



The indirect impact of antiretroviral therapy: Mortality risk, mental health, and HIV-negative labor supply[☆]



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ABSTRACT

To reduce the burden of the HIV/AIDS epidemic, international donors recently began providing free antiretroviral therapy (ART) in parts of Sub-Saharan Africa. ART dramatically prolongs life and reduces infectiousness for people with HIV. This paper shows that ART availability increases work time for HIV-negative people without caretaker obligations, who do not directly benefit from the medicine. A difference-in-difference design compares people living near and far from ART, before and after treatment becomes available. Next we explore the possible reasons for this pattern. Although we cannot pinpoint the mechanism, we find that ART availability substantially reduces subjective mortality risk and improves mental health. These results show an undocumented economic consequence of the HIV/AIDS epidemic and an important externality of medical innovation. They also provide the first evidence of a link between the disease environment and mental health.

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1. Introduction

The social, demographic, and economic repercussions of HIV/AIDS in Sub-Saharan Africa (SSA) have been severe. According to recent figures from UNAIDS (2010), around 33 million people in SSA have HIV and 1.8 million become infected annually. AIDS has reduced period life expectancy in Southern Africa from 62 to 48 years over the past decade and a half (UNPD, 2010). However,

recent improvements in access to antiretroviral therapy (ART) have profoundly changed the course of the epidemic, as well as its social and economic consequences. ART is a powerful treatment regimen that prolongs life and reduces morbidity and infectiousness for people with HIV (NIAID, 2011; Smith et al., 2011; Tanser et al., 2013; Bor et al., 2013). To address the prohibitive cost of ART, a major international initiative began supplying free medicine in endemic countries in 2002. By 2005, 810,000 people began treatment under these programs. Free ART has reversed the upward mortality trend in countries with the highest HIV prevalence (Jahn et al., 1962; Bongaarts et al., 2011; Herbst et al., 2009).

Living in an HIV-endemic environment may influence economic decision-making regardless of physical illness (Conroy et al., 2013). Respondents in our sample from rural Malawi (described below) attend a median of three funerals per month, many of which are due to AIDS. They know two people who are sick with AIDS and two others who have died of AIDS in the past year. Although 6 percent of respondents have HIV, 39 percent think they might be infected and 58 percent worry about contracting the disease. By reducing life expectancy, HIV/AIDS risk may lead people to reoptimize life-cycle decisions like labor supply and education (Ben-Porath, 1967; Cervellati and Sunde, 2013). It may also affect economic outcomes by worsening mental health. In this setting, 30 percent of respondents report feeling depressed and 44 percent report feeling

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anxious in the past four weeks. 12 percent say that mental distress interferes with their activities or accomplishments.

ART clearly benefits HIV-positive recipients and their caretakers (Thirumurthy et al., 2008, 2012; McLaren and Zoe, 2010). In addition, the availability of treatment reduces health risk for HIV-negative people by lowering the probabilities of both infection and mortality conditional on infection. Lakdawalla et al. (2014) call this benefit, which is not well-documented empirically, the insurance value of medical innovation. Studies of the benefits of medical innovation do not generally include risk-reduction value (e.g. Philipson and Jena, 2006; Yin et al., 2012). Indeed, studies of the HIV-negative response to ART focus exclusively on sexual behavior (DeWalque et al., 2007; Friedman, 2014) and do not examine other economic outcomes. Because of the prevalence and severity of HIV/AIDS in Sub-Saharan Africa, the risk-reduction benefit of ART may be substantial and have broad economic implications.

This study estimates the effect of ART availability on work time in rural Malawi. With support from the Global Fund, the Ministry of Health (MoH) began to offer free ART in the study area in 2008. We implement a difference-in-difference empirical strategy that compares the change in work time near and far from ART facilities, and find that ART availability increases daily work time by 38 min for people near an ART facility. It increases daily cultivation time by 17 min and other production time by 14 min. We exclude people with HIV and caretakers in order to isolate a robust effect for people who do not directly benefit from ART.

Our identification strategy relies on the assumption that ART proximity is uncorrelated with unobservable changes in work time. Several results support the validity of this assumption. First, ART proximity is uncorrelated with pre-interventions levels and changes in work time and demographic characteristics. ART proximity is also uncorrelated with concurrent levels and changes for 13 measures of economic shocks and social support. Secondly, estimates are robust if we control for the interaction of Post with these variables, which suggests that correlated unobservable trends do not confound our estimates. Following Oster (2014) and Altonji et al. (2005), we quantify the unobservable selection needed to generate our findings spuriously under a proportional selection assumption. This test suggests that unobservable selection would need to be unrealistically strong to cause a spurious result. Finally, we implement placebo tests using the proximity of non-ART clinics, roads, trading centers and schools, all of which show small and insignificant estimates. These results support the validity of our empirical approach.

The strong response of HIV-negative non-caretakers (HIV-/NCTs) suggests that ART availability may influence risk perceptions. We validate this hypothesis by showing an effect on subjective mortality risk. ART availability reduces subjective five-year mortality risk by 3 percentage points (8 percent) for HIV-negative non-caretakers within 6 km of an ART facility. HIV infection risk and mortality risk conditional on infection both contribute to mortality risk for someone who is HIV-negative.¹ We show that ART availability reduces both mortality risk components.

The impact of ART availability on work time could arise through multiple channels, and a reduced-form study cannot directly isolate causal pathways. In principle, ART availability could affect either labor supply or labor demand. The labor demand channel is not especially plausible because most respondents are subsistence farmers and because ART availability has no effect on paid

employment or occupation choice. The intervention may increase labor supply by either strengthening the incentive to save or by improving mental health. Under the savings mechanism, ART availability leads people to work more in order to accumulate savings for the future. This mechanism is consistent with Baranov and Kohler's (2014) finding that ART availability leads people to invest in child human capital.

However life-cycle reoptimization may not fully explain the work time effect. Subsistence farmers who have increased labor supply to reoptimize production should arguably adjust the use of other farm inputs such as fertilizer, land, hired labor, and farm equipment. They may also invest in livestock, which is both an agricultural product and an asset. These farm variables, which are sensitive to other economic shocks, do not respond to ART availability, suggesting that another mechanism may contribute to this pattern. In the status quo, HIV risk threatens to exacerbate depression, anxiety, and the mental disorders that reduce labor supply (Ettner et al., 1997; Hamilton et al., 1997; Kessler and Frank, 1997; Berndt et al., 1998; Lim et al., 2000; Marcotte and Wilcox-Gok, 2003; Patel and Kleinman, 2003; Fletcher, 2013). ART availability has a strong and significant effect on mental health, improving an established mental health index by 0.13 standard deviations for HIV-negative non-caretakers near an ART facility. Although the direction of causality between mental health and labor supply is ambiguous, we find that ART availability reduces perceived mental-health limitations on activities and accomplishments, which is consistent with an effect of mental health on labor supply, rather than the reverse. This result suggests a new mechanism through which the disease environment may affect economic outcomes.

In summary, this paper makes several contributions. First, we document a novel and important economic spillover of the HIV/AIDS epidemic and ART. Studies of the labor-market impact of the HIV/AIDS epidemic focus on lost productivity for people who are HIV-positive (Young, 2005; Marinescu, 2014). However the economic impact for HIV-negative people is likely to matter simply because most workers are HIV-negative. Our findings complement other studies of the indirect effects of HIV/AIDS on risky behavior (DeWalque et al., 2007; Friedman, 2014; Baird et al., 2014; Gong, 2015) and health care delivery (Wilson et al., 2014). Secondly, we provide direct evidence of the risk-reduction benefit of medical innovation. While Lakdawalla et al. (2014) calibrate the benefit using US data on quality-of-life improvements, our estimates for mental health and subjective happiness quantify the effect of ART in a well-identified way. The large risk-reduction benefit of ART that we observe is understandable in light of the severity of the HIV/AIDS epidemic in this setting. Thirdly, we provide the first direct estimate of the effect of the disease environment on mental health. Although a literature examines how the disease environment affects productivity via physical health (Acemoglu et al., 2007; Bleakley, 2007), the contribution of mental health has not been considered. High mortality in developing countries may contribute to underdevelopment by fostering mental disorders that hamper productivity. Finally, we show the relationship between objective and subjective mortality risk in a developing country context. Other studies of the impact of mortality risk on behavior posit but do not show an effect on mortality risk perceptions (Jayachandran and Lleras-Muney, 2009; Fortson, 2011).

2. Context

2.1. Setting

Malawi is a small, landlocked country in Southern Africa with a population of 15.4 million and GDP per capita of \$343. The population is 85 percent rural. Most people live in remote villages

¹ Although researchers only established the impact of ART on transmission risk recently, scientists have long suspected this mechanism because ART dramatically reduces the viral load in the body. In addition, people who formulate risk perceptions according to observational heuristics may perceive an impact of ART on infection risk because they encounter fewer sick people.

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