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. We explore the possible reasons for this pattern and 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. 2008, 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. HIV/AIDS risk may lead people to reoptimize life-cycle decisions like labor supply and education by reducing life expectancy (Ben-Porath 1967, Cervellati and Sunde 2013). It may also affect economic outcomes by worsening mental health. In this setting, 30 percent of of respondents report feeling depressed and 44 percent report feeling 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, McLaren 2010, Thirumurthy et al. 2012). 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, Malani and Reif (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 33 minutes for people within six kilometers of an ART facility. It increases daily cultivation time by 15 minutes and other production time by 12 minutes. 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 level and changes for thirteen 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, Elder and Taber (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 effect 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 six kilometers of an ART facility. HIV infection risk and mortality risk conditional on infection both contribute to mortality risk for someone who is HIV-negative. 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. We find a strong impact of ART availability on HIV−/NCT mental health. 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 0.11 standard deviations for HIV-negative non-caretakers within six kilometers of an ART facility. 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, Gong 2014) and health care delivery (Wilson et al. 2014). Secondly, we provide direct evidence of the risk-reduction benefit of medical innovation. While Lakdawalla, Malani and Reif (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 and Johnson 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 and support themselves through subsistence farming of maize and other crops. In our data, 63 percent of respondents cultivate their own field and only 5 percent of respondents work for pay as the primary occupation. This setting differs from conventional labor markets in two important ways. Subsistence farmers do not interact extensively with labor or output markets, which means that work time largely reflects labor supply rather than labor demand. Secondly, people who are self-employed face fewer institutional restrictions like the forty-hour work week that dampen the labor supply elasticity. Therefore the work time response may be larger than we would expect in a formal labor market.

The HIV/AIDS epidemic is the central public health issue in Malawi. National HIV prevalence declined from 14.7 percent to 11 percent from 1998 to 2010 (UNAIDS 2010). As of 2008, life expectancy at birth is 52.9 years (WHO 2010) and AIDS is the leading cause of adult death (AVERT 2012). Heterosexual sex is the primary mode of HIV transmission in Malawi and elsewhere in SSA.

With US$294 million from the Global Fund to Fight AIDS, Tuberculosis and Malaria, the Ministry of Health (MoH) began offering free ART through existing public health clinics in 2004. Most facilities, which were not equipped to measure CD-4 counts, based eligibility for ART on a clinical diagnosis of Stage 4 AIDS. In 2004 and 2005, the MoH only offered ART through the largest and most advanced facilities. It expanded the program and offered ART through clinics with at least one clinician and clerk in 2006. Appendix Table 1 shows the characteristics of clinics throughout Malawi that received ART before May of 2006, from

June of 2006 to May of 2008, and after May of 2008. The earliest ART facilities are clearly larger and more advanced, however the difference between the second and third groups is less dramatic. As we describe below, a subset of clinics in the second group provide ART to the study population.

There is no evidence that the MoH targeted ART according to HIV prevalence or other HIV indicators. The MoH had an explicit policy to maximize geographic coverage while ensuring that ART facilities could administer the program correctly (MoH 2008, Libamba et al. 2006). The 2010 distribution of clinics suggests that the MoH faithfully implemented this policy. The North Zone had the highest concentration of ART facilities and the fewest potential recipients, while the South East Zone had the lowest concentration of facilities and the most potential recipients (MoH 2010). The lack of local data on HIV prevalence would have made targeting difficult. At the time, testing was not comprehensive enough to provide geographically precise HIV prevalence information.

Rudimentary transportation infrastructure limits the access to ART facilities in rural Malawi. Primary roads are paved but secondary roads (which lead to most villages) are unimproved. Few people own cars or motorcycles and public transportation is extremely limited. To receive treatment, an ART patient must visit a facility once every two weeks for the first two months and then once per month subsequently. Pinto et al. (2013) report that in the Zomba District of Malawi, ART patients travel $1-2$ hours each way to obtain medicine and spend an average of 7.1 hours seeking care, which may be very difficult for someone with AIDS. ART candidates cannot easily relocate closer to clinics because land is communally managed and property rental markets do not exist (Matchaya 2009).[1] Patients must appear in person during the first several months of treatment but may eventually send a proxy.

[1] Unless they happen to migrate to another MLSFH sample village, respondents who relocate closer to ART are recorded as attriters in our data set. As we discuss in Appendix Section A.1, this mechanism is unlikely to confound our estimates because attrition is uncorrelated with ART proximity.

2.2 Data

The Malawi Longitudinal Study of Families and Health (MLSFH) is an ongoing biennial panel survey of up to 4,000 respondents across 119 villages in three distinct regions of Malawi (Kohler et al. 2014, Anglewicz et al. 2009). Rumphi, Mchinji, and Balaka Districts are located in the north, center, and south of the country, respectively. We use survey rounds from 2004, 2006, 2008, and 2010. ART became available near MLSFH villages between August of 2007 and March of 2008. Surveys are conducted in June and July, and the median time between the opening of ART clinics and the 2008 interviews is 7 months, which appears to be a sufficient interval for expectations and mental health to adjust (Baird et al. 2013, Okeke and Wagner 2013).[2]

We use household-specific GPS coordinates to calculate each respondent's distance by road to the nearest ART facility in 2008. As an example, the circle in Figure 1 shows the approximate locations of sample households, which are confidential. The figure also shows the actual locations of ART and non-ART clinics, markets, and roads in Mchinji District. The north-south artery through the sample area is unpaved. Figure 2 shows the kernel density of the distance to an ART facility in 2008. 18 percent of respondents live within 5 kilometers of a facility and 68 percent live within 10 kilometers. All respondents live at least 1 kilometer away. Our main regressor is the the "proximity" to ART, which is defined as the inverse distance, although we also show results non-parametrically.

MLSFH data from 2012 allow us to validate the relationship between ART proximity and ART access. Spatial proximity is a standard proxy for access to health care in Africa (Guenther et al. 2012). The 2012 MLSFH survey round (which we do not use in our main analysis because it focuses on respondents over age 45) includes 23 HIV-positive respondents, 16 of whom receive ART. ART recipients live an average of 3.5 kilometers closer to

[2]Before nearby clinics began offering ART, the median distance to an ART facility was 27 kilometers. Several more clinics began to offer ART between 2008 and 2010. All of these facilities were further from respondents than the ART facilities that opened in 2008. The correlation between the distance by road and the straight line distance is 0.895.

ART facilities than non-recipients, a statistically significant difference. 4 out of 5 of respondents living within 6 kilometers of ART receive treatment, compared to only 3 out of 7 of respondents living over 12 kilometers away.

Clinics are usually located along primary roads and near trading centers. As a result, the distance to an ART facility is correlated with other geographic features. Many villages have schools, which tend to be centrally located near high-traffic areas. Respondents live a median of 4.2 kilometers from a primary road, 5.0 kilometers from a trading center, and 1.6 kilometers from a school. The correlation coefficients between the distance to ART and the distances to a road, trading center, and school are 0.17, 0.54, and 0.10 respectively.

Like other longitudinal data sets from developing countries, the MLSFH is subject to considerable attrition (Alderman et al. 2001, Thomas et al. 2012). The MLSFH loses approximately 10 percent of respondents to follow-up in between adjacent survey rounds because surveyors do not interview respondents who emigrate from sample villages. Instead, they refresh the sample with several hundred new respondents in each round (Kohler et al. 2014). Around 45 percent of one-time attriters appear in subsequent survey rounds, suggesting that they have migrated temporarily. Section A.1 discusses attrition in more detail. Since attrition is uncorrelated with ART proximity, it is unlikely to confound our estimates. Results are robust if we limit the sample to non-attriters.

Some estimates below restrict the sample to HIV-negative non-caretakers in order to isolate HIV risk as a mechanism. Surveyors tested respondents for HIV in 2004, 2006, and 2008 (Obare et al. 2009). The 2008 test results proxy for HIV status in 2010.[3] HIV prevalence was 5.3 percent in the MLSFH in 2006, before the arrival of ART. We define a caretaker as someone whose household includes at least one adult in poor health, regardless of the specific illness. This definition is conservative because it minimizes the chance of misclassifying caretakers as non-caretakers. However it may mistakenly identify "caretakers" who are not

[3] Adult HIV incidence is under 1 percent per year in the MLSFH population and throughout Malawi (Kohler et al. 2014, UNAIDS 2012). The 2008 test results should leave only a handful of undetected HIV cases by 2010.

individually responsible or whose family members have illnesses besides AIDS. This form of misclassification slightly reduces statistically power but does not otherwise threaten validity. Our sample includes 99 HIV-positive respondents and 425 caretakers.[4]

2.3 Measurement

To measure work time, the survey elicits the number of hours per day that respondents spend on productive activities, including farm cultivation, household production, and other economic activities. We define total work time as the sum of these components. This method of measuring work time is similar to other survey-based metrics, such as the Panel Study of Income Dynamics (PSID). 89 percent of respondents are interviewed in either June or July, which coincides with the maize harvest. Work time data are available in 2004, 2006, and 2010. The change from 2004 to 2006 allows us to investigate pre-intervention trends and the change from 2006 to 2010 provides the basis for our estimates. By 2010, ART had been available for over two years.

The MLSFH measures subjective mortality risk though an innovative, interactive methodology (Delavande and Kohler 2009). After explaining the concept of probability, surveyors elicit the subjective probability that the respondent will die within the next 1, 5, or 10 years. The survey also measures subjective perceptions of HIV infection risk and HIV status. Our analysis focuses on the 5-year horizon, although results for 1 year and 10 years are similar. According to Delavande and Kohler (2009), responses "take into account basic properties of probability and vary meaningfully with observable characteristics and past experience." When asked about the likelihood of visiting the market within two days as well as within two weeks, over 90 percent of respondents correctly provide a weakly greater probability over the longer interval. Delavande, Giné, and McKenzie (2011a, 2011b) show that responses are robust to variations in the elicitation methodology.

[4]Results for HIV-positive and caretaker respondents appear in Section A.2. We do not focus on these groups because the sample sizes are small and other studies already examine the direct impacts of HIV and ART (Chandra et al. 1998, Els et al. 1999, Tostes et al. 2004, Thirumurthy et al. 2008, Thom 2009, Kuo et al. 2012, McLaren 2010, Thirumurthy et al. 2012, Okeke and Wagner 2013).

ART availability may reduce subjective mortality risk by reducing either HIV-positive mortality risk or HIV infection risk. The MLSFH elicits the hypothetical mortality risk for someone with HIV. The survey also measures the respondent's perceived likelihood of contracting HIV "in the future", which is measured on a Likert scale from 0 (no likelihood) to 3 (high likelihood).[5]

The survey measures mental and physical health with the "twelve-item short form" (SF-12) questionnaire in 2006, 2008, and 2010. The SF-12 includes indicators for depression, anxiety, energy, and mental-health limitations on activities and accomplishments. The MCS-12 is a summary mental health score based on a factor-analytic weighting of these responses. It ranges from 0 to 100 with a mean of 50 and a standard deviation of 10 among respondents in the United States. Higher values indicate better health. The psychiatry literature has extensively used and validated the MCS-12 (Ware et al. 1996, Kessler et al. 2002). By combining SF-12 responses with clinical diagnoses, Gill et al. (2007) show that a threshold score of 45 predicts the presence of depression in 87 percent of cases and the absence of depression in 83 percent of cases. We analyze the depression, anxiety, and energy components of the MCS-12 individually by defining binary versions of these variables, which are originally measured on Likert scales. The binary variables indicate whether the respondent ever felt depressed and whether the respondent has always felt calm and energetic in the past four weeks. Estimates do not depend on this transformation and untransformed results are available from the authors. The survey also measures subjective well-being by asking "how satisfied are you with your life, all things considered?" on a five-point Likert scale. In 2006, 69 percent of respondents indicate that they are "somewhat satisfied" or "very satisfied".

[5]The survey also measures the probability of HIV infection (ranging from 0 to 1) within one year for a hypothetical person with "normal sexual behavior." Respondents perceive that a normal person has a 22 percent chance of contracting HIV within one year, which greatly exceeds Kohler et al.'s (2014) MLSFH incidence estimate of under 0.7 per 100 person years. Estimates using this variable (available from the authors) are equivalent to results for our primary HIV risk variable.

2.4 Baseline Characteristics

Table 1 shows summary statistics for key variables in 2006, prior to the intervention. Columns 1−3 focus on the full sample, including people who are HIV-positive or care for someone with HIV. Columns 4 − 6 provide information on the HIV-negative non-caretaker (HIV−/NCT) sample, which is similar. In Column 1, respondents are an average of 35 years old and have 5 years of education. 80 percent are married and 16 percent have a metal roof (a common wealth proxy). Respondents work an average of 8.2 hours per day, although a quarter work fewer than 6 hours and a quarter work more than 11 hours per day. They spend 32 percent of their time on cultivation, 49 percent on home production, and 19 percent on other economic activities. Respondents perceive a 39 percent risk of death within five years, which dramatically exceeds the life-table estimate of 8.5 percent for Malawians in this age cohort. They believe that HIV prevalence is 29 percent (although it is actually 6 percent) and that someone with HIV has a five-year mortality risk of 69 percent. Half of respondents perceive nonzero risk of becoming infected in the future, and 16 percent believe that this risk is "medium" or "high". 30 percent of respondents report feeling depressed in the last four weeks and 10-11 percent say that mental health limits their activities or accomplishments.

Columns 2 and 5 of Table 1 assess baseline balance by showing the coefficient from a regression of each variable on ART proximity with 2006 data. The difference in proximity above and below the median is 0.11 so that multiplying coefficients by this factor gives the mean difference between near and far respondents. ART proximity is uncorrelated with baseline work time. The insignificant coefficient of -0.22 implies that people near ART work around 2 fewer minutes per day. Cultivation work time has a similarly flat ART proximity gradient. People near ART spend 11 additional minutes on home production and 12 fewer minutes on other production than people far from ART, which is statistically significant but not an economically meaningful difference. ART proximity is also uncorrelated with age, marital status, household size, and monetary wealth. People near ART have 0.2 additional years of schooling and are 4 percentage points more likely to have a metal roof, which are the only significant demographic differences. Finally, ART proximity is uncorrelated with HIV prevalence, which is consistent with the lack of ART targeting.

In contrast, baseline subjective mortality risk and mental health are modestly correlated with ART proximity. Mortality risk perceptions are 2.5 percentage points higher and MCS-12 scores are 0.64 points lower (0.08 standard deviations) for people near ART. This pattern seems to arise because actual and perceived HIV conditions are worse near high-traffic areas, both in the MLSFH and in nationally-representative data (Feldacker et al. 2011).[6] People who witness AIDS mortality and morbidity have more extreme perceptions of the epidemic. Montgomery (2000) and Anglewicz and Kohler (2009) argue that people formulate beliefs about HIV and AIDS through observational heuristics. People may incorporate visible signals such as observed mortality and morbidity to arrive at perceptions of less observable HIV parameters like prevalence.[7]

In Columns 3 and 6, we assess this explanation by regressing each variable on ART proximity while controlling for the distance to a primary road, trading center, and school. We control for these distances semi-parametrically though region-specific quartile dummies for each variable. Although the estimates leave much unexplained variation (R^2 values range from 0.1 to 0.2), the spatial controls greatly reduce the correlation between ART proximity and the characteristics in the table. Coefficients are insignificant for all but two variables. In particular, the coefficients for own mortality risk and the MCS-12 score are 50-53 percent smaller and are no longer significant. These results suggest that people near ART perceive greater mortality risk and have worse mental health because they also live in places with

[6]Appendix Figure 1 shows local polynomial regressions of actual and perceived HIV prevalence and perceived infection risk on the distance to a trading center in Balaka District. The non-zero slopes in the figure show that both actual and perceived prevalence, subjective mortality risk, and mental health are worse near trading centers. Equivalent figures for the distance to a road and school and figures that combine the three districts (available from the authors) show the same pattern.

[7]In 2006, respondents had a median of two acquaintances with AIDS and had seen two other acquaintances die of AIDS in the past year. Appendix Figure 2 shows that respondent-observed AIDS mortality is strongly correlated with perceived infection risk despite being only weakly correlated with actual HIV prevalence. Perceived prevalence is 29 percent among respondents with no acquaintances who have recently died of AIDS, but is 38 percent among respondents with three or more dead acquaintances. These variables also predict subjective mortality risk and mental health. A similar figure for observed AIDS morbidity (available from the authors) shows the same pattern.

more foot traffic and therefore greater exposure to AIDS-related mortality and morbidity.

3 Estimation

3.1 Empirical Strategy and Identification

This section estimates the effect of ART availability on work time. Regressions are based on the following difference-in-difference specification, in which i indexes the individual, j indexes the village, r indexes the region, and t indexes the survey year.

$$y_{ijrt} = \beta[Post_t \cdot Prox_{ijr}] + \alpha_{ijr} + \delta_{rt} + \varepsilon_{ijrt} \tag{1}$$

$Prox_{ijr}$ is the inverse distance by road to the nearest ART facility once ART becomes available in 2008. This parameterization allows us to interpret access in terms of proximity, although we also show key results non-parametrically. Below we refer to the differential effects for "nearby respondents", which we obtain by scaling the coefficient estimates by 0.11, the average difference in proximity above and below the median. $Post_t$ is a dummy for the 2008 and/or 2010 survey rounds. α_{ijr} is an individual fixed effect (which replaces $Prox_{ijr}$) and δ_{rt} is a region-specific time fixed effect (which replaces $Post_t$). We cluster standard errors by village, which allows for arbitrarily-correlated errors for respondents in the same village, including respondents in the same household.

This empirical strategy relies on the assumption that ART proximity is uncorrelated with trends in the unobservable determinants of work time and other outcomes. As we discuss above, it is unlikely that policymakers targeted ART based on the local severity of the HIV/AIDS epidemic. However ART proximity could be incidentally correlated with economic shocks such as foreign aid, agricultural subsidies, or labor market conditions. We test the validity of the parallel trends assumption in two ways. First, we use data from 2004 and 2006 to test for pre-intervention trends in work time and available demographic characteristics. Secondly, we investigate concurrent trends in thirteen measures of economic shocks and support.

Table 2 tests for differential pre-trends by regressing work time and demographic variables on ART proximity, $2006 \cdot$ ART proximity, and regional time dummies with data from 2004 and 2006. The ART proximity coefficient provides the cross-sectional gradient in 2004 and the $2006 \cdot$ ART proximity coefficient provides the differential change near ART facilities. Panel A shows estimates for the full sample and Panel B shows estimates for the HIV$-$/NCT sample.

Column 1 of Table 2 shows that total work time has no differential pre-trend. According to the (statistically insignificant) coefficient of 0.26 in Panel A, work time differentially increases by just two minutes near ART. The 95-percent confidence interval for this estimate indicates that the differential pre-trend could range from -9 to 12 minutes. Even the upper-bound of 12 minutes is only 38 percent as large our main estimate below. This pre-trend is even smaller in the HIV$-$/NCT sample. Panel A of Figure 4 (which we discuss below) shows the absence of a differential pre-trend graphically by plotting the ART distance gradient for work time non-parametrically by year. Although work time increases from 2004 to 2006, there is no differential change because the gradient remains flat in both years.

The rest of Table 2 investigates differential pre-trends for the components of work time and for demographic characteristics. In Columns 2 and 3, pre-trends for cultivation and home production time are small and insignificant. Column 4 shows a small but significant differential pre-trend for time spent on other economic activities. The estimate indicates that, from 2004 to 2006, people near ART differentially reduced other economic time by 10 minutes in the full sample and by 12 minutes in the HIV$-$/NCT sample. The sign of this trend is the opposite of our main estimate below. Columns $5-8$ show that there are no significant pre-trends in education, marital status, household size, or metal roof ownership. In Column 9, there is no differential HIV prevalence trend, which further suggests a lack of targeting.

Next we assess whether economic conditions are correlated with ART proximity. ART availability may appear to increase work time if economic conditions differentially encourage labor near ART facilities. The MLSFH measures seven individual economic shocks, including income loss, property loss, the death of a breadwinner, divorce, poor harvest, heavy grain price fluctuations, and "other" shocks. The survey also measures the utilization of six forms of social support, including nutrition programs, agricultural subsidies, secondary and tertiary tuition subsidies, food-for-work programs, congregational support, and direct cash transfers. Since these variables are only available in 2008 and 2010, we cannot test for differential pre-trends. However we can assess whether ART availability is correlated with concurrent levels and changes in these variables. We regress these outcomes on ART proximity, $2010 \cdot$ ART proximity and regional time dummies with 2008 and 2010 data. The ART proximity coefficient measures the cross-sectional gradient in 2008 and the $2010 \cdot$ ART proximity coefficient measures the differential change from 2008 to 2010 near ART facilities.

Table 3 shows that concurrent economic shocks are not systematically correlated with ART proximity. Most estimates are economically small and statistically insignificant. According to the largest and most significant coefficient of 0.30 in Column 1, the probability of lost income increases differentially by 3 percentage points near ART, which is a small effect. Table 4 also shows a weak relationship between ART proximity and economic support. The coefficient on ART proximity is small and insignificant for five out of six variables while the coefficient on $2010 \cdot$ ART proximity is insignificant for four out of six variables. The estimates in the table do not show a consistent pattern: for instance, people near ART receive additional congregational support but less agricultural support. In general, these results suggest that concurrent economic patterns are unlikely to confound our estimates.

3.2 Estimates for Work Time

Table 5 shows the impact of ART availability on work time. In Panel A, which focuses on the full sample, the coefficient on ART proximity is 5.04. According to this estimate, ART availability increases daily work time differentially by 33 minutes for nearby respondents, which is 8 percent of the 2006 level. Panel A of Figure 4 illustrates this effect graphically by showing the ART distance gradient by year. Although the gradient is flat in the 2004 and 2006 pre-intervention rounds (consistent with the absence of pre-trends), it declines strikingly in ART distance in 2010, two years after ART becomes available. Panel B shows the gradient for the difference in work time between 2010 and 2006 and includes confidence intervals. ART proximity has the strongest effect in the range of 3 to 8 kilometers from a facility. By showing the effect non-parametrically, the figure also establishes that parametric assumptions are not responsible for the significant regression estimates.

Columns 3, 5, and 7 show that people primarily respond by spending more time on farming and other economic activities, rather than household production. Nearby respondents spend 15 additional minutes farming, 6 additional minutes on home production (which is not statistically significant), and 12 additional minutes on other economic activities. The magnitude of the farming time effect is consistent with the strong labor supply response to a 2005/2006 fertilizer subsidy program (Dorward et al. 2011), as well as other health interventions in developing countries (Behrman et al. 1997, Louriero 2009, Fink and Masiye 2012).[8]

Panel B of Table 5 focuses on the HIV−/NCT sample. Estimates in these panels closely resemble the results for the full sample in Panel A. Point estimates for total work time, cultivation time, and other production time are slightly larger (although the differences with Panel A are insignificant) for HIV-negative non-caretakers than for the full sample. In Column 1, ART availability increases daily work time by 37 minutes for nearby HIV-negative non-caretakers. Farm time and other economic time increase by 15 minutes and 12 minutes respectively. These results are striking because HIV-negative non-caretakers do not directly benefit from ART. This pattern strongly suggests that ART has a risk-reduction benefit for the majority of people who do not receive medicine.

[8] ART availability increases the maize yield differentially by 6 percent for nearby respondents ($p = 0.02$). Additional maize results are available from the authors. Because the data collection coincides with the maize harvest in June and July, these estimates do not address the potential work time response in other months. We cannot rule out that results arise through inter-seasonal labor substitution.

3.3 Robustness

Next we assess the robustness of the work time estimates. One concern is that the placement of ART may be correlated with demographic and economic determinants of work time. Tables 2−4 already address this issue by showing that ART proximity is not systematically correlated with observable demographic characteristics, economic shocks, or the utilization of economic support. As another test, the even columns of Table 5 estimate the impact of ART availability after controlling for trends in these variables. We include the controls flexibly by creating distinct year-specific versions of every control and interacting all of these variables with year dummies. Joint significance tests (available from the authors) show that these controls significantly impact work time. If unobservable trends are positively correlated with these variables and ART proximity, this approach should attenuate our estimates.

A comparison of the even and odd columns of Table 5 shows that estimates are insensitive to the controls. Including the controls causes the coefficient of interest to decrease by a maximum of 15 percent. However, Oster (2014) notes that the power of this exercise hinges on the explanatory power of the controls. We implement this test more systematically by following Altonji, Elder and Taber (2005) and Oster (2014) to assess whether unobservables could plausibly explain our results under the assumption that selection on observables and unobservables is proportional. Oster derives the proportionality coefficient (δ) necessary to cause the observed treatment effect spuriously.[9] A large value of δ indicates that a high degree of correlated unobservable selection is necessary to negate the observed estimate, which connotes robustness. Oster proposes $\delta = 1$ as a benchmark at which controls and unobservables are equally correlated with treatment. In fact a lower benchmark may be reasonable if the observables explain most of the selection. Negative values of δ, which occur when the controls strengthen the treatment effect estimate, mean that unobservables must

[9] In Oster's notation, X is the treatment, W_1 is a vector of observable controls and W_2 is a vector of unobservables. She defines δ so that $\frac{Cov(X,W_2)}{Var(W_2)} = \delta\frac{Cov(X,W_1)}{Var(W_1)}$. Therefore δ represents the strength of selection on unobservables relative to selection on observables. We assume conservatively for this exercise that all of the residual variation in work time may arise through unobservable selection.

be *negatively* correlated with the controls to negate the estimate. Since positively correlated unobservables (e.g. unmeasured economic shocks) are the main threat to identification, negative δ's also connote robustness.

We report estimates of δ in brackets for regressions with controls. In Column 2, the estimate that $\delta = -2.23$ in Panel A means that unobservable trends must cause more than twice as much selection as the controls and be negatively-correlated with the controls to negate the full-sample estimate. According to the estimate of $\delta = 1.11$ in Panel B, unobservable trends must cause more selection than the controls to negate the HIV−/NCT estimate. Unobservable trends of this magnitude are unlikely because the controls already catalog the main economic shocks in this setting. δ estimates for the components of work time in Columns 4, 6, and 8 are similarly large or negative, although δ values are mechanically smaller for coefficients with less statistical significance.

3.4 Placebo Tests

Next we test the validity of our findings through four placebo tests. One concern is that our estimates may reflect a spatial correlation between ART and other features such as medical facilities and population centers. If differential trends near clinics confound our estimates, then regressions based on non-ART clinic proximity may yield spurious results. Similarly, if results arise because of differential trends near population centers, then regressions based on the proximity of roads, trading centers, and schools may show effects.

Table 6 shows the interactions between a 2010 dummy and ART, clinic, major road, trading center, and school proximities. Conditional on ART proximity, the $2010 \cdot$clinic proximity coefficient is identified through the 68-percent subsample whose nearest clinic does not offer ART. Columns $1-4$ show full sample estimates and Columns $5-8$ show HIV−/NCT estimates. In Columns 1 and 5, the effects of clinic proximity, road proximity, and school proximity on work time are small and insignificant.[10] The effect of trading center proximity

[10] One limitation the clinic proximity test is that ART and non-ART clinics also differ in other dimensions.

is marginally significant but small. In contrast, the impact of ART availability conditional on these variables closely resembles the Table 5 estimate. The full-sample estimate in Column 1 is 96 percent as large in Table 5, while the HIV−/NCT estimate in Column 5 is 94 percent as large. These patterns suggest that results are due to ART access rather than proximity to other geographic features.

Figure 5 explores this pattern graphically by plotting distance gradients to a non-ART clinic, major road, trading center, and school for the change in work time from 2006 to 2010. These plots are analogous to the ART distance gradient in Panel B of Figure 4.[11] These gradients are much flatter that Figure 4, and suggest further that the impact of ART availability is not based on a correlation with the distance to these features.

4 Interpretation

4.1 Subjective Mortality Risk

The strong effect of ART availability on the work time of HIV−/NCT respondents is puzzling since these people do not directly benefit from AIDS treatment. However ART availability may affect work time by changing risk perceptions in this population. This subsection shows that ART availability reduces subjective mortality risk for HIV−/NCT respondents. In principle, ART benefits HIV-negative people by reducing HIV infection risk and mortality risk conditional on infection. Mortality risk data are available in 2006, 2008, and 2010. Without multiple pre-intervention rounds for these outcomes, we cannot investigate differential pre-trends. Table 1 shows that prior to the intervention, HIV−/NCT respondents perceived a 37 percent risk of death within five years, nearly four times as large as the life-table estimate for this age cohort in Malawi. They perceived a 68 percent mortality risk conditional on HIV infection.

A comparison of Columns 2 and 3 of Appendix Table 1 shows that ART clinics are more advanced than non-ART clinics, but that for the most part these facilities offer similar non-ART health services.

[11] The plot for non-ART clinic distance in the upper left uses the subsample whose nearest clinic does not offer ART.

For someone who is HIV-negative, subjective mortality risk depends on both infection risk and HIV-positive mortality risk. Table 7 shows the effect of ART availability on subjective mortality risk, infection risk, and HIV-positive mortality risk for the HIV−/NCT sample. As above, even columns include demographic and economic controls and proportional selection δ's in brackets. We report interactions with 2008 and 2010 dummies, both of which belong to the "post" period.[12] Columns 1 and 2 show estimates for own five-year mortality risk. Multiplying the coefficient by 0.11 shows that ART availability reduces subjective mortality risk differentially by 3 percentage points for nearby respondents by 2010.

Figure 6 illustrates this result graphically by plotting the ART distance gradient by year (Panel A) and for the 2006−2010 change (Panel B). The 2006 gradient shows higher baseline mortality risk near ART facilities, which is also evident in Table 1. As we discuss above, this pattern most likely arises because evidence of AIDS morbidity and mortality is more visible near populated areas. The figure also shows that perceived mortality risk increases over time, which is likely due to a temporal increase in observed AIDS morbidity and mortality.[13] Our regression estimate arises because the ART distance gradient flattens between 2006 and 2008 and reverses sign by 2010, so that people near ART eventually perceive less risk than people far away. Estimates for subjective mortality risk over one-year and ten-year horizon (available from the authors) closely resemble the results in the table.

Columns 3 and 4 of Table 7 show that ART availability significantly reduces HIV-positive mortality risk and Columns 5 and 6 show that it significantly reduces perceived HIV infection risk. It is difficult to compare the magnitudes of these effects because HIV-positive mortality risk is measured on a probability scale and infection risk is measured on a Likert scale. Finally, Columns 7 and 8 show that ART availability significantly reduces the

[12] ART became available in designated facilities several months before the 2008 survey round. However 2010 effects may be stronger than 2008 effects due to greater exposure to treatment.

[13] The average number of observed AIDS deaths per year grew from 2.0 to 3.7 from 2006 to 2010. This pattern concurs with an 88 percent increase in MLSFH attrition due to mortality over the period (Kohler et al. 2014). The average number of acquaintances with AIDS (which is not available in 2010) grew from 2.2 to 3.4 from 2006 to 2008. During this period, perceived HIV prevalence grew from 28 to 37 percent and the share of respondents who were "worried" about HIV/AIDS rose from 41 to 51 percent.

extent to which respondents "worry about HIV." This estimate suggests a link between ART availability, subjective mortality risk, and mental health, which we explore further below.

4.2 Reasons for the Work Time Response

4.2.1 Life-Cycle Incentives

ART availability may increase HIV−/NCT work time because life expectancy influences the life-cycle incentive to save. The sign of this effect is ambiguous because additional life expectancy increases both the demand for assets and the earnings time horizon (Hazan 2009). Therefore ART availability may either lead people to supply more labor to save for the future or to supply less labor by providing a longer horizon to accumulate savings. Baranov and Kohler (2014) show that ART availability leads to an increase in expenditures on children, which is consistent with life-cycle reoptimization (Bloom et al. 2003, Ben-Porath 1967, Cervellati and Sunde 2013).

To investigate this possibility further, we explore whether people respond to ART availability on other margins. Cultivation of own land is the primary occupation for 63 percent of the sample, while paid employment is the primary occupation for just 4 percent of the sample. Nearly all respondents, including those with other primary occupations, cultivate maize. While maize is labor intensive, farmers can increase yields with fertilizer and basic mechanization. Column 3 of Table 5 shows that ART significantly increases agricultural work time. A person who reoptimizes agricultural work time should also reoptimize other farm inputs that are within his or her control.

Table 8 estimates the impact of ART availability on fertilizer use, new equipment purchases, hired labor, and seed purchases, as well as the ownership of cattle, goats, pigs, and chickens. Before proceeding, we regress these variables on economic shock and support controls to confirm that they are sensitive to economic incentives. P-values are below 0.01 in every case, indicating that these variables are sensitive to shocks (estimates available from the authors).[14] Since all of these outcomes are censored at zero, we estimate Tobit models in which positive observations are expressed in logs.[15] Columns 1−4 show that ART availability does not increase the utilization of other farm inputs. Both extensive and intensive impacts are insignificant for fertilizer, equipment, and seeds. In Column 3, respondents utilize *less* hired labor, which is consistent with substitution between own and hired labor inputs.

Livestock are both a farm product and an asset. People who have reoptimized farm labor to save for the future may accumulate livestock either to increase production or to save. Columns 5 − 8 of Table 8 show that ART availability does not lead people to accumulate livestock. Column 5 indicates that people near ART decrease cattle ownership while Columns 6 − 8 show no effect on ownership of goats, pigs, and chickens. These findings suggest that life-cycle reoptimization may not fully explain the strong HIV−/NCT work time response.

4.2.2 General-Equilibrium Effects

Alternatively, ART availability may increase HIV−/NCT work time by increasing labor or output demand. ART recipients may demand additional goods and services, increasing economic opportunity near ART facilities. They may supply more labor, which could increase HIV-negative labor demand if labor inputs are complementary. These mechanisms are not especially plausible for two reasons. First, in a subsistence economy, most people are self-employed and consume their own output, so that markets do not heavily influence labor supply decisions on the margin. Secondly, with HIV prevalence of 6 percent (for adults in the MLSFH), ART provision only affects the behavior and physical health of a small share of the community. It is unlikely that the health improvement for ART recipients would be large enough to change labor or output demand. It is also unlikely that ART-related activities such as travel to and from clinics would influence local economic conditions.

[14]We also find no effect on land ownership below. However land ownership is not sensitive to economic shock and support variables, perhaps because land markets do not exist in this setting. The results in Table 8 are similar if we look only at respondents who work primarily in agriculture.

[15]This econometric model is appropriate for log-normally distributed outcomes such as expenditures (Cameron and Trivedi 2010, p. 545). This specification omits individual fixed effects, which are incompatible with the Tobit model.

To support this argument further, we estimate the impact of ART availability on occupation choice (results available from the authors). We distinguish between subsistence farming (the modal category) and all other occupations, such as wage labor market work, domestic activities, and unemployment. With a joint p-value of 0.11, subsistence farming is sensitive to economic shocks and support. However ART availability has a small and insignificant effect on occupation choice. The coefficient on ART proximity is -0.08 in 2008 and 0.09 in 2010, with p-values of 0.63 and 0.60 respectively. Although the magnitude is small, the positive 2010 coefficient suggests that, if anything, ART availability *increases* subsistence farming, which is incompatible with labor demand as the explanation for the impact on work time.

4.2.3 Mental Health

Finally, ART availability may increase work time by improving mental health. People who worry about HIV/AIDS are at risk of depression, anxiety, and other mental disorders. Traumatic life events such as the deaths of family members are also common in HIV-endemic settings.[16] Mental health may affect labor supply through the disutility of effort. The marginal benefit of a unit of labor increases with effort, so that a mental health improvement increases the return to labor and the optimal labor supply (Fortin et al. 2010). Economic and psychiatric studies correlate mental health and labor market outcomes such as employment, absenteeism, and earnings (e.g. Ettner et al. 1997, Kessler and Frank 1997, Hamilton et al. 1997, Berndt et al. 1998). sd 8.78

Table 9 shows the impact of ART availability on mental health. Columns 1 and 2 show results for the MCS-12 score without and with demographic and economic controls. According to the 2010 estimate, ART availability increases the MCS-12 nearby respondents by 0.93 points (0.11 standard deviations), which is 25 percent of the pre-ART mental health

[16] Although studies show that HIV infection worsens mental health (Chandra et al. 1998, Els et al. 1999, Tostes et al. 2004, Thom 2009, Okeke and Wagner 2013), we are unaware of research on the mental health impact of HIV risk for people who are HIV-negative.

difference between HIV-negative and HIV-positive respondents (3.74 points). MCS-12 deviations of this magnitude are associated with tangible differences in income and household circumstances in other settings (Larson 2002, Balsa et al. 2009). A comparison of Columns 1 and 2 shows that the estimate is insensitive to the controls, although δ's are somewhat lower than for work time or mortality risk.

Figure 7 illustrates the identifying variation for these estimates by plotting the ART distance gradient for the MCS-12 score non-parametrically by year. Panel A shows two important patterns. Mental health is worse near eventual ART facilities in the 2006 pre-intervention round, which is also evident in Table 1. As we discuss above, greater exposure to AIDS morbidity and mortality near populated areas is the most likely explanation for this pattern. Secondly, the MCS-12 declines over time, falling by 0.3 standard deviations from 55.6 to 53.0 from 2006 to 2010. An increase in AIDS morbidity and mortality over time may explain this pattern, as we discuss in Section 4.1. The regression estimate for mental health arises because mental health falls differentially over time for people who live far from ART.

Columns $3-7$ of Table 9 show the impact on MCS-12 components, including depression, energy, anxiety (calm), and mental-health limitations on activities and accomplishments. These variables are symptomatic of poor mental health but may not predict mental disorders independently. In Columns $3-5$, ART availability reduces the depression and anxiety measures by 5 and 6 percentage points, respectively, for nearby respondents. In Columns 6 and 7, ART availability has negative and significant effects on perceived mental-health limitations on activities and accomplishments.[17] Column 8 shows a significant positive effect on subjective well-being.

The strong impact on mental health suggests that mental health may contribute to the impact of ART availability on HIV$-$/NCT work time. Table 10 provides more suggestive evidence of this relationship by showing the association between mortality risk, mental health,

[17] The impact of ART availability on work time and mental health is stronger for women than for men. Women may respond more because they face biologically higher HIV infection risk. HIV risk may also have a larger effect on female mental health because women have less control over their sexual behavior and HIV risk exposure. More detailed results by gender are available from the authors.

and work time. We regress mental health on subjective mortality risk in Columns 1 and 2 and work time on mental health in Columns 3 and 4. Odd columns, which omit individual fixed effects, are identified through both cross-sectional and temporal variation while even columns, which include individual fixed effects, are identified through temporal variation within individuals. Columns 1 and 2 imply that mental health is $4-6$ points lower for someone who is certain she will die than for someone who is certain she will survive. Columns 3 and 4 indicate that a one-point increase in the MCS-12 is associated with $2-3$ additional minutes of work per day.[18] Regressions that control for demographic, economic, and safety net variables (available from the authors) lead to very similar estimates.

A reduced-form analysis cannot establish mechanisms definitively. Instead of an effect of mental health on work time, the increase in work time in Table 5 may improve mental health. Studies in several contexts show that economic circumstances (e.g. retirement, macroeconomic conditions, winning the lottery) affect mental health (Mandal and Roe 2008, Dave et al. 2008, Tefft 2011, Latif 2013, McInerney et al. 2013, Apouey and Clark 2014). The significant impact of ART availability on perceived mental-health limits on activities and accomplishments directly suggests an effect of mental health on labor supply. People near ART perceive that poor mental health has less of an effect on their lives.

5 Conclusion

We find that ART availability increases work time for HIV-negative non-caretakers, who do not directly benefit from AIDS treatment. Several tests show that this result is robust. Total work time and demographic characteristics do not have differential pre-intervention trends that could cause a spurious result. ART availability is not systematically correlated with observable economic shocks or measures of economic support, which minimizes the concern

[18] Taken at face value, this magnitude suggests that mental health cannot fully explain the impact of ART availability on work time in Table 5. However the MCS-12 score is a proxy variable with substantial measurement error, which may attenuate the estimates in Table 10. This issue does not interfere with Table 9 because the MCS-12 score is not a regressor.

that ART proximity is incidentally correlated with economic determinants of work time. Estimates are robust if we control flexibly for these variables. Placebo tests for non-ART clinics, roads, trading centers, and schools show that the proximity of these features does not lead to similar results.

Next we explore the possible channels for this effect. Estimates for subjective mortality risk confirm that ART availability reduces perceived risk for people who are HIV-negative. We investigate the three primary ways through which ART availability may affect HIV−/NCT work time, including life-cycle optimization, general-equilibrium market effects, and mental health. While respondents may increase labor supply to accumulate savings, the lack of an impact on other farm activities suggests that this channel may not fully explain the response. ART availability has a large and significant effect on mental health, which suggests that this mechanism may be important.

These results lead to two broader points. Estimates suggest that ART, one of the most significant recent global health innovations, has a large risk-reduction benefit in Sub-Saharan Africa. This finding is not surprising given the prevalence and severity of HIV/AIDS. Health economists do not normally account for the risk-reduction benefit of medical innovation (Lakdawalla et al. 2014). Our results for work time and mental health direct document the large economic and welfare benefit of ART through the risk reduction channel.

Secondly, we show that the impact of the HIV/AIDS epidemic is broader than previously understood. Existing analyses of the economic consequences of HIV/AIDS focus on the health impact for HIV-positive people (Young 2005, Marinescu 2014). Studies of HIV-negative people mostly examine risky sexual behavior (DeWalque et al. 2007, Friedman 2014, Gong 2014), which is reasonable since this behavior determines transmission and HIV prevalence. By showing that HIV-negative people respond strongly to ART availability, we indirectly demonstrate that HIV/AIDS distorts behavior in important wants that microeconomic and macroeconomic analyses of HIV should acknowledge.

Finally, the estimates for mental health suggest an important potential relationship between the disease environment and economic development. Acemoglu and Johnson (2007) and Bleakley (2007) show that the disease environment affects development via physical health, but existing work does not explore the way that the disease environment may affect development via mental health. Extreme disease conditions like the HIV/AIDS epidemic create trauma, stress, and uncertainty that may hamper productivity by exacerbating poor mental health.

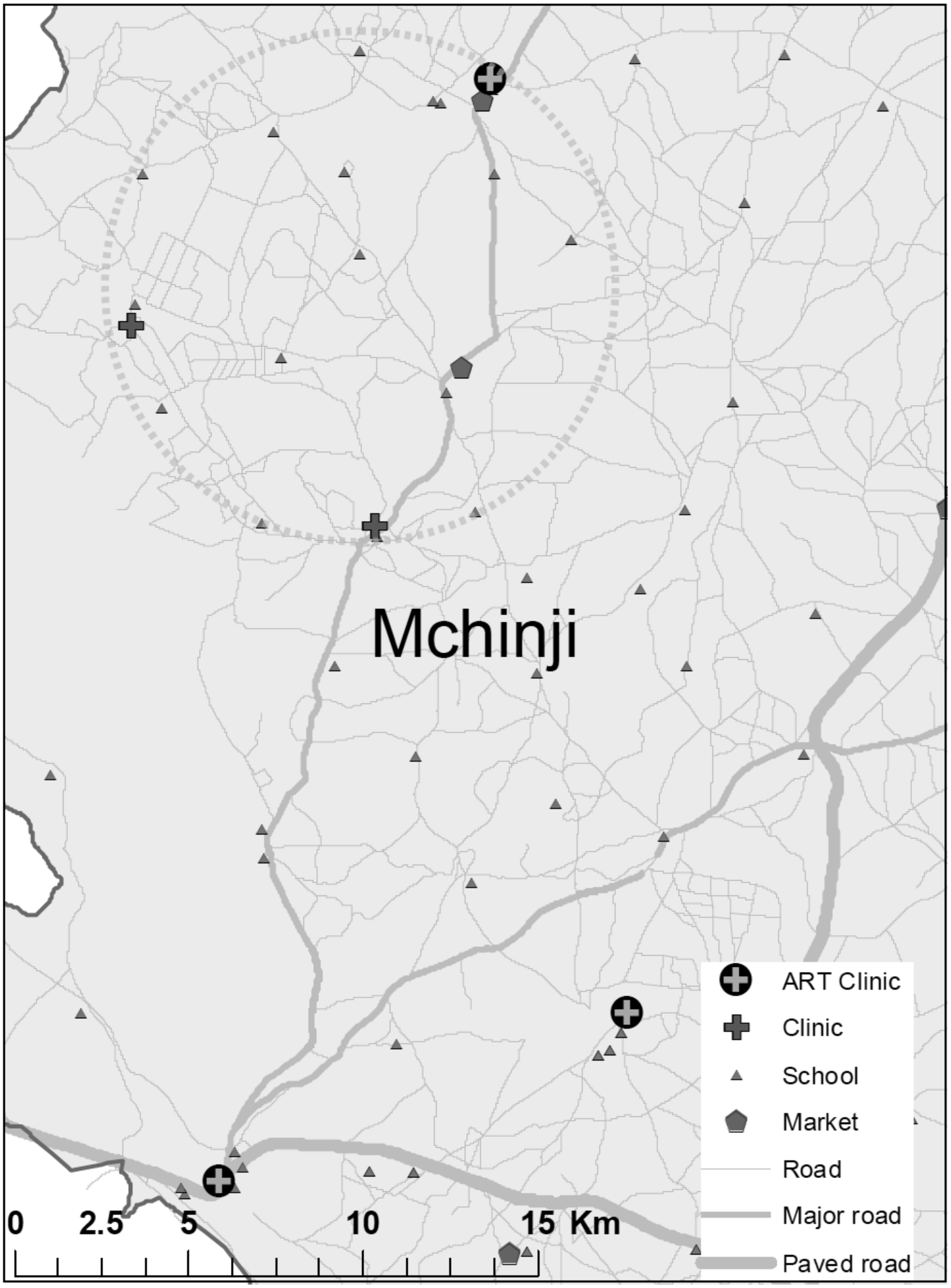


Figure 1: The Approximate Survey Area Within Mchinji Region

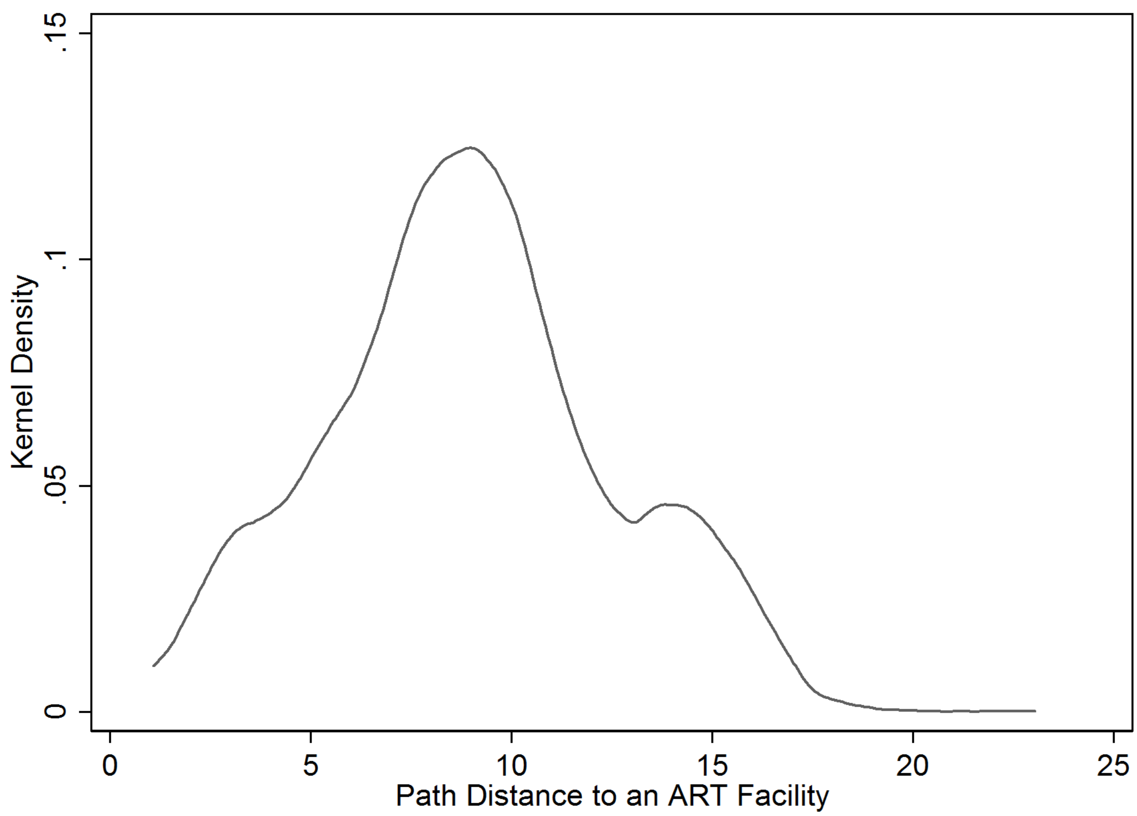


Figure 2: Kernel Density of the Distance to an ART Facility

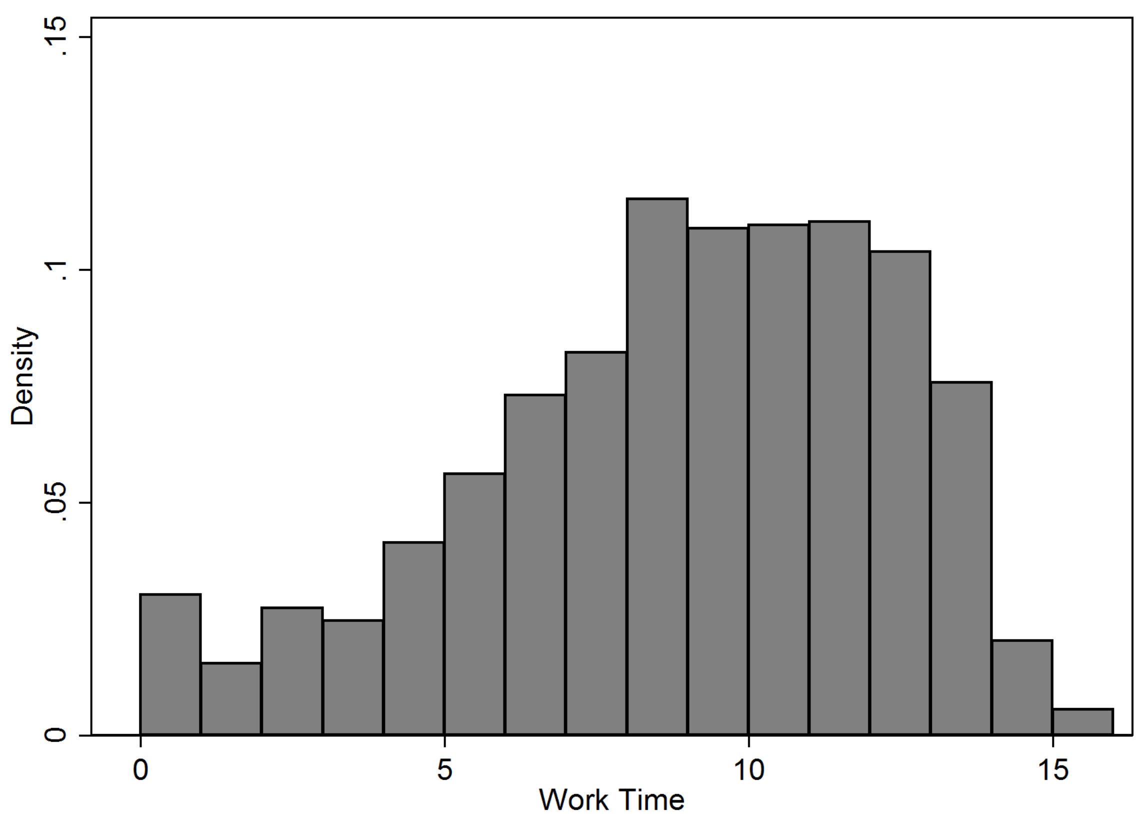


Figure 3: Histogram of Total Daily Work Time

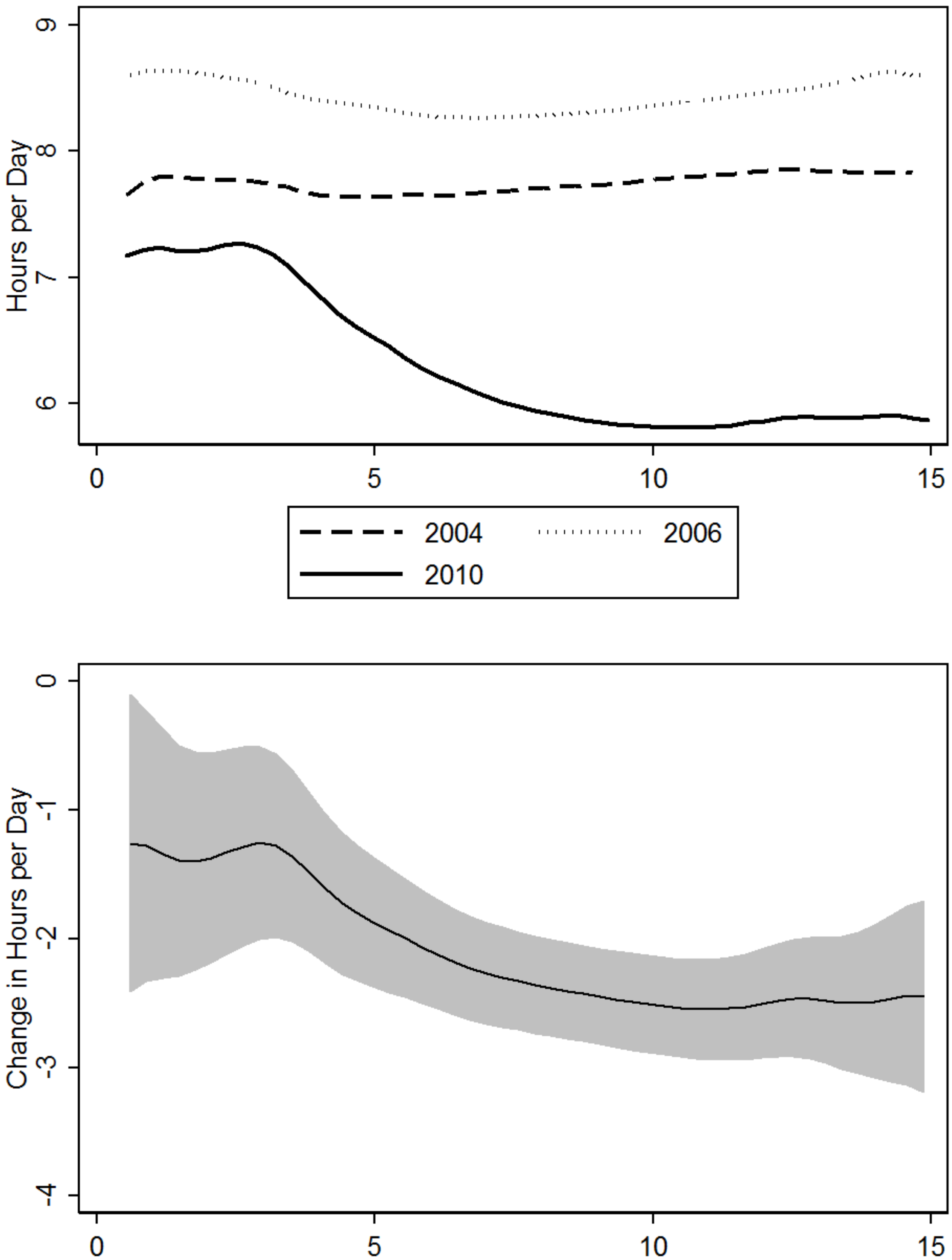


Figure 4: Local Linear Regressions of Work Time on the Distance to ART by Year (Above) and with 2006-2010 Changes (Below)

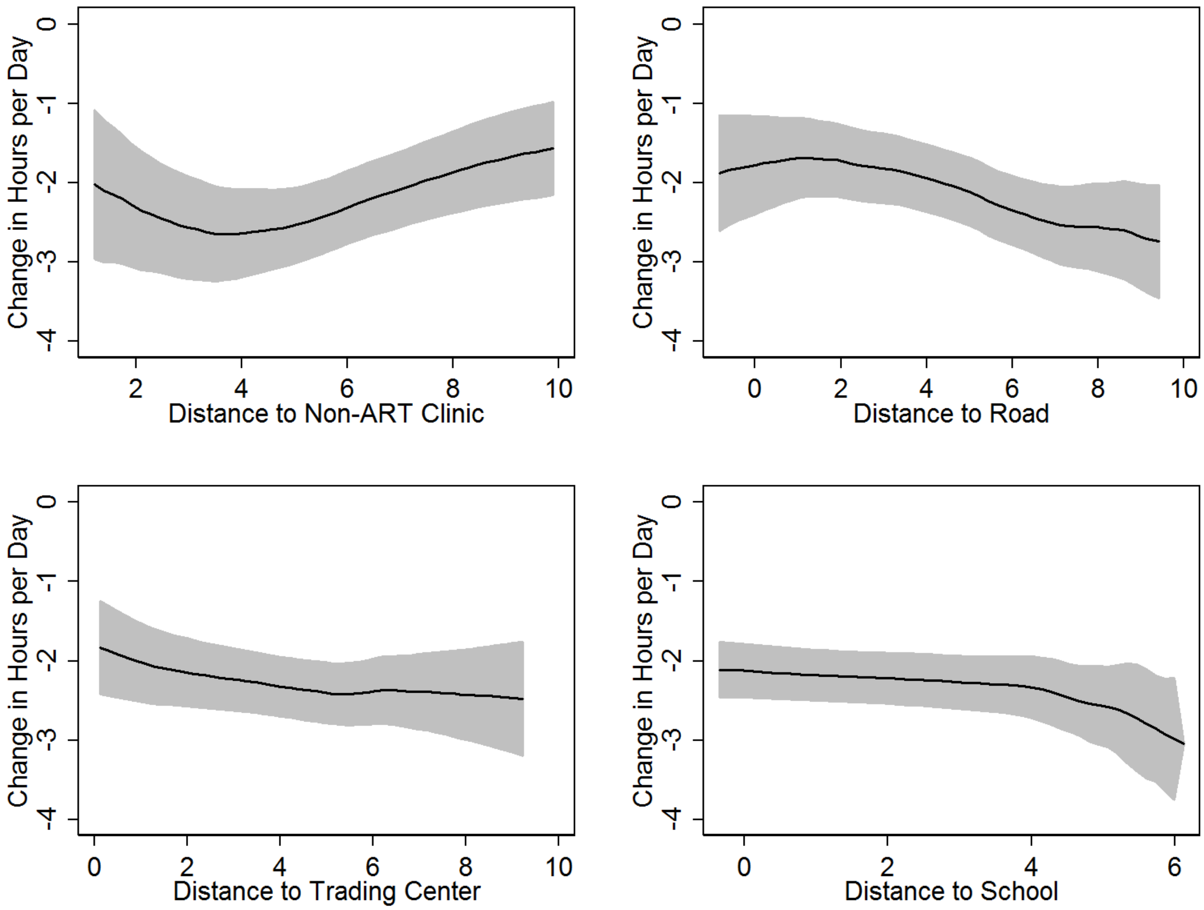


Figure 5: Local Linear Regressions of the 2006-2010 Change in Work Time on Alternative Distances

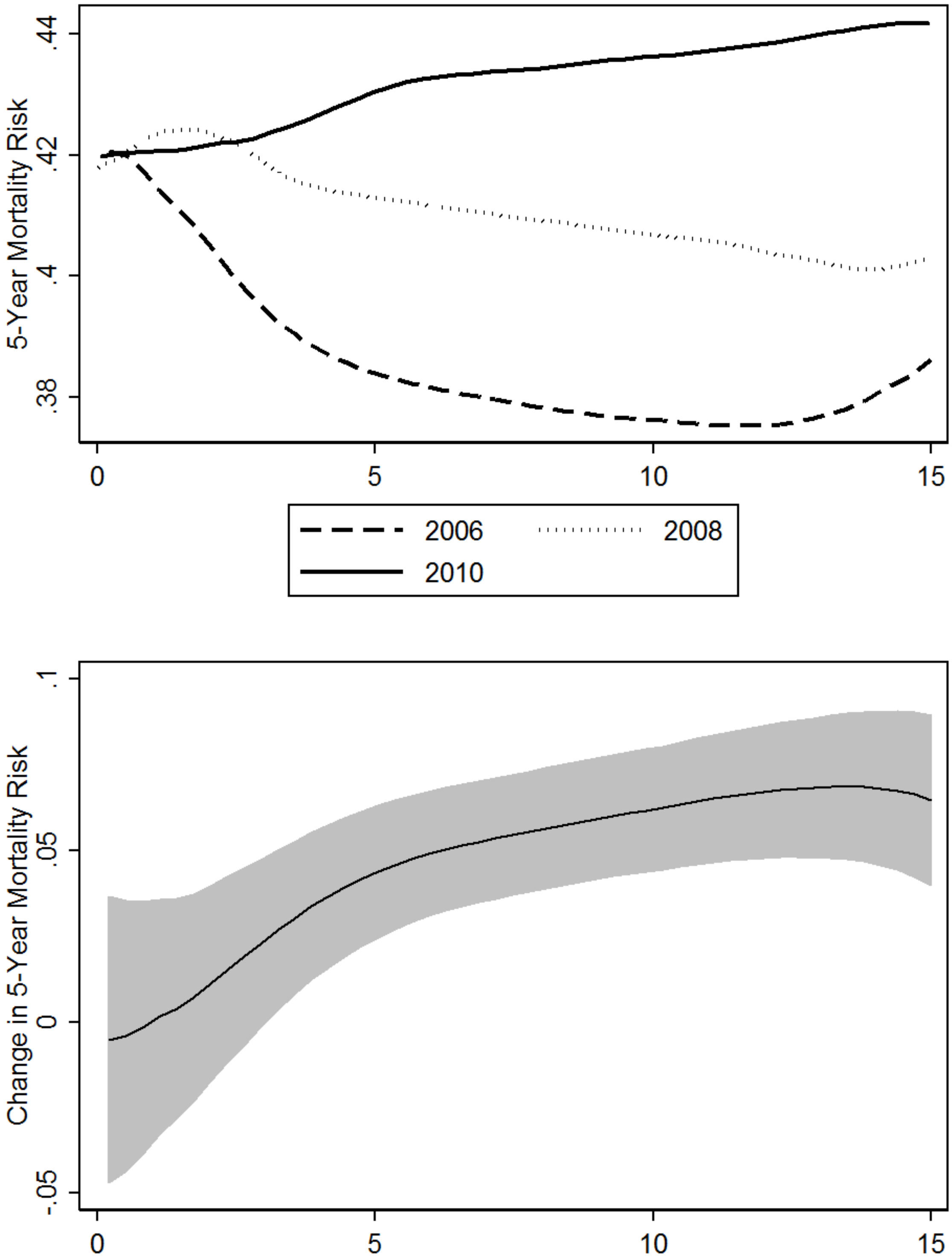
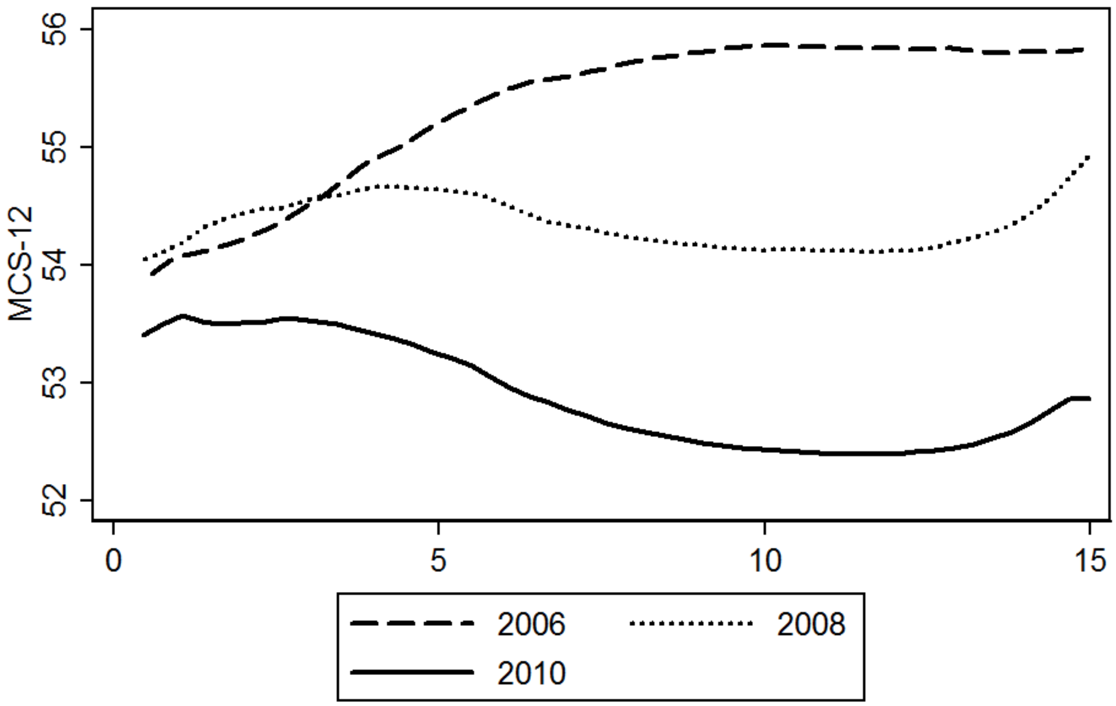


Figure 6: Local Linear Regressions of Subjective Mortality Risk on the Distance to ART by Year (Above) and with 2006-2010 Changes (Below)



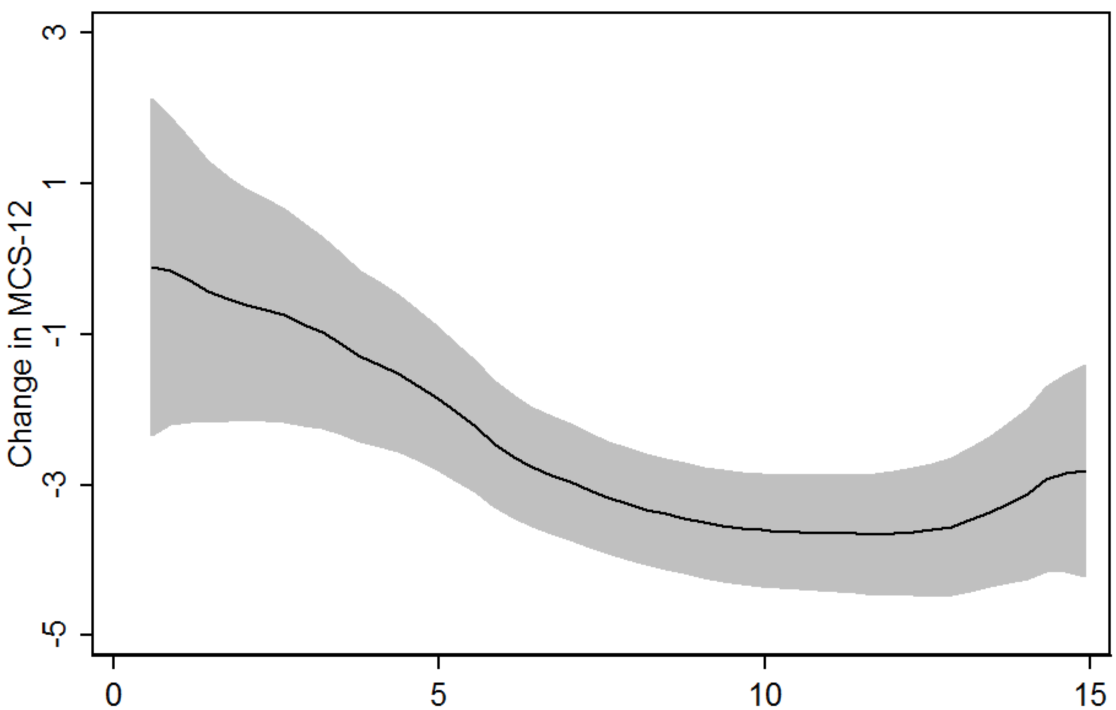


Figure 7: Local Linear Regressions Mental Health on the Distance to ART by Year (Above) and with 2006-2010 Changes (Below)

Table 1: Pre-Intervention Summary Statistics

	Full Sample			HIV−/NCT Sample		
	Mean	$\hat{\beta}$(ART Prox.)		Mean	$\hat{\beta}$(ART Prox.)	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Demographics						
Education	5.16	1.78**	0.25	5.43	1.44*	-0.09
Age	35.4	0.63	2.87	34.3	1.10	2.54
Married	0.79	-0.11	0.14	0.80	-0.17	0.00
Household size	5.24	0.31	0.95	5.32	-0.20	0.31
Metal roof	0.16	0.37**	0.15	0.16	0.39**	0.16
Monetary wealth (USD)	31.2	31.3	-76.7	31.9	50.5	-95.9
HIV-positive	0.05	0.10	0.57	0.00	-	-
Panel B: Work Time						
Total (hours per day)	8.24	-0.22	1.02	8.20	-0.60	1.11
Farming	2.64	-0.10	-0.10	2.67	-0.08	0.67
Home production	4.05	1.69**	1.01	3.95	1.78**	0.29
Other production	1.54	-1.81*	0.11	1.59	-2.30**	0.15
Panel C: Mortality Risk						
Own five year	0.39	0.23***	0.11	0.37	0.15**	-0.02
HIV+ five year	0.69	0.24***	0.17***	0.68	0.24***	0.17**
Infection risk	0.73	0.77***	0.34	0.68	0.56***	-0.11
HIV prevalence	0.29	0.11**	0.09	0.28	0.05	-0.05
Worried about HIV	1.57	0.60***	0.36	1.53	0.50**	-0.02
Panel D: Mental Health						
MCS-12	55.6	-5.8***	-2.9	56.2	-5.32**	-0.90
Depressed in last 4 weeks	0.30	0.54***	0.33	0.28	0.43***	0.21
Energetic in last 4 weeks	0.57	-0.23	0.02	0.60	-0.17	0.13
Calm in last 4 weeks	0.56	-0.38***	-0.23	0.59	-0.33***	-0.20
MH limits on activities	0.10	0.11	-0.02	0.09	0.10	-0.05
MH limits on accomps.	0.11	0.10	0.01	0.09	0.11	-0.05
Geographic controls	-	No	Yes	-	No	Yes

Note: we regress each variable on ART proximity using 2006 data in Columns 2, 3, 5, and 6. Columns 2 and 5 only control for region fixed effects. Columns 3 and 6 control semi-parametically for road, trading center, and school proximity. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 2: Pre-Intervention Changes in Work Time and Demographic Characteristics

	Work Time						HH	Metal	
	Total	Farm	House	Other	Educ.	Married	Size	Roof	HIV+
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Full Sample									
ART proximity	-0.48	-0.99	0.73	-0.22	1.47	-0.17**	0.65	0.29*	0.029
	(0.86)	(0.90)	(0.73)	(1.06)	(1.15)	(0.072)	(0.75)	(0.17)	(0.072)
2006 · ART proximity	0.26	0.89	0.96	-1.59**	0.43	-0.04	-0.99	0.11	0.06
	(0.85)	(0.96)	(0.74)	(0.63)	(0.60)	(0.08)	(0.74)	(0.09)	(0.05)
Dependent variable mean	8.03	2.50	4.08	1.46	4.94	0.86	5.32	0.15	0.06
Observations	3757	3757	3757	3757	3667	3702	3061	3675	3609
R^2	0.01	0.08	0.03	0.04	0.38	0.04	0.03	0.04	0.01
Panel B: HIV−/NCT Sample									
ART proximity	-0.68	-1.32	1.12	-0.48	1.35	-0.21**	0.83	0.27	-
	(1.09)	(0.87)	(0.75)	(1.08)	(1.29)	(0.092)	(0.72)	(0.18)	
2006 · ART Proximity	0.08	1.25	0.65	-1.82***	0.43	-0.017	-1.50*	0.16	-
	(1.16)	(0.85)	(0.87)	(0.51)	(0.62)	(0.096)	(0.82)	(0.10)	
Dependent variable mean	8.03	2.53	4.01	1.49	5.13	0.87	5.29	0.15	-
Observations	2804	2804	2804	2804	2733	2762	2278	2742	
R^2	0.01	0.08	0.03	0.04	0.40	0.06	0.04	0.04	

Note: Village-clustered standard errors appear in parentheses. Regressions are based on data from 2004 and 2006. All regressions include region · year fixed effects. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: ART Proximity and Post-Intervention Economic Shocks

	Lost income	Damages	Loss of provider	Divorce	Poor crop	Grain price fluctuation	Other shocks
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Full Sample							
ART Proximity	-0.11	0.04	0.01	0.08	-0.21	-0.11	-0.01
	(0.12)	(0.09)	(0.11)	(0.07)	(0.18)	(0.11)	(0.01)
2010 · ART proximity	0.30*	-0.13	0.02	-0.12	0.12	-0.21	0.16
	(0.17)	(0.09)	(0.16)	(0.09)	(0.21)	(0.15)	(0.13)
Dependent variable mean	0.40	0.12	0.39	0.09	0.68	0.73	0.35
Observations	3032	3032	3032	3032	3032	3032	3032
R^2	0.05	0.01	0.01	0.00	0.06	0.04	0.48
Panel B: HIV−/NCT Sample							
ART proximity	-0.030	0.024	0.046	0.084	-0.23	-0.093	-0.007
	(0.15)	(0.093)	(0.11)	(0.088)	(0.19)	(0.10)	(0.007)
2010 · ART proximity	0.27	-0.086	-0.095	-0.11	0.20	-0.27	0.16
	(0.21)	(0.11)	(0.20)	(0.13)	(0.22)	(0.17)	(0.13)
Dependent variable mean	0.40	0.11	0.38	0.09	0.67	0.72	0.35
Observations	2280	2280	2280	2280	2280	2280	2280
R^2	0.06	0.00	0.02	0.00	0.06	0.04	0.49

Note: Village-clustered standard errors appear in parentheses. Regressions are based on data from 2008 and 2010. All regressions include region · year fixed effects. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: ART Proximity and Post-Intervention Economic Support

Dependent variable:	Nutrition programs (1)	Agro. support (2)	Tuition subsidies (3)	Food for work (4)	Congregation support (5)	Direct cash transfers (6)
Panel A: Full Sample						
ART proximity	0.12	0.04	0.07	-0.04	-0.02	0.10***
	(0.14)	(0.14)	(0.05)	(0.12)	(0.05)	(0.04)
2010 · ART proximity	-0.14	-0.31***	-0.03	0.08	0.19**	-0.070
	(0.14)	(0.10)	(0.071)	(0.12)	(0.08)	(0.07)
Dependent variable mean	0.22	0.68	0.02	0.14	0.09	0.03
Observations	3100	3100	3100	3100	3100	3100
R^2	0.05	0.09	0.01	0.05	0.01	0.01
Panel B: HIV−/NCT Sample						
ART proximity	0.16	0.0011	0.092	-0.023	-0.022	0.087*
	(0.19)	(0.14)	(0.065)	(0.11)	(0.065)	(0.052)
2010 · ART proximity	-0.20	-0.29**	-0.042	0.086	0.21**	-0.045
	(0.16)	(0.12)	(0.085)	(0.12)	(0.082)	(0.052)
Dependent variable mean	0.21	0.68	0.02	0.13	0.09	0.03
Observations	2333	2333	2333	2333	2333	2333
R^2	0.05	0.09	0.02	0.04	0.01	0.01

Note: village-clustered standard errors appear in parentheses. Regressions include data from 2008 and 2010. All regressions include region · year fixed effects. Nutrition programs include free food or maize, targeted nutrition programs, and programs to feed malnourished children. Agricultural support includes inputs-for-work programs, agricultural input supply programs, and other agricultural input subsidies. Tuition subsidies apply to secondary and tertiary tuition. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: The Effect of ART Availability on Work Time

	Hours per Day							
	Total		Farm		Home		Other	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Full Sample								
2010 · ART proximity	5.04***	5.17***	2.21*	2.08*	0.98	1.23	1.85*	1.86*
	(1.89)	(1.80)	(1.18)	(1.20)	(1.05)	(1.10)	(1.03)	(1.01)
		[-2.23]		[0.86]		[-0.19]		[-4.14]
Dependent variable mean	7.49	7.49	2.48	2.48	3.58	3.58	1.44	1.44
Observations	5380	5380	5380	5380	5380	5380	5380	5380
R^2	0.10	0.15	0.06	0.10	0.16	0.26	0.00	0.05
Panel B: HIV−/NCT Sample								
2010 · ART proximity	5.59***	5.34***	2.84***	2.74**	0.79	0.89	1.96**	1.71**
	(1.77)	(1.62)	(1.07)	(1.17)	(1.04)	(0.95)	(0.93)	(0.84)
		[1.11]		[1.27]		[-0.89]		[0.63]
Dependent variable mean	7.49	7.49	2.50	2.50	3.52	3.52	1.46	1.46
Observations	4030	4030	4030	4030	4030	4030	4030	4030
R^2	0.10	0.16	0.05	0.11	0.15	0.27	0.01	0.06
Demogr. and economic controls	-	Yes	-	Yes	-	Yes	-	Yes

Note: Village-clustered standard errors appear in parentheses. Even columns control for Post · demographic characteristics, economic shocks, and access to social safety nets. $n = 5380$ in Panel A, $n = 5068$ in Panel B, and $n = 3872$ in Panel C. Proportional selection δ's appear in square brackets for specifications with controls. All regressions include individual and region · time fixed effects. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Placebo Tests with ART Proximity and the Proximity of Clinics, Roads, Trading Centers, and Schools

	Full Sample				HIV−/NCT Sample			
	Hours per Day				Hours per Day			
	Total	Farm	Home	Other	Total	Farm	Home	Other
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2010 · ART proximity	4.83**	1.81	1.04	1.97*	5.23***	2.35**	0.81	2.07**
	(1.97)	(1.21)	(1.04)	(1.04)	(1.93)	(1.14)	(1.05)	(0.94)
2010 · Any clinic proximity	-0.12	0.19	-0.06	-0.25	0.03	0.37	-0.10	-0.24
	(0.61)	(0.47)	(0.15)	(0.27)	(0.52)	(0.43)	(0.20)	(0.25)
2010 · Road proximity	0.22	0.14	0.15	-0.07	0.25	0.10	0.21	-0.05
	(0.18)	(0.14)	(0.11)	(0.10)	(0.19)	(0.15)	(0.15)	(0.099)
2010 · Trading center proximity	0.47*	0.28*	0.03	0.16	0.45	0.28*	0.05	0.12
	(0.27)	(0.15)	(0.13)	(0.12)	(0.29)	(0.15)	(0.16)	(0.12)
2010 · School proximity	-0.007	-0.0003	-0.007	-0.0001	0.01	0.01	-0.003	0.003
	(0.006)	(0.009)	(0.007)	(0.003)	(0.009)	(0.009)	(0.006)	(0.005)
Dependent variable mean	7.49	2.48	3.58	1.44	7.49	2.50	3.52	1.46
Observations	5380	5380	5380	5380	4066	4066	4066	4066
R^2	0.10	0.07	0.16	0.01	0.10	0.06	0.16	0.01

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: The Impact of ART Availability on Subjective Mortality Risk for HIV-Negative Non-Caretakers

	Own Mort. Risk		HIV+ Mort Risk		Infection Risk		Worried HIV	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2008 · ART proximity	-0.13	-0.097	-0.14**	-0.18**	-1.09**	-0.78	-0.52*	-0.35
	(0.11)	(0.10)	(0.066)	(0.074)	(0.42)	(0.51)	(0.28)	(0.29)
		[0.42]		[-0.55]		[0.42]		[0.21]
2010 · ART proximity	-0.24**	-0.20*	-0.12*	-0.15*	-0.87***	-0.56	-1.09**	-0.94**
	(0.11)	(0.11)	(0.070)	(0.080)	(0.27)	(0.35)	(0.44)	(0.43)
		[0.74]		[-0.55]		[0.29]		[0.69]
Demo and economic controls	-	Yes	-	Yes	-	Yes	-	Yes
Dependent variable mean	0.40	0.40	0.70	0.70	0.90	0.90	1.68	1.68
Observations	3663	3663	3663	3663	3663	3663	3663	3663
R^2	0.04	0.11	0.06	0.14	0.10	0.15	0.13	0.17

Note: Village-clustered standard errors appear in parentheses. Even columns control for Post · demographic characteristics, economic shocks, and access to social safety nets. All regressions include individual and region · year fixed effects. $n = 4864$ in Panel A, $n = 4601$ in Panel B, and $n = 3665$ in Panel C. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Tobit Estimates of the Impact of ART Availability on Agricultural Variables for HIV-Negative Non-Caretakers

	Fertilizer Purchases	Equip. Purchases	Hired Labor	Seed Purchases	Cattle	Goats	Pigs	Chickens
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: M.E. on $pr(y > 0)$								
2008 · ART Proximity	0.0048	0.10	-0.18*	0.16	-0.026*	0.20	-0.053	-0.065
	(0.14)	(0.16)	(0.11)	(0.17)	(0.014)	(0.20)	(0.17)	(0.050)
2010 · ART Proximity	-0.18	0.18	-0.44***	0.19	-0.031*	0.19	-0.050	-0.10*
	(0.18)	(0.14)	(0.11)	(0.17)	(0.018)	(0.19)	(0.19)	(0.060)
Panel B: M.E. on $E(\ln y \| y > 0)$								
2008 · ART Proximity	0.047	0.78	-1.31*	1.06	-1.13*	1.10	-0.30	-1.18
	(1.41)	(1.17)	(0.76)	(1.15)	(0.61)	(1.11)	(0.98)	(0.88)
2010 · ART Proximity	-1.76	1.37	-3.20***	1.31	-1.33*	1.09	-0.28	-1.87*
	(1.80)	(1.06)	(0.77)	(1.14)	(0.75)	(1.08)	(1.10)	(1.05)
Observations	5430	5430	5430	5430	4993	5087	5014	5385
Pseudo R^2	0.03	0.01	0.02	0.02	0.09	0.00	0.11	0.01

Note: clustered standard errors appear in parentheses. Dependent variables are expressed in logs. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: The Impact of ART Availability on Mental Health and Subjective Well-Being for HIV-Negative Non-Caretakers

						MH limits on:		Well-
	MCS-12		Depression	Energy	Calm	Activities	Accomps.	Being
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2008 · ART proximity	5.61*	4.22	-0.21	0.28*	0.28*	-0.12	-0.10	0.15
	(3.02)	(3.23)	(0.20)	(0.14)	(0.16)	(0.12)	(0.099)	(0.20)
		[0.35]						
2010 · ART proximity	8.45***	7.05***	-0.42**	0.33	0.58***	-0.16*	-0.16*	0.48**
	(2.42)	(2.57)	(0.18)	(0.20)	(0.15)	(0.090)	(0.088)	(0.19)
		[0.59]						
Demo and economic controls	-	Yes	-	-	-	-	-	-
Dependent variable mean	55.0	0.55	0.39	0.53	0.50	0.10	0.10	0.74
Observations	3854	3854	3854	3854	3854	3854	3854	3853
R^2	0.04	0.09	0.06	0.04	0.05	0.02	0.02	0.04

Note: Village-clustered standard errors appear in parentheses. We transform the outcomes in Columns 3-5 and 8 into binary variables, as we describe in the text. All regressions include individual and region · year fixed effects. Column 2 controls for Post · demographic characteristics, economic shocks, and access to social safety nets.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 10: Mortality Risk, Mental Health, and Work Time

	MCS-12		Work Time	
	(1)	(2)	(3)	(4)
Subjective Mortality Risk	-6.24***	-3.75***	-	-
	(0.75)	(1.05)		
MCS-12	-	-	0.030***	0.056***
			(0.0089)	(0.016)
Individual fixed effects	-	Yes	-	Yes
Observations	3303	3303	3303	3303
R^2	0.05	0.08	0.08	0.18

Note: Village-clustered standard errors appear in parentheses. All regressions control for region · time fixed effects. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

A Appendix: Robustness Tests

A.1 Attrition

This subsection discusses attrition in more detail and examines whether attrition may bias our results. MLSFH interviewers do not pursue respondents who are absent from the village, which leads to a 10 percent loss to follow-up between adjacent survey rounds. Surveyors replenish the sample in order to maintain the sample size (Kohler et al. 2014). In addition to death and permanent emigration, temporary migration contributes substantially to loss to follow-up. 44 percent of respondents who are absent in 2008 (but present in 2006) reappear in 2010.

Attrition may confound our estimates if it is correlated with ART proximity and the outcome variables. For instance, attrition by people near ART with poor mental health or low work time may spuriously suggest that ART availability increases these outcomes. We analyze attrition for respondents who are present in 2006, the final pre-ART survey round. We distinguish between three types of respondents: non-attriters are present in 2006, 2008, and 2010; "temporary migrants" are present in 2006 and 2010, but not 2008; attriters are present in 2006 but are absent in 2010. By this definition, people who leave temporarily in 2010 are categorized as attriters.

In practice, attrition is unlikely to pose a problem because it is uncorrelated with ART proximity. Appendix Figure 3 shows the non-parametric relationship between the three attrition categories and the distance to ART. The ART distance gradient is generally flat, which indicates that attrition does not vary systematically with the distance to ART. Analogous linear regressions (available from the authors) also show small and insignificant effects. The figure also addresses the concern that respondents may move in order to live closer to an ART facility. Anyone who relocates (for ART or another reason) is classified as an attriter. Systematic relocation toward ART would lead to an upward sloping attrition gradient, which is not evident in the figure.

Appendix Table 2 examines how baseline characteristics vary with attrition status. Mental health is similar across all groups but work time is significantly lower for attriters and temporary migrants. In principle, this difference could confound our estimates if attriters differentially live near ART. In addition to the lack of such a correlation, the work time difference between attriters and non-attriters is too small to explain our estimates. As a bounding exercise, we reproduce our work time regressions after assigning attriters the maximum value of ART proximity (0.99). After this modification, the effect on work time is 24 percent smaller but remains statistically significant. Other differences by attrition status are consistent with death and permanent emigration as causes of attrition: attriters are younger, wealthier, more often married, and more likely to have HIV.

As another test of whether results are sensitive to attrition, we reproduce our main results for only non-attriters in Appendix Table 3. Respondents in these regressions are present in all survey rounds, which eliminates selection as a possible confound. Estimates are strongly significant and closely resemble the results in the paper. As before, results are not sensitive to including the interaction of Post and demographic and economic controls.

A.2 Estimates for HIV-Positive Respondents and Caretakers

This subsection reports results for HIV-positive and caretaker respondents. The analysis in the paper excludes these respondents in order to isolate the role of HIV *risk*. Existing economic and public health studies document the direct effect of ART on the mental health and labor supply of HIV-positive recipients and caretakers (Els et al. 1999, McLaren 2010, Tostes et al. 2004, Thirumurthy et al. 2008, Thom 2009, Kuo et al. 2012, Thirumurthy et al. 2012, Okeke and Wagner 2013). Small samples of HIV-positive and caretaker respondents limit the power to detect effects for these groups. The sample includes 99 people who are ever HIV-positive and 425 people who ever qualify as caretakers.

Appendix Table 4 reproduces our main estimates for HIV positive and and caretaker respondents. Estimates for HIV-positive respondents in Panel A are extremely imprecise.

Standard errors are over four times larger in the HIV-positive subsample than in the HIV-negative subsample. The effect on mental health has a 95 percent confidence interval of -21.0 to 20.3, compared to an interval of 3.7 to 13.2 for HIV−/NCTs. Estimates for caretakers in Panel B resemble the HIV−/NCT results in the paper. The effects on mental health and subjective mortality risk are slightly larger than results in the paper and are statistically significant, while the effect on work time is smaller and is not significant. Other estimates for these subsamples are available from the authors.

A.3 Policy Targeting and Mean Reversion

Regression toward the mean may confound our estimates if ART proximity is correlated with unobservable shocks in the outcome variables. Under this mechanism, outcomes improve near ART because of random variation rather than a causal effect. ART proximity could be correlated with unobservable shocks if policymakers targeted ART toward places with poor mental health, either directly or through other variables like HIV prevalence. As we discuss above, the MoH adopted an explicit policy to maximize geographic coverage. The resulting coverage pattern, in which ART demand is negatively correlated with supply, suggests that officials adhered to this policy.

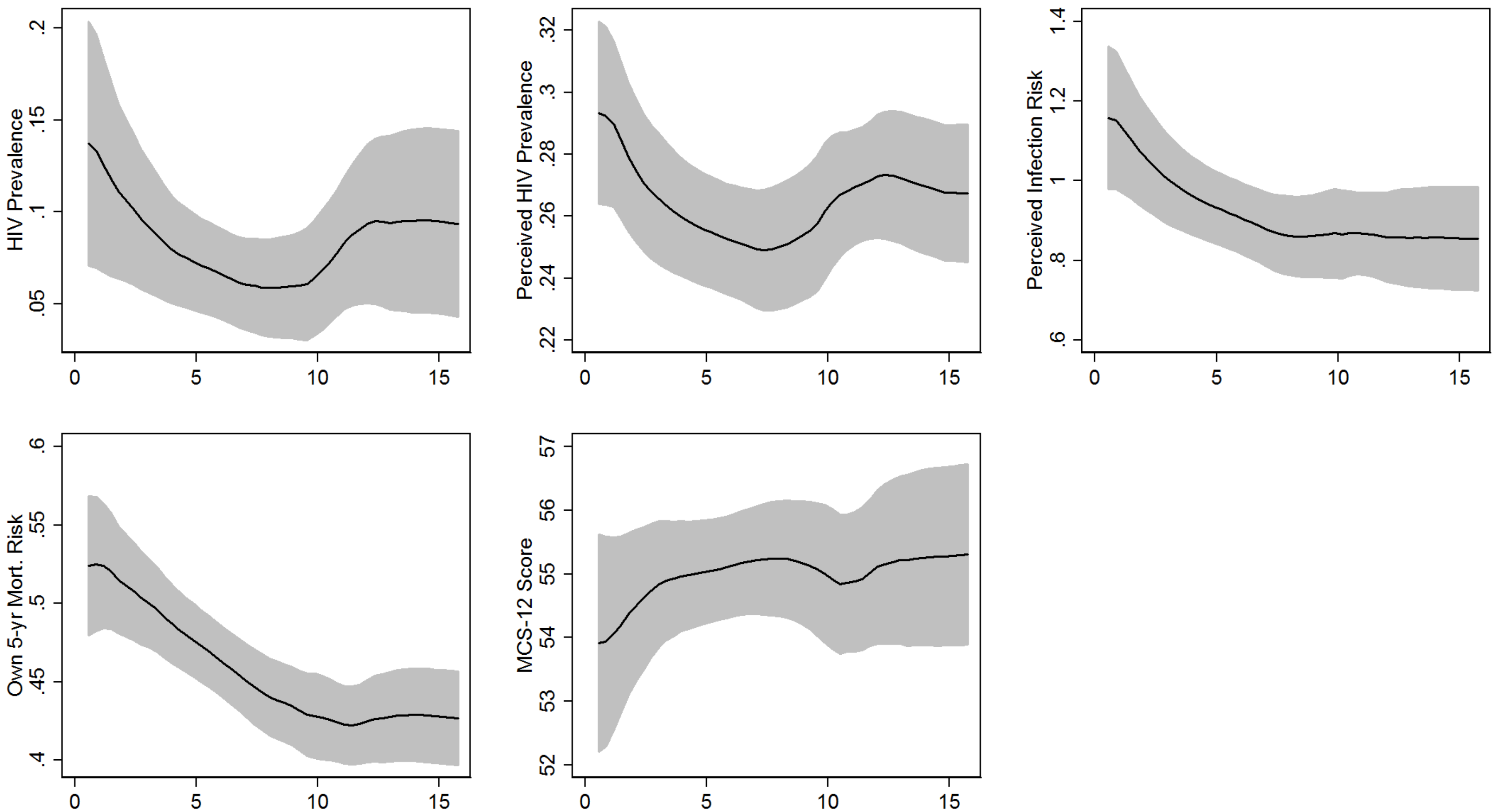
We address this concern further by controlling for the interaction between the initial level of the dependent variable and 2008 and 2010 dummies. This approach addresses the possibility mean reversion because unobservable trends are correlated with the baseline level of the dependent variable under this mechanism.[19] Panel A of Appendix Table 5 shows estimates for our main outcomes under this approach. All estimates are attenuated but effects on work time and mental health remain significant. The effect on subjective mortality risk is also marginally significant with a p-value of around 0.15. Estimates for HIV-negative and non-caretaker subsamples are similar and are available from the authors. These results suggest that mean reversion does not explain our findings.

[19]For work time, which has two pre-intervention rounds, we interact with both the 2004 and 2006 levels of the dependent variable.

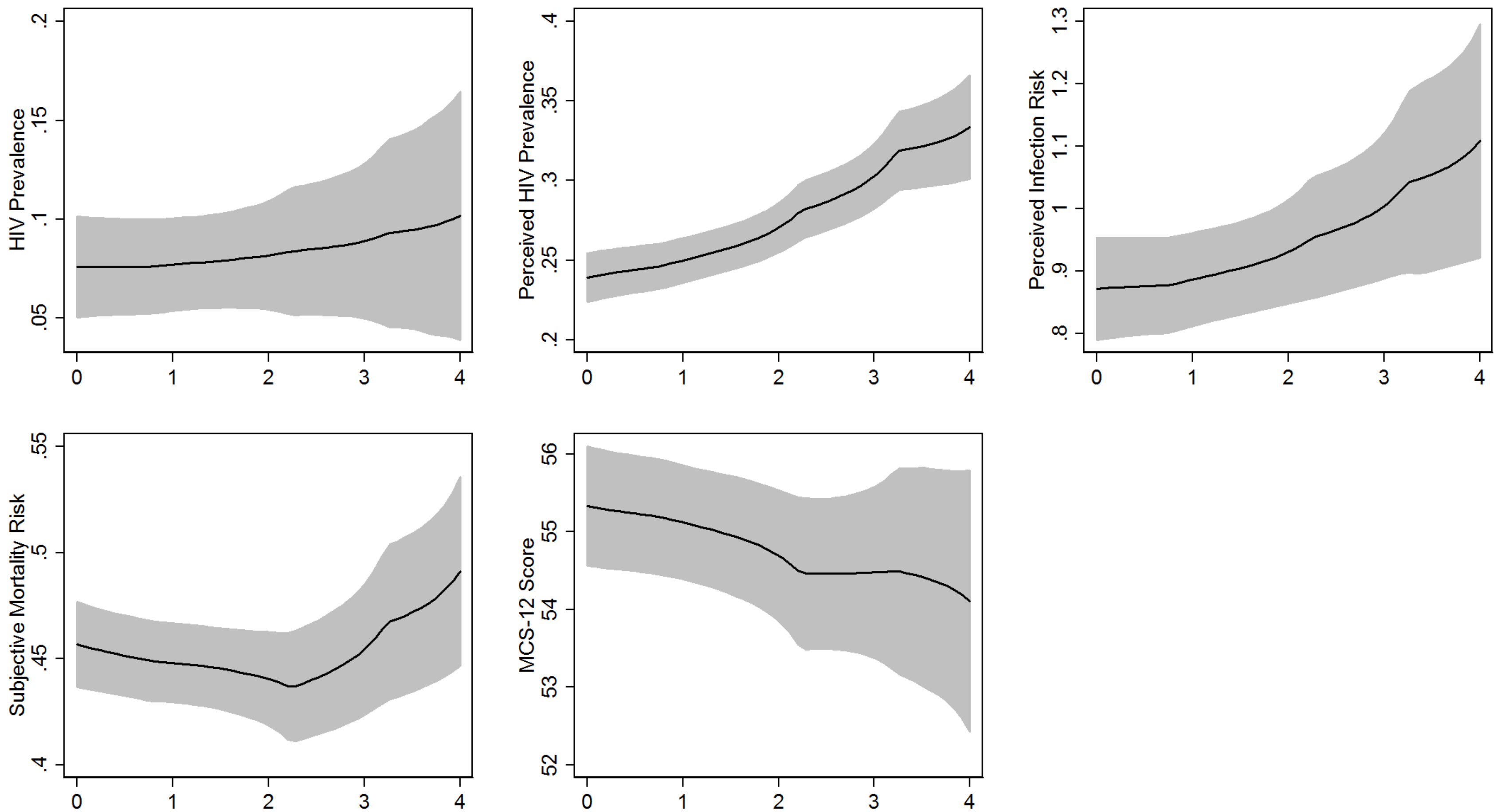
A.4 Discrete Distance Bins

In this subsection, we reproduce our estimates using discrete distance bins rather than ART proximity. Using ART proximity as a proxy for ART access imposes a functional form assumption that could influence the magnitude or significance of our estimates. Figures 4, and 6, 7 address this concern by plotting ART distance gradients by year non-parametrically. The figures show the greatest distance gradient in the range of 5-8 kilometers from an ART facility.

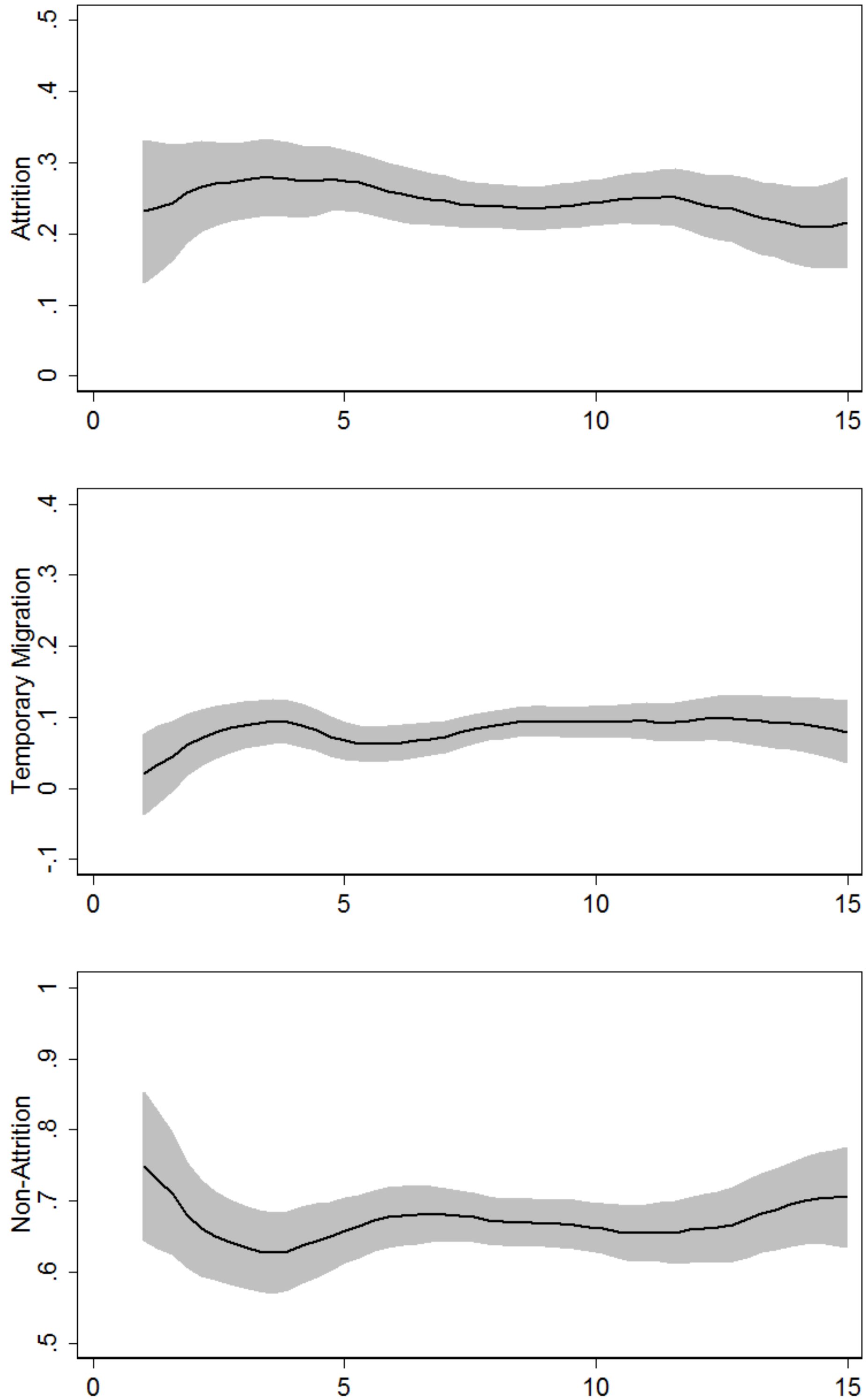
We adopt a different functional form assumption by dividing respondents into "near" and "far" distance bins in Panel B of Appendix Table 5. We distinguish between groups at a threshold of 6 kilometers. Although the threshold distance between near and far groups is arbitrary, the distance with the steepest ART access gradient minimizes measurement error. In Column 1, the MCS-12 scores of nearby respondents improve by 1.96 points by 2008 and by 2.87 points by 2010 relative to distant respondents. ART availability increases work time by 1.01 hours and reduces subjective mortality risk by 7 percentage points for nearby respondents in Columns 2 and 3.



Appendix Figure 1: HIV Severity and the Distance to a Trading Center in the Balaka Region



Appendix Figure 2: HIV Severity and Respondent-Observed AIDS Deaths in Balaka District, 2006



Appendix Figure 3: Local Linear Regressions of Attrition Status on the Distance to ART

Appendix Table 1: Clinic Characteristics

ART Arrival:	Through May 2006	June 2006 - May 2008	June 2008- Sept. 2010
	(1)	(2)	(3)
Catchment Population (thousands)	54***	32	19***
Number of Beds	182***	20	12**
Electricity	0.97***	0.53	0.42
Flush Toilet	0.98***	0.45	0.31**
HIV Testing	0.95	0.95	0.82**
Outpatient	0.98	1.00	0.96
Inpatient Maternity	0.95	1.00	0.74***
Inpatient General	0.86***	0.26	0.15**
Antenatal Clinic	0.98	1.00	0.81***
STI Clinic	0.83***	0.46	0.34*
TB Clinic	0.92*	0.82	0.70**
Laboratory	0.91***	0.44	0.17***
Observations	65	57	483

Note: Stars in Columns 1 and 3 indicate significant differences with Column 2. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table 2: 2006 Respondent Characteristics by Attrition Status

	Non-attriters	Temporary Migrants	Attriters
	(1)	(2)	(3)
Panel A: Mental Health and Labor Supply			
MCS-12	55.6	55.9	55.4
Depressed in last four weeks	0.30	0.30	0.30
Energetic in last four weeks	0.59	0.58	0.54
Calm in last four weeks	0.56	0.55	0.55
MH limits on activity	0.10	0.08	0.12
MH limits on accomplishments	0.10	0.09	0.12
Subjective well-being	0.67	0.65	0.73**
Total productive time (hrs per day)	8.50	7.79**	7.66***
Cultivation time (hrs per day)	2.84	2.21**	2.25***
Home production time (hrs per day)	4.20	3.94	3.60***
Other production time (hrs per day)	1.49	1.63	1.80**
Panel B: Mortality Risk			
Five-year subjective mortality risk	0.39	0.38	0.41*
Infection risk A (Likert scale)	0.70	0.87**	0.77
Infection risk B	0.22	0.20	0.22
Five-year subjective HIV+ mortality risk	0.69	0.66	0.70
HIV-positive	0.04	0.07**	0.09***
Perceived HIV prevalence	0.27	0.28	0.30**
Worried about HIV	0.40	0.46	0.39
Panel C: Demographic Characteristics			
Education	5.1	6.0***	5.3
Age	36.9	31.8***	34.0***
Married	0.84	0.66***	0.73***
Household size	5.5	5.1*	5.2**
Metal roof	0.15	0.15	0.21**
Monetary wealth (2006 USD)	25.5	28.1	47.7**
Sample size	1260	154	463

Note: Attrition is defined with respect to the 2006 survey. Non-attriters are present in 2006, 2008 and 2010. Temporary migrants are present in 2006 and 2010 but absent in 2008. Attriters are present in 2006 but absent in 2010. Stars in Columns 2 and 3 indicate significant differences with Column 1. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table 3: Key Estimates for Non-Attriters

Dependent variable:	Work Time		Own Mort. Risk		MCS-12	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Full Sample:						
2008 · ART proximity	-	-	-0.19**	-0.19**	6.39**	6.87**
			(0.079)	(0.085)	(2.71)	(2.76)
				[1.72]		[-0.70]
2010 · ART proximity	5.18**	5.40***	-0.28***	-0.27***	7.18***	7.75***
	(2.04)	(1.82)	(0.083)	(0.082)	(2.07)	(2.54)
		[-1.95]		[1.70]		[-0.65]
Dependent variable mean	7.46	7.46	0.41	0.41	54.3	54.3
Observations	3711	3711	3828	3828	3840	3840
R^2	0.12	0.18	0.04	0.09	0.04	0.08
Panel B: HIV−/NCT Sample:						
2008 · ART proximity	-	-	-0.16	-0.12	5.95**	5.91*
			(0.096)	(0.098)	(2.99)	(3.10)
				[0.46]		[5.33]
2010 · ART proximity	5.74***	5.25***	-0.25**	-0.21*	6.67***	6.72***
	(2.09)	(1.90)	(0.11)	(0.11)	(2.29)	(2.49)
		[1.04]		[0.72]		[-3.46]
Dependent variable mean	7.47	7.47	0.40	0.40	54.9	54.9
Observations	2769	2769	2865	2865	2866	2866
R^2	0.12	0.20	0.04	0.11	0.04	0.10
Demo. and economic controls	-	Yes	-	Yes	-	Yes

Note: Village-clustered standard errors appear in parentheses. Regressions only include respondents who are present in 2006, 2008, and 2010. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table 4: Estimates for HIV-Positive and Caretaker Respondents

	Work Time	Own Mort. Risk	MCS-12
	(1)	(2)	(3)
Panel A: HIV+ Sample			
2008 · ART proximity	-	0.053	0.44
		(0.55)	(14.4)
2010 · ART proximity	6.90	-0.13	-1.23
	(7.96)	(0.37)	(11.1)
Dependent variable mean	7.51	0.48	52.0
Observations	348	265	265
R^2	0.13	0.07	0.04
Panel B: Caretaker Sample			
2008 · ART proximity	-	-0.44***	9.01*
		(0.16)	(5.39)
2010 · ART proximity	3.46	-0.37**	10.8**
	(5.36)	(0.14)	(4.89)
Dependent variable mean	7.52	0.45	52.3
Observations	1110	1033	1033
R^2	0.13	0.06	0.05

Note: Village-clustered standard errors appear in parentheses. A person is classified as HIV-positive or a caretaker if he or she satisfies these conditions in any survey round. All regressions include individual and region × year fixed effects. $n = 263$ in Panel A and $n = 1033$ in Panel B. $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table 5: Additional Robustness Tests

Dependent variable:	Work Time	Own Mort. Risk	MCS-12
	(1)	(2)	(3)
Panel A: Address Mean Reversion			
2008 · ART proximity	-	0.053	2.66
		(0.060)	(2.78)
2010 · ART proximity	2.43	-0.13	5.68***
	(1.98)	(0.084)	(1.89)
Panel B: Discrete Distance Bins			
2008 · Near	-	-0.051	1.79*
		(0.037)	(0.91)
2010 · Near	1.13**	-0.049	3.32***
	(0.53)	(0.038)	(0.77)

Note: Village-clustered standard errors appear in parentheses. Regressions in Panel A control for the 2006 value of the dependent variable × 2008 and 2010, as well as the 2004 value of the dependent variable × 2008 and 2010 in Column 2. In Panel B, Near ART is defined as within 6 kilometers of an ART facility. All regressions include individual and region × time fixed effects. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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