system ([Vu & Glewwe, 2011](#)). Second, spikes in local food prices due to reductions in aggregate food production can further precipitate this effect, in particular when markets are fragmented ([CDC, 2010](#); [Warner & van der Geest, 2013](#); [World Bank, 2010, 2012](#)). Third, drought conditions can lead to increased infectious diseases due to scarcity of potable water ([CDC, 2010](#); [World Bank, 2010](#)). The breeding and survival of disease vectors also increases the risk of infections ([Kovats et al., 2003](#)). In addition, for the case of Vietnam, degraded soil conditions can increase the physical burden from on-farm labor in rural households who engage in cropping ([Burgess, Deschenes, Donaldson, & Greenstone, 2011](#)).

This paper provides new estimates on the short-term effects of drought on health outcomes and health-related expenditures for households in rural Vietnam. Using data on local rainfall, this study identifies episodes of drought by comparing current precipitation patterns with historic trends. By following households over four panel waves during 2007–13, the analysis exploits variation over time and space. Methodologically, the empirical analysis comes in two parts. In a first part, variations in local rainfall are related to individual indicators of health conditions in order to estimate the direct impact of drought on health outcomes. To unravel potential transmission channels, the analysis also assesses the relationship of drought-related health shocks with regard to the performance of the agricultural sector and specifies which economic characteristics drive a household's vulnerability to drought. The second part quantifies the effect of drought on health expenditures, using an Instrumental Variable (IV) approach in which the incidence of health shocks is estimated using varying degrees of drought intensity.

The results reveal the immediate burden of drought in terms of human health and contribute to closing a gap in the development literature on the short-term health effects of drought. Specifically, the empirical results suggest that drought negatively affects agricultural production as well as revenues from crop sales for the surveyed households in rural Vietnam. Comparing the most with the least drought-affected households in the sample, the estimated effects amount to reductions of more than 40%. As for the impact on health conditions, there is evidence that drought increases the probability of being affected by disease, particularly when households experience significant

reductions in agricultural production. Given a mean incidence of diseases around 16% in the sample, a one standard deviation increase in drought severity raises the likelihood of diseases by two percentage points, on average. The adverse effect is found to be more pronounced among households with limited access to coping mechanisms such as selling assets or tapping off-farm income sources. Access to public and private health insurance schemes is not found to robustly reduce the adverse effects of drought on health. In terms of the financial burden on the household budget, the IV estimates suggest that drought-related health shocks cause substantial financial cost. The additional expenditures sum up to around 9–17% of what the median household in the sample spends in terms of total consumption throughout the year. Against the background that the major share of health expenditures is financed out-of-pocket, these findings do not only reveal the direct microeconomic costs of drought events in the short-term, but also show that drought may pose a non-negligible burden for many households vulnerable to poverty in rural Vietnam. These results have important policy implications for risk management, including insurance against adverse weather shocks, and health care financing.

The remainder of the paper is structured as follows. Section 2 briefly discusses the drought-health nexus in light of recent developments in Vietnam. Section 3 details the empirical strategy and Section 4 introduces the panel dataset and the central variables for the empirical analysis, including the measure of drought. Section 5 presents the results with implications on health outcomes and household finances. Section 6 offers concluding remarks.

2. RURAL VIETNAM'S VULNERABILITY TO DROUGHT AND HEALTH SHOCKS

Vietnam has an extensive record of climate shocks including drought, commonly defined as prolonged periods of abnormally low rainfall.² In fact, Vietnam ranks 13th on an index of the vulnerability to the impacts of climate change.³ Over the past decade, episodes of drought have increased both in terms of severity and duration—and so have the associated economic costs ([UNISDR, 2011](#)). For a single drought in 2005, for instance, the estimated economic damage was 110 million USD, or roughly 0.2% of the country's GDP ([UNISDR, 2011](#)). In the search of explanations for the increasing prevalence of drought-like conditions in Vietnam, external factors (such as poor and unequally distributed rainfall) and internal factors matter. The most important internal causes include ongoing deforestation, the cultivation of water-intensive crops, and increased unregulated industrial activity ([NCHDMF, 2013](#)). In the widespread absence of large-scale irrigation systems in rural areas, climate shocks will likely continue to affect poor households in the years to come.⁴

Given the distinct features of Vietnam's agrarian economy, several pathways between drought and health outcomes and health expenditures are pertinent. First, poor rainfall conditions likely lead to reduced agricultural output through lower yields, reduced availability of fodder for livestock, and possibly the increase of rice-eating insects ([CDC, 2010](#); [Gaurav, 2015](#); [Toulmin, 1987](#); [Warner & van der Geest, 2013](#); [World Bank, 2010, 2012](#)). In the face of the high dependency on income from crops and livestock that many households in rural Vietnam have, slumps in agricultural income might not only directly lead to the degradation of the supply of food and basic nutrients from subsistence agriculture, but might also lower the ability to secure a sufficient nutritional intake through purchases at local markets. The effect is particularly

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