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Health, Enterprise, and Labor Complementarity in the Household*

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Abstract

We study the role of household enterprise as a coping mechanism after health shocks. Using variation in the cost of traveling to formal sector health facilities to predict recovery from acute illness in Tanzania, we show that individuals with prolonged illness switch from farm labor to enterprise activity. This response occurs along both the extensive (entry) and intensive (capital stock and labor supply) margins. Family members who are not ill exhibit exactly the same pattern of responses. Deriving a simple extension to the canonical agricultural household model, we show that our results suggest complementarities in household labor.

Keywords

enterprise; health shocks; intra-household allocation; labor supply

1 Introduction

Health shocks can have large negative effects on income and productivity (Schultz and Tansel, 1997; Strauss and Thomas, 1998; Thomas et al., 2006; Wagstaff, 2007; WHO, 2000). Households in low-income contexts are particularly vulnerable: smoothing mechanisms like savings, credit, insurance, and informal financial networks often function poorly in these contexts (Dupas and Robinson, 2013; Kochar, 1999, 2004; Pande and Burgess, 2005; Paxson, 1992; Townsend, 1994). Moreover, income-generating activities within the household are often intertwined: parents and children work together on family farms, and extended family members pool resources in business (Adhvaryu et al., 2013; Benjamin, 1992; Dercon and Krishnan, 2000). Shocks affecting one family member thus spill over onto others, and could amplify negative impacts (d'Adda et al., 2009; Graff Zivin et al., 2009).

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Facing significant constraints, how do poor households cope with health shocks? Do the effects of shocks indeed spill over onto other household members, and if so, why? And can policy intervention mitigate negative impacts?

We study these questions in the context of agricultural households in Tanzania. Most households in our sample are primarily farmers with small plots; they grow staples along with coffee, a cash crop. Acute illnesses (manifesting as fevers and coughs) are highly prevalent: 75 percent of households had at least 1 sick member in the month preceding interview. Recovery is not always quick: more than 40 percent of individuals who reported recent illnesses were still ill at the time of survey.

How does acute illness affect these farmers' livelihoods? Identifying households' responses to health shocks is difficult because of the potential endogeneity of these shocks. Individuals without access to proper nutrition and health technologies, or without adequate knowledge of and preference for health, may be more likely to experience health shocks or might experience shocks with greater intensity (Grossman, 2000). We use exogenous variation in the (short-term) costs of access to formal health care—at government and NGO clinics and facilities—following acute illness to predict the speed of recovery (Adhvaryu and Nyshadham, 2012a). Specifically, we instrument for the utilization of formal care by sick household members using the interaction of proximity to health facilities and rainfall during the time of illness, controlling for both main effects in flexibly non-linear forms as well as the interaction between rainfall and the proximity to other resources. Individuals treated at the formal sector, as opposed to self-medicating or seeking no care, recover significantly faster: formal-sector care reduces the likelihood of prolonged illness by 45 percentage points.

Next, we look at how households cope during illnesses. Given the financial constraints these households face, and the lack of insurance mechanisms to smooth consumption in this context, how do households compensate for the productivity and income losses associated with health shocks? We show that individuals who are slow to recover switch from farm labor to enterprise activity. This pattern is consistent with the idea that illness is a sector-biased productivity shock, in that it affects productivity more in sectors like agriculture, which demand greater physical effort. While sick, the individual is more productive in enterprise than on the farm. This response occurs on both the extensive (entry) and intensive (capital stock and labor supply) margins. Merchant enterprises exhibit the largest response.

Given the large sectoral shift in labor supply for sick individuals, we ask whether other household members change their behavior, as well. In other words, do prolonged illnesses spill over onto those who are not sick? These spillovers could arise through the many ways in which decision-making and allocation in the household are intertwined, for example, through joint production on the farm and in enterprise activities, time spent caring for the sick, or shifts in the household budget constraint (d'Adda et al., 2009; Graff Zivin et al., 2009; Pitt and Rosenzweig, 1990; Pitt et al., 1990).

We find evidence of substantial spillovers. Family members who are not ill exhibit exactly the same pattern of enterprise entry and labor supply responses. That is, prolonged illnesses

cause shifts away from farm labor toward enterprise activity for the whole household. We develop a simple extension to the canonical agricultural household model to interpret these joint labor reallocation patterns. Our findings, together with the assumptions embedded in this model, suggest that complementarities in household labor exist in at least one sector of production. This complementarity between labor inputs increases the potential productivity loss from acute illness in the absence of labor reallocations, and in turn, increases the importance of enterprise as a coping mechanism.

We add to the rich literature on health and health care in developing countries. Health shocks are frequent in poor households, and have outsized impacts on productivity (Dercon and Krishnan, 2000; Kochar, 2004; Schultz and Tansel, 1997; Strauss and Thomas, 1998; Thomas et al., 2006). Given that health insurance mechanisms are still weak or nonexistent in many developing contexts, informal networks (including family networks) play a major role in coping with illnesses (De Weerd and Dercon, 2006; Lindelow and Wagstaff, 2005; WHO, 2000). We demonstrate that treatment in the formal health care sector has a large impact on duration of illness, and further, on labor supply decisions for the sick individual and her household.

More broadly, we contribute to our understanding of the way in which poor households cope with shocks. Agricultural incomes are highly volatile, and often depend on factors completely out of households' control, like natural disasters, rainfall, and commodity market fluctuations (Adhvaryu et al., 2013; Deaton, 1999; Jensen, 2000; Yang and Choi, 2007). Where financial markets are weak, and price protections or insurance mechanisms are imperfect, household incomes are even more uncertain (Cole et al., 2013; Gertler et al., 2009; Karlan et al., 2012). We show that intermittent enterprise activity plays a significant role as a coping mechanism. This is consistent with previous studies on agricultural households' labor supply adjustment to shocks (see, e.g., Fields (1975); Kochar (1999)), and with the fact that a majority of agricultural households in developing countries operate non-farm enterprises (Ellis, 1998, 2000).

Finally, we add to the policy debate on access to the formal health care sector in developing countries. Government-operated health facilities tend to be farther away than self-treatment options like drug kiosks and pharmacies, and often lack in quality in many low-income contexts (Das et al., 2008). It is not clear, therefore, that removing barriers to formal sector access would be beneficial for patients. Our study strongly implicates a role for such policies. Our results suggest that not only do health outcomes improve (as also shown in Adhvaryu and Nyshadham (2012a,b)), but labor supply shifts substantially, as well, both for the sick individual and other members of his household. The benefits of policies that improve access to formal sector care thus include this sizable and previously unmeasured spillover onto household labor supply.

The remainder of the paper is organized as follows. Section 2 describes our data set and construction of important variables. Section 3 presents our empirical strategy and discusses its validity. Section 4 presents results from the empirical exploration of enterprise responses to health shocks and access to care. Section 5 discusses possible mechanisms (such as labor complementarity) and references the development in section A of an appropriate theoretical

context in which to interpret the empirical results. This section also presents additional empirical results for the sake of comparing possible mechanisms. Finally, section 6 concludes.

2 Data

2.1 Overview

This study uses survey data from the Kagera region of Tanzania, an area west of Lake Victoria, and bordering Rwanda, Burundi and Uganda. Kagera is mostly rural and primarily engaged in producing bananas and coffee in the north, and rain-fed annual crops (maize, sorghum, and cotton) in the south. The Kagera Health and Development Survey (KHDS) was conducted by the World Bank and Muhimbili University College of Health Sciences (MUCHS). The sample consists of 816 households from 51 “clusters” (or communities) located in 49 villages covering all five districts of Kagera, interviewed up to four times, from Fall 1991 to January 1994, at 6 to 7 month intervals. The randomized sampling frame was based on the 1988 Tanzanian Census.¹ KHDS is a socio-economic survey following the model of previous World Bank Living Standards Measurement Surveys. The survey covers individual-, household-, and cluster-level data related to the economic livelihoods and health of individuals, and the characteristics of households and communities. In the following paragraphs, we outline the variables we use in our analyses.

2.2 Health variables

In the health module of the KHDS, all household members are asked about chronic illnesses and acute illness episodes; care sought for these episodes; and current illness (at the time of survey).² As our main sample restriction, we use information on whether households contained at least one sick member (i.e. a member who reported having been sick in the last 14 days with an *acute illness*) and one non-sick member. We collapse our observations to the household-year level, by constructing within-household-year means for important health, enterprise, and labor supply variables. We also construct enterprise and labor supply means separately for the subsamples of ill and non-ill members of each household. Our means are constructed using the number of *productive* household members, which is defined as the number of household members who answered the time use survey (all individuals above the age of 7). We restrict the sample in this way so that the labor means do not erroneously take into account household members for whom the time use survey was not asked.

Table 1 shows summary statistics for the Kagera sample. The number of household-year observations with at least one sick and one non-sick household member is 1932; this comprises roughly 75% of the household sample. Within these households, 42% of sick individuals report still being ill at the time of survey.

¹A two-stage, randomized stratified sampling procedure was employed. In the first stage, Census clusters (or communities) were stratified based on agro-climatic zone and mortality rates and then were randomly sampled. In the second stage, households within the clusters were stratified into “high-risk” and “low-risk” groups based on illness and death of household members in the 12 months before enumeration, and then were randomly sampled.

²In the case of individuals below the age of 15, the primary caretaker of the child is asked to answer on the child’s behalf.

Our main independent variable is the proportion of sick household members who visited formal-sector healthcare, defined as care at a hospital, health center or dispensary (which includes government, NGO, and private facilities). We normalize this variable by its standard deviation for ease of interpretation. The mean for this normalized proportion is reported in Table 1. Without normalization, about 25% of sick household members sought formal sector healthcare for their illness episode.

2.3 Enterprise Variables

In the analysis that follows, we explore effects of speedy recovery from illness on the enterprise activity of households. Specifically, we look at whether or not at least one member of the household operates an enterprise. We also investigate enterprise activity by type of business: fish, merchant, high skilled (including education, accounting, and health businesses), and high capital (including transportation, construction, factory, and bar/hotel businesses). We also address labor and capital inputs for these enterprises. Specifically, at the household level, we look at the number of household members that work for its enterprises, both paid and unpaid; the number of workers hired from outside of the household; the number of assets owned by the household's enterprises, and the number of assets bought and sold by the enterprises over the last 6 months (12 months for households interviewed in the 1991).

The means and standard deviations for these variables are reported in Table 1. We report means for the whole sample of households, and for the subsample of households that have no sick members. Nearly 30% of the households reported having at least one household member engaged in non-agricultural enterprise, while only 18% of households with no ill members operate an enterprise. On average, only one household member is involved in the enterprises in our sample, but this statistic is a bit misleading. In order to reflect, the accurate picture for the study sample, these statistics are not conditional on having a business. Therefore, in reality many households have no enterprises and therefore 0 members working for household-owned enterprises, while practically none of the households which operate enterprises have less than 2 members working for that enterprise. This is manifested in the large standard deviation.

On the other hand, the small mean reported for the number of household members paid to work for the enterprise accurately reflects the minimal extent to which household members are paid to work for enterprises in the sample. Only 3% of households have paid household workers, which amounts to roughly 20% of households with any members working for a household-owned enterprise. As reflected in Table 1, it is more likely for households to hire workers from outside of the household than to pay household members for their work. Roughly, 7% of households hired at least 1 worker for a household-owned enterprise (which amounts to nearly 30% of entrepreneurial households). Households own nearly 1.8 business assets on average. All household enterprises own at least one asset and many own more (5% of households have more than 10 business assets). There is also a great deal of change in stock of assets over time. On average, households bought more than 0.5 assets (roughly 30% of entrepreneurial households sold at least 1 asset). Very few household enterprises sell assets in our sample.

Additionally, in the analysis that follows, we investigate effects on enterprise activity separately for ill and non-ill members of the household. In the bottom panel of Table 1, we report means for the enterprise activity (overall and by industry) of ill and non-ill members of the household. Non-sick members of the household are more likely than sick members to engage in all types of enterprise. The means among the members of entirely “non-sick” households fall somewhere in between in general; however, they appear slightly more likely to engage in high skilled and high capital business than both sick and non-sick members of “sick” households.

2.4 Labor variables

The time use module of the KHDS collects detailed information on various types of labor supply for all individuals seven years of age and older. Individuals are asked how many hours in the past 7 days they spent in each of a variety of activities. We construct a composite variable for the total labor hours of household members above 7 years old. We then divide the total hours by the number of productive household members to obtain a per-capita measure of hours across 1) all household members; 2) sick members; and 3) non-sick members. Finally, we break these various per-capita measures into activity in different sectors.

In particular, we split total labor hours into farm hours, enterprise hours, and home hours. Farm hours include farm employment hours, field and herd hours, and processing hours. Farm employment hours include hours spent working on a neighbor’s farm. Other wage employment outside of the home is included here as well; however, hired farm work makes up the largest component of wage labor. Field and herd hours include time spent on the individual’s own farm, on a community farm and time spent herding livestock. Processing hours include time spent making farm produce and animal products into marketable goods.

Enterprise hours includes any non-farm activities the profit from which accrues to the individual (as opposed to working for someone else’s business); this may include production or sale of market goods or operating another type of small business (restaurant, hotel, etc.). Home hours include time spent in household chores, and time spent collecting water and firewood. For further details on the definitions of the labor supply variables and the method we used to aggregate them into totals, please refer to the data appendix.

In Table 1, we compare means in these labor variables for sick versus non-sick members in households with at least 1 sick and 1 non-sick member; and for non-sick members of households with no sick members (i.e. households in which all members are not acutely ill). Several interesting features of the labor data are revealed. First, within “sick” households, sick and non-sick members appear to be spending nearly the same amount of time in each sector and sub-sector. For example, both types of individuals report working a total of about 29 hours last week. Of this time, a little less than half (13.5 hours) is spent on the farm, while only 3 hours a week are spent on enterprise activity and roughly 12.5 hours are spent on home chores. t-tests confirm the statistical equality of per-capita labor amounts across all sectoral categories. The low allocation of hours to enterprise on average is particularly interesting. In equilibrium, it seems that households in our sample engage in very little enterprise activity.³

On the other hand, we see significant differences (as again confirmed by t-tests) between the amount worked by members in “sick” versus “non-sick” *households*. In households with no sick members, total labor is significantly greater, and that difference is reflected in both sectors. In percentage terms, farm labor is about 18% greater in “non-sick” households, while non-farm labor is 14% greater. Similar to the “sick” households, “non-sick” households allocated only about 3 hours per member in the last week to enterprise activity.

The differences in these per-capita time use variables across “sick” and “non-sick” households, but *not* across sick and non-sick individuals within the same household, suggest that sick and non-sick household members may adjust to illness shocks in the same way. In particular, at least from the mean differences, it appears as though following illness, both sick and non-sick individuals draw down farm labor relative to off-farm labor, while total labor hours declines slightly. Clearly, we must not interpret these differences as causal estimates of sickness on the intra-household allocation of labor. In subsequent sections, we test more rigorously that this pattern of labor adjustments holds in a causal sense.

2.5 Other household- and cluster-level variables

We use a variety of household- and community-level demographic and socioeconomic characteristics in our regressions. The most important for the purposes of our analysis is the existence (or, to be precise, the lack of existence) of a formal healthcare facility in the cluster. As Table 1 reports, about 50% of households were located in communities without a formal-sector healthcare facility. As we describe in Section 3, we control for a variety of other variables related to the existence of other resources in one’s community; these are existence of a daily market, periodic market, motorable road, public transportation, secondary school, bank, and post office/telephone. We also control for the distance to various types of formal-sector care options if they are not in the household’s community; in particular, we include the distances to the nearest dispensary, health facility, and hospital (*n.b.*: if these options are in the individual’s cluster, this variable equals 0).⁴ Table 1 reports the means for these variables.

We control for various household characteristics. In particular, specifications include the maximum years of completed schooling across all household members (quintiles); mean age of household members (cubic polynomial); and household demographic composition, including the number of females, adults (age 15 or older), children (younger than age 15), males, females, men (adult males), women (adult females), boys (male children), and girls (female children). We also include household size (cubic polynomial); total assets owned by the household (quintiles of an asset index generated using principal components analysis); and year of survey (fixed effects). Finally, we include district fixed effects.

³The mean of total labor hours of the household in our sample appears low as compared to statistics from more developed and/or urban contexts. However, this apparently less than full labor supply is common in developing contexts. Previous studies have suggested various causes of these low labor supplies: malnourishment (Strauss and Thomas (1998)), inefficiently low wages in spot labor markets (Jayachandran (2006)), behavioral “target-income” models (Dupas and Robinson (2014)), etc.

⁴We control for a cubic polynomial in the distance to nearest formal-sector care facility (which could be any one of the three types mentioned above), as well as quintiles of the distance to each option separately.

It is worth noting at this point that retrospective data on household consumption and expenditure spanning the time of illness are not available. That is, a natural extension to the analysis undertaken in this paper would be to explore the ultimate impacts of health-based productivity shocks and subsequent enterprise smoothing on consumption and expenditure in order to assess the degree to which households are successful in their attempts to smooth using enterprise activity. Unfortunately, household consumption and expenditure data are collected as estimated aggregates for the 6 or 12 month period prior to each survey wave, while the timing of illness is restricted to month directly preceding survey. Accordingly, it is unlikely that we can measure an impact of a few weeks of illness and enterprise activity on a years aggregate consumption and expenditure; moreover, it would not be particularly informative to do so.

2.6 Rainfall data

We obtained monthly rainfall data from the Tanzania Meteorological Agency spanning from 1980 to 2004.⁵ The data set includes the amount of rainfall (in millimeters) per month and total days with rainfall per month for 21 weather stations in Kagera region. The data set provides a matching file which report the closest and second closest weather station to each cluster in the KHDS sample. Two measures of “closest” have been used: a straight-line distance between each cluster and each rainfall station, and a distance measure which takes into account the location topology of the area. We use the straight-line measure definition of “closest,” and use the number of days of rainfall in the month the individual was sick as the primary measure of rainfall in our regressions. Further, we match the rainfall observation to the households with sick members by taking the rainfall value in the month the household was surveyed, in the cluster in which the household is located. If the rainfall value for this cluster-by-month observation is missing, we use the value at the second closest rainfall station to the cluster.

We also control for the number of days of rainfall in the month *prior to* the illness episodes reported by household members (discussed further in Section 3); the historical mean and historical standard deviation of the distribution of rainfall in the given month, computed over all the years of available data for the month in question (quadratic terms of these variables are included as well); fixed effects for the closest rainfall station; deciles for the number of days of rainfall; deciles for the amount of rainfall (in millimeters) in the month the individual fell sick; and interactions of days of rainfall with the existence of resources variables defined in the previous sub-section. For further details on the construction of rainfall variables, please see the data appendix.

3 Empirical Strategy

We are interested in exploring healthcare choice as a driver of recovery from illness and subsequent enterprise, capital, and labor decisions. However, the unobserved severity of the illness (and perhaps other omitted factors) likely jointly determines the healthcare choice and subsequent economic outcomes. To address these endogeneity concerns, we use an

⁵The data set is downloadable from the EDI-Africa website: <http://www.edi-africa.com/research/khds/introduction.htm>.

instrument for healthcare choice which exploits exogenous variation in the costs of formal-sector healthcare. The instrument builds on the methodology introduced in Adhvaryu and Nyshadham (2012a) and applied in Adhvaryu and Nyshadham (2012b) at the individual level to the same data used in this study. A major point discussed in those papers is the fact that the largest costs of formal-sector care in developing countries are often those associated with the opportunity cost (or the direct costs) of travel to the care facility. Distance to the nearest facility (or alternatively, the presence of a formal care facility in one's community) is thus a large determinant of healthcare choice in developing countries, through its effects on costs (Gertler et al., 1987; Mwabu, 2009; Mwabu et al., 1995).

3.1 An instrument for healthcare choice

Following Adhvaryu and Nyshadham (2012a), we propose an interaction instrument: specifically, we interact a dummy variable for the absence of a formal-sector health facility in a household's community with the number of days of rainfall in the month in which the household reported having at least one ill member, and exclude only this interaction from the second stage, while controlling for the main effects of facility "existence" and days of rainfall in the first and second stages of a two-stage instrumental variables estimator. In doing so, we use as our instrument only the temporary, random amplification caused by rainfall of the opportunity cost of time represented in the facility existence dummy, thereby avoiding issues of unobserved systematic variation in long-term access to resources that accompany the use of facility existence alone.

The two stages of analysis are specified as follows. Define $NoFac_j$ to be a dummy variable which equals 1 if *no* formal-sector health facility exists in cluster j , and R_{ij} to be the number of days of rainfall in cluster j in the month in which household i reported having at least one sick member (and one non-sick member, to allow for analysis on intrahousehold enterprise and labor effects of sickness).⁶ Note we do not include household fixed effects in the specification. While the panel structure of the data allows for identification from within household variations over time, restricting attention to households reporting an ill member in multiple waves would reduce the sample size and power a great deal and would also render any estimates largely unrepresentative of the sample as a whole.⁷

The two-step estimator is written as follows:

$$\text{1st stage: } h_{ij} = \alpha_1 (NoFac_{ij} \times R_{ij}) + \alpha_2 NoFac_{ij} + \alpha_3 R_{ij} + X'_{ij} \alpha_4 + \zeta_{ij} \quad (1)$$

⁶We define the facility "existence" variable in the negative in order to make interpretation of the interaction coefficient easier; of course, changing this variable to reflect the existence of a health facility as opposed to the lack of existence has no effect on the estimation procedure or the results (barring changing the sign of the coefficients on the interaction term and the main effect of facility existence).

⁷The sample restriction we use in the analysis below, one ill member and one non-ill member, retains roughly 70% of the household-year observations; while restricting attention to households reporting ill members in multiple waves would reduce the sample to well below 50% of the available household-year observations.

$$\text{2st stage: } O_{ij} = \beta_1 h_{ij} + \beta_2 \text{NoFac}_{ij} + \beta_3 R_{ij} + X'_{ij} \beta_4 + \varepsilon_{ij} \quad (2)$$

The intuition behind the instrument is simple. The main effects of facility non-existence and rainfall are likely both negative; that is, not having a facility in a household's community and being exposed to more rainfall should, for the purposes of travel costs, discourage the household from sending sick members to formal-sector health facilities. Moreover, heavier rains should discourage households that are farther away *more* than households located in a community with a health facility.

Imagine one household located directly next to a facility, while another is located many villages away. In times of dry weather, clearly the household in the community with a health facility will be more likely to choose formal-sector care than the one farther away. However, in times of heavy rains, the rain should incrementally deter the farther household *more* than the one just next door.

3.2 Instrument validity

Ideally, we would like variation in the instrument to be equivalent to experimental variation in the price of formal-sector care. That is, we would like to answer the question, "Holding all other prices constant, if we shift only the price of formal-sector care, how does the demand for this care change, and subsequently, how do these shifts affect health and enterprise outcomes?" One crucial element of our argument is thus that the interaction instrument must induce price changes solely in the costs of formal-sector care, as opposed to shifting other prices which determine access to other resources, as well as directly influence economic activity and capital and labor allocations.

3.2.1 Controlling for general remoteness—It is plausible that fluctuations in rainfall induce differential price shifts in communities with health facilities as compared with communities without. For example, suppose nonexistence of a formal care facility was correlated with a community's general remoteness; that is, communities lacking health facilities lacked access to other important resources (commodity and labor markets, roads, irrigation, etc.). In controlling for the main effect of the existence of a health facility in the community, and excluding only its interaction with days of rainfall, we control for the long-term, baseline effects of access to various resources, as mentioned above. However, since rainfall, through the interaction instrument, acts as a randomized amplifier of the costs of access to formal-sector care, rainfall could amplify the costs of access to these other resources as well. If this were true, the instrument would not be excludable. To address this problem, borrowing the strategy used in Adhvaryu and Nyshadham (2012b), we control for the existence and distance to a variety of important resources, as well as the interactions of these variables with days of rainfall.⁸ Controlling for the main effects of this rich set of variables and its interaction with rainfall ensures that the variation induced by the instrument is specific to the costs of formal-sector care.

⁸For example, we include existence of a daily market, motorable road, public transport, and secondary school; for a full listing of the variables included, please refer to the note at the bottom of Table 2.

3.2.2 Selection into sickness—One desirable feature of the instrument for healthcare choice must be that it does not predict selection into sickness, but rather only the choice of care conditional on acute sickness. To check that this is indeed the case, we regress a dummy for having at least one sick member and one non-sick member in the household of at least 7 years of age on the interaction instrument, the main effects, and the full set of controls. The results, reported in column 1 of Table B.1, verify that the instrument does not predict selection into acute sickness: the coefficient on the interaction instrument is a precisely estimated zero. In column 2 of Table B.1, we report results from a similar regression which checks that the instrument does not predict selection into the sample of households with no sick members. The coefficient from on the instrument from this regression is weakly significant at the 10 percent level; however, the point estimate is quite small relative to the size of the sample.

3.2.3 Instrument does not shift labor supply for non-sick households—We posit that the interaction instrument shifts the costs of access to formal-sector care, and thus generates exogenous shifts in the healthcare choices—and ultimately the health and economic outcomes—of sick individuals. If this is the dominant mechanism through which our instrument works, we should not observe that this variable shifts enterprise activity and labor allocations for households with *no sick members*. To test this hypothesis, we regress enterprise activity and per-capita labor outcomes (hours of non-sick members aggregated to the household level, divided by number of non-sick household members) on the instrument and the full set of controls using the sample of households which had no sick members. The results, reported in Table B.5, verify that the instrument does not predict fluctuations in labor hours for all categories of labor included in our analysis; in each case, the coefficient is quite small and insignificantly different from zero, except for a weakly significant, small positive coefficient for high skilled enterprise. This falsification provides further evidence that the instrument affects enterprise and labor outcomes purely through its effect on healthcare choice, and therefore, evidence of the validity of the instrument's exclusion from second stage regressions.

3.2.4 Nonlinear effects of endogenous distance and rain—Finally, we allow for the possibility that distance enters the first and second stages nonlinearly. We do this to further preclude the possibility that the interaction instrument is only capturing a nonlinear effect of distance (or extreme remoteness), rather than the interaction of distance with a randomized, transitory source of variation. To account for this concern, we include quintiles of the distribution of distance to the nearest health facility, hospital and dispensary in all regressions.

We allow for the analogous possibility in rainfall and rainy days as well by including dummies for deciles of the rainfall and rainy days distributions as controls. Furthermore, in order to more transparently demonstrate the empirical validity of the instrument along the entire distribution of rainy days, we plot the difference in care-seeking as nonparametric functions of rainy days between individuals living in villages with and without health facilities. This difference is depicted in Figure 1 and shows a strong and increasingly negative relationship across the entire distribution of rainy days in the month of survey. That

is, individuals living in villages with no health facility are less likely to seek care at all values of rain, but are incrementally less likely to seek care with each additional day of rain in the month of survey. The figure also depicts the number of observations at each value of rainy days for individuals living in villages with no facility, those living in villages with a facility, and the total sample. The three dotted lines corresponding to these different rain days distributions show that rainfall is well-balanced across individuals with different access to health facilities ensuring that any distributional imbalances will not confound our main results.

4 Results

4.1 First Stage Results

Results from the first stage regressions are presented in Table 2. In the first stage specifications, we regress the number of sick individuals in the household who visited a healthcare facility on the proposed instrument (normalized by its standard deviation) of the interaction of days of rainfall in month of survey and a dummy for the lack of a formal-sector health-care facility in the individual's community. All specifications reported in Table 2 include controls for the main effects of rainfall (decile dummies for days and millimeters of rainfall) and presence of or distance (quintile dummies and continuous distance) to a health facility in the cluster along with dummies for the presence of other resources (markets, motorable road, post or telephone, etc.) in the cluster and group effects for household assets, max education of household members, number of household sick, and household size. The preferred specification reported in column 2 also includes interactions of dummies for cluster resources and days of rainfall. The results in column 2 of Table 2 show a significant reduction in the number of sick individuals choosing formal-sector care when the interaction instrument increases. The F-stat on the instrument coefficient is nearly 21 ($p = 0.00000502$).

As a robustness check, we run the same specification as reported in column 2 with alternate sets of controls. The specification reported in column 3 omits interactions of days of rainfall and cluster resource existence dummies; while the specification reported in column 1 of Table 2 includes, in addition to all controls from the preferred specification, controls for number of household members of various ages and gender; polynomials in distance to health facility, household size, max age of household; and quadratic terms in historical mean and standard deviation of days of rainfall (see section 2 for details). The results, reported in columns 1 and 3 of Table 2, respectively, are qualitatively similar to the original specification, though the coefficient on the instrument and the F-stat are reduced in column 3.

In column 4 of Table 2, we report the results of a specification with the same set of controls as in the specification reported in column 3, but excluding the interaction instrument. Here, as expected, we see a strongly negative correlation between choosing formal-sector care and the non-existence of a health facility in the household's village. The coefficient on days of rainfall in the month of survey is small and insignificant. This result is also in line with our expectations, as the composite effect of rainfall on healthcare choice is conceptually ambiguous: as discussed in section 3, rainfall affects not only the cost of travel to a facility

but also many other economic and health-related outcomes for households in agricultural societies.

4.2 Health Outcomes

Column 2 of Table 3 presents results from the second stage IV regression of the number of household sick who were still ill at the time of survey on the number of household sick who visited formal-sector care. The results show a large and significant reduction in the number of individuals still ill when these individuals are driven exogenously to formal-sector care. One additional household member driven to formal-sector care reduces the number of household members who are still ill at the time of survey by nearly a half (0.451). Compared to the mean of the dependant variable, this is a fairly large effect on number of household members who are still ill at the time of survey.⁹ Column 1 of Table 3 reports the results from the reduced form regression of number of household members still ill at the time of survey on the normalized interaction instrument.

4.3 Enterprise Activity

Now that we have verified the power of the interaction instrument to predict the use of formal-sector care and the effects of formal-sector care on health outcomes, we next investigate the effects of formal healthcare on the enterprise activity of sick and non-sick members of the household. We first explore effects on the extensive margin of entry into enterprise. Table 4 presents second stage IV results from the regression of binaries for whether at least one household member engaged in enterprise activity on the number of acutely ill household members who visited formal-sector care. The specifications are identical to that reported in column 2 of Table 3.

In column 1 of Table 4, we see that one additional ill member of the household visiting a formal-sector care facility leads to a 60 percentage point reduction in the probability of at least one member of the household engaging in enterprise activity. In columns 2 and 3 of Table 4, we present results from similar regressions which restrict attention to the enterprise activity of acutely ill and non-ill members of the household, respectively. The results show that *both* acutely ill and non-ill members of the household are more likely to engage in enterprise activity in response to illness in the household, and discontinue this enterprise activity after ill members of the household visit formal-sector care. That is, an additional ill member of the household visiting a formal care facility leads to a 43 percentage point reduction in the probability of *both* acutely ill and non-ill members of the household engaging in enterprise activity.

4.4 Intra-Household Labor Allocations

Given the results on the extensive margin of entry into and exit from enterprise activity, we next investigate the effects of formal healthcare on the intensive margin of enterprise; that is, the total labor supply of sick and non-sick members of the household and the allocations of

⁹The magnitude of these results corresponds to the results in Adhvaryu and Nyshadham (2012b), which applies a similar analysis at an individual level to a subsample of school-aged children from the same data, and in Adhvaryu and Nyshadham (2012a), which applies a similar analysis to nationally representative data on children under five in Tanzania.

labor across enterprise, farm, and domestic chores. In order to identify the causal effect of formal-sector acute care on the labor supply of household members, we run the same IV specification reported in column 1 of Table 4 with per capita labor supplies as outcomes. In Panel A of Table 5, we present results on per capita total labor supply and on allocations of total labor to each type of activities for all members of the household. Each outcome is calculated by summing across all members of the household and dividing by the number of productive members in the household (age ≥ 7).

The results in Panel A of Table 5 show that when sick household members are exogenously driven to formal-sector care, the household as a whole reallocates its time away from enterprise activities and domestic chores and back towards farm labor. When one additional sick household member visits formal-sector care, per capita hours spent in enterprise activity by the household are reduced by nearly 10 hours; time spent on domestic chore is reduced by nearly 3 hours; and farm labor is increased by more than 7.5 hours during the week prior to survey. The effect on per capita time spent on enterprise activity is significant at the 5 percent level.

In Panels B and C of Table 5, we report the same regressions as those reported in Panel A, but conducted on the per capita labor supplies and allocations of sick and non-sick household members, respectively. The results show the same pattern among *both* sick and non-sick members' labor allocations as was reported in Panel A. That is, when sick members of the household are driven exogenously to seek formal-sector care, *both* sick and non-sick members of the household draw down their enterprise hours and hours spent on domestic chores and increase their farm labor hours.

The estimates in Panel B show that when one additional sick member of the household visits formal-sector care, each sick member of the household decreases their time spent in enterprise activity by an average of more than 12 hours and increases their farm labor by more than 13 hours on average. The effect on the enterprise hours is significant at the 5 percent level, while the effect on farm labor is significant at the 10 percent level. The estimates in Panel C show that when one additional sick member of the household visits formal-sector care, each non-sick member of the household reduces their time spent in enterprise by nearly 10 hours and increase their farm hours by over 5 hours. The effect on self-employment hours of non-sick household members is significant at the 10 percent level, while the effect on farm hours of non-sick members is not significant at conventional levels. Both sick and non-sick members of the household reduce their domestic chore hours by over 5 hours on average, but neither estimate is significant at conventional levels.

4.5 Types of Enterprise Activities

The results presented above suggest the use of non-agricultural self-employment as a means of weathering health shocks. In light of the short-term nature of enterprise activity in response to acute health shocks, we next explore the types of enterprises in which these households engage. In particular, we are interested to see whether households that switch into enterprise activity in response to acute health shocks participate activities that are easy to start up as opposed to activities that require a great deal of skill or capital.

In Table 6, we present results from regressions identical to those reported in Table 4, but with the enterprise binary outcome split up by type of business. Specifically, in Panel A of Table 6, we explore effects of formal-sector care on the probability that any member of the household engaged in a fishing business, merchant business, high skilled business such as health care or accounting, or high capital business such as running a factory, bar, or hotel. The results in Panel A of Table 6 show that households are most likely to engage in merchant and fishing businesses in response to health shocks rather than high skilled or high capital businesses. In Panels B and C of Table 6, we show results for sub-samples of sick and non-sick members of the household. Once again, the patterns of results are similar to those presented in Panel A; however, we find no evidence in Panel B that acutely ill household members engage in fishing businesses.

It is important to note that the magnitudes of the effects on merchant and fishing enterprises are very large as compared to the means of these dependant variables. This is certainly indicative of the importance of this margin of adjustment; however, the means of the dependant variables reported in Table 6 are somewhat attenuated in that they include the households in the sample who never engage in enterprise at all during the study period. That is, the population on the margin of adjustment will have potentially a higher mean probability of operating a merchant enterprise. For example, while only 20% of the entire sample of households operate a merchant business, nearly 70% of households that operate an enterprise at some point during the study period operate one in the merchant sector.

4.6 Labor Inputs and Capital Assets

Finally, in order to explore the degree to which households commit to their enterprises, we turn to effects on input allocations toward household enterprises. In Table 7, we present results of regressions of variables measuring number of paid and unpaid household laborers and hired laborers from outside of the household and number of capital assets owned, bought and sold on the number of ill household members that sought formal-sector care using the preferred specification. In Panel A of Table 7, we show that when one additional ill household member is exogenously driven to seek formal-sector care the business has nearly half an unpaid household member less contributing labor to the business and more than a tenth of a hired worker less. There is no evidence of an effect on the number of paid household members. In Panel B, similarly, we find that the business owns 0.35 less assets and roughly 0.22 less assets are bought. These results suggest that households that engage in enterprise activity in response to acute health shocks invest in their businesses with both household labor (consistent with the results in Table 5) and hired labor as well as capital assets. Unfortunately, these outcomes are only collected at the household level and, therefore, cannot be attributed to ill or non-ill members of the household.

Table 8 explores similar effects on the continuous measures of input expenditure on labor and capital. These expenditure measures are collected at the individual level and, therefore, can be explored at the household level as well as for ill and non-ill subsets of the household. The outcomes in all specifications reported in Table 8 are the logs of monetary values. The patterns observed in these continuous expenditure measures is quite similar to that shown in Table 7. In particular, one additional ill household member seeking formal-sector care leads

to a 4.3 percent reduction in total expenditure on inputs on average among all household members (7.5 percent reduction among ill household members, and 25 percent reduction among non-ill members). These reductions come almost entirely from reductions in the value of business assets owned and bought. There is little evidence of a reduction in the value of labor wages paid both to other household members and hired laborers.

One might argue that the ephemeral nature of the enterprise activity observed in the sample renders a study of such activity unimportant. However, the breadth and magnitude of the observed responses depict a strong commitment to enterprise when weathering sector-biased productivity shocks such as acute illness among some members of the household. Specifically, the wholesale reallocation of household labor and the presence of effects even on capital stock and acquisition are quite notable and establish the importance of understanding the enterprise activities of these seemingly marginally entrepreneurial households as well.

Furthermore, the responses among these households, if observed in a single cross-section or a sufficiently short panel, might lead to a miscategorization of these households as entrepreneurial rather than primarily agricultural and “occasionally” entrepreneurial over the long-run. This miscategorization will drive improper targeting of policy and research interventions and lead to an attenuation in the measured impacts of interventions and efficacy of policy reforms.

5 Explanations

5.1 Household Labor Complementarity

The results show that households engage in enterprise (particularly low fixed cost, low skilled activities such as merchant businesses) in response to acute illness among some members of the household. Sick individuals, and their healthy household members, tend to engage in enterprise activity when recovery from illness is delayed, and shift back to farm labor when sick individuals recover quickly. In this section, we explore a framework to explain these results.

Our interpretation rests on the premise that health has heterogeneous effects on marginal productivity across sectors. Recovering quickly from illness thus generates different changes in the marginal productivity of labor on the farm and in enterprise. If farm labor is more physically demanding than business activity, we would expect that illness generates larger decreases in productivity on the farm than in business. Under this premise, when sick, individuals should shift labor to the enterprise sector, where it is relatively more productive.

Moreover, if labor inputs are used jointly in household production, a change in the productivity of one household member should elicit changes in the labor of other members. The direction and size of these changes will depend on the way in which labor inputs interact in the household production functions in each sector, and on the nature of the shifts in productivity. For example, if household labor is perfectly substitutable, we might expect that when one individual falls ill and shifts his labor from the farm to the enterprise sector,

his household will compensate by working longer hours on the farm, and perhaps fewer hours in enterprise.

Our results show the opposite: sick individuals shift labor away from the farm and into enterprise, and other household members do the same. Following the same intuition, then, the observed pattern of reallocation should imply that complementarities exist in some sector of household production. When household labor inputs are complementary and recovery from illness is prolonged, it might be worthwhile even for both sick and health household members to spend more time in enterprise activity, and less on the farm.

We formalize this insight by extending the canonical agricultural household model to include health and treatment for acute health shocks. Ours is a simple model of household production and labor decisions with two household members and two sectors of production—farm and enterprise. We use the model to demonstrate that the pattern of engagement in enterprise and labor allocations observed in the data implies labor complementarities exist in at least one sector of household production. The model is presented in the Appendix.

Labor complementarity in our context could be technical, arising as feature of the sector-specific production functions, or it could arise as a result of the nature of the shift in productivity. For example, switching from farm labor to enterprise activity may make it easier to care for a sick household member who is confined to the home. Time spent in the business sector may thus have an additional return (caring for the sick while working) when members of the household fall ill.

We test for this additional return to enterprise activity by breaking down domestic chore hours into hours spent in caring for ill household members, in home production activities, in gathering firewood, and in fetching water. The results are reported in Table B.4. The result in column 1 on hours spent caring for sick individuals suggests that this type of complementarity is not salient in our context.¹⁰

5.2 Health Spillovers

We consider one main category of alternative explanations: the presence of health spillovers between sick and non-sick household members. Two main types of spillovers are considered. First, health shocks to one household member may affect another member's health directly through disease contagion. Second, individuals seeking treatment for acute health shocks may enable easier access to medicines or information for other (non-acutely ill) members of the household (treatment spillovers). We address these two possibilities below.¹¹

5.2.1 Contagion—It seems implausible in our context that health spillovers through contagion can entirely explain the pattern of adjustments we observe. Since we divide the

¹⁰One caveat is that care hours may be underreported or grouped into home production or another type of labor activity if they overlap enough with that activity. Underreporting might also help to explain the low mean on care hours (0.86 hours per person per week) despite the high number of individuals reporting sickness in the two weeks preceding survey.

¹¹Note that our model explicitly allows for utility spillovers in health. The individual-specific utility function is allowed to depend (non-separably) on both own health and the health of the other household member. The complementarities result described above goes through when allowing for utility spillovers of health. Please see the Appendix for details.

household into individuals who reported being acutely sick and those who did not, the contagion effect would need to be small enough that though non-sick individuals (as we classify them) are affected, they are not affected *enough to report being sick*, but large enough that it drives changes in the labor allocations of the non-sick that are commensurate, both in absolute magnitude and as a percentage of total hours, with the changes observed for sick household members. We propose that the likelihood is small that the contagion effect achieves this balance perfectly.

5.2.2 Treatment spillovers—The second concern regarding spillover effects relates to the idea that *treatment* sought by acutely ill members of the household has spillover effects on the health of non-sick members. One might imagine that household members who are chronically ill, but not acutely so, accompany acutely ill members to treatment, or that acutely ill individuals bring back medication or treatment-related information to other members of the household. These examples can be explained by the same extension to the model as shown above.

In this case, we would expect to see that increases in the proportion of sick members of the household visiting formal care generates improvements in the health status of reportedly non-acutely-ill members of the household. In columns 1–3 of Table B.3, we report results from reduced form regressions of the proportion of non-sick members who reported various chronic illnesses on the proportion of sick members who visited formal healthcare in our usual specification. We find no significant effects of the formal healthcare of sick members on chronic fever, weight loss, and rash among non-sick members.

6 Conclusion

Our study explores the importance of sector-biased productivity shocks as a determinant of enterprise activity in developing country contexts. We focus on households' responses to acute illnesses, which affect productivity more in sectors demanding greater physical effort, such as farming. Using exogenous variation in the cost of accessing formal-sector health care following acute health shocks, we provide empirical evidence that when acutely ill individuals are slow to recover, households start up non-agricultural enterprises (primarily merchant businesses); invest in capital assets for the business; and allocate large portions of household labor supply to these enterprises.

We find that family members who are not ill also reallocate labor toward enterprise activities during these times. With guidance from a simple extension to the canonical agricultural household model, we interpret this parallel shift in labor allocations as evidence of labor complementarities. Further, the degree of labor and capital reallocation toward these enterprises during times of illness emphasize the importance of enterprise activity in the economic livelihood of households in developing country contexts, even for households that are predominantly agricultural.

Perhaps, the use of small-scale intermittent enterprise to weather productivity shocks is evidence of the failure of other smoothing mechanisms (e.g., insurance, credit, savings, wage labor) to adequately insulate the household from shocks to productivity and income

such as those arising from acute illness. Additionally, this study emphasizes that acute illness, if not met with adequate care, can have large and lasting impacts on productivity, making it necessary for the household to respond more wholly and dramatically (i.e., shifting sectoral choice and household labor allocation). Improvement of both financial (e.g. insurance, credit, and savings) and health infrastructure could help to attenuate or even sever this link between acute illness and household production decisions, leading to more stable productivity and income for agricultural households in developing country contexts.

A A Model of Household Labor Allocations

A.1 Setup

Consider a household with two members $i \in \{1, 2\}$. Let Ω be the individual time endowment; each household member's time is allocated toward leisure L_i , labor on one's own farm (l_i); non-farm enterprise (t_i); and outside wage employment (t_i^o) at wage rate w .¹² The time constraint for each i is therefore $\Omega = L_i + l_i + t_i + t_i^o$. Individuals value their own consumption of the two market goods ($c_i = (c_i^f, c_i^e)$), own leisure (L_i), own health h_i , and the health and leisure of the other family member, h_{-i} and L_{-i} respectively. Each member's preferences are represented by a utility function $u_i(c_i, L_i, L_{-i}, h_i, h_{-i})$.¹³ Goods are produced via the production functions for farm labor and enterprise, $f(l_1, l_2, h_1, h_2)$ and $e(t_1, t_2, l^o, h_1, h_2)$, respectively, where l^o is the total outside labor employed in the household's business. The market prices of the two goods are $\mathbf{p} = (p^f, p^e)$.

Health enters the household allocation problem in two ways. First, it directly provides utility, as described above. Second, it affects each household member's productivity. We make only one restriction on the way in which h_i enters f and e : we assume that the health of person i

does not *directly* affect the marginal productivity of person $-i$. That is, $\frac{\partial^2 f}{\partial l_{-i}^f \partial h_i} = 0$ and $\frac{\partial^2 e}{\partial t_{-i}^e \partial h_i} = 0$.¹⁴ Of course, the marginal productivity of $-i$ in each sector is still free to shift as a result of labor adjustments to an acute health shock to i .

Our focus in this paper is on acute health shocks and corresponding (acute) investments in treatment for these shocks. Accordingly, we define the health production function as $h_i = h(\sigma_i Q_i, \varepsilon_i)$, where $\sigma_i \in \{0, 1\}$ is an acute health shock indicator, Q_i is the corresponding intensity of treatment (which we think of as the quality of healthcare for individual i), and ε_i is a vector of other inputs into health, such as endowments, long-term care, chronic illness etc. The price of one unit of Q_i is p^Q . Note that as we have defined the health production function above, Q_i only improves health in the event of a health shock (i.e. when $\sigma_i = 1$). We

¹²In keeping with empirical context—and other agricultural settings in the developing world (Fafchamps 1993; Udry 1996)—we assume that a market does not exist for farm labor. In our sample, though the average number of hours spent farming per week by a member of a household with at least one sick and one non-sick member is roughly 14.5, less than .5 of these hours is spent working on someone else's farm for a wage.

¹³Note that we allow explicitly for non-separability of leisure and health across household members. The results of the model are also robust to considering a fully non-separable utility function within a unitary representation of the household's problem. We choose to focus on the collective model in keeping with the recent literature on intra-household decision-making in developing countries.

¹⁴One way in which this assumption may be violated is through disease contagion; we address this possibility below.

restrict Q_i in this way to underscore its role as *curative care*, rather than long-term health investment, preventative care or the like.

A.2 Utility maximization

An efficient allocation of resources within the household is characterized as a solution to the following problem:¹⁵

$$\max_{\mathbf{c}_i, L_i, l_i, t_i, t_i^o, t^o, Q_i, i \in \{1, 2\}} u_1(\mathbf{c}_1, L_1, L_2, h_1, h_2) + \Phi u_2(\mathbf{c}_2, L_1, L_2, h_1, h_2) \text{ subject to}$$

$$\mathbf{p} \cdot (\mathbf{c}_1 + \mathbf{c}_2) + p^Q(Q_1 + Q_2) \leq p^f f(l_1, l_2, h_1, h_2) + w(t_1^o + t_2^o - t^o) + p^e e(t_1, t_2, t^o, h_1, h_2) \quad (3)$$

$$L_i + l_i + t_i + t_i^o = \Omega_i, \quad i \in \{1, 2\} \quad (4)$$

$$h_i = h(\sigma_i Q_i, \mathcal{E}_i), \quad i \in \{1, 2\} \quad (5)$$

Note that we have omitted the standard non-negativity constraints on labor in the optimization program above. We make the following standard assumptions about the shapes of the utilities and production functions:

1. Utility is increasing and concave in own consumption: $\frac{\partial u_i}{\partial c_i^f}, \frac{\partial u_i}{\partial c_i^e} > 0$ and $\frac{\partial^2 u_i}{\partial c_i^{f^2}}, \frac{\partial^2 u_i}{\partial c_i^{e^2}} < 0$, for $i = 1, 2$.
2. Consumption goods are normal.
3. The production functions are increasing and concave in their labor inputs: $\frac{\partial e}{\partial t_i} > 0$ and $\frac{\partial^2 e}{\partial t_i^2} < 0$, for $i = 1, 2$; and $\frac{\partial f}{\partial l_i} > 0$ and $\frac{\partial^2 f}{\partial l_i^2} < 0$.

Under the above assumptions, we obtain interior solutions for consumption demand, labor supply and healthcare quality choice as functions of the model's parameters.

We focus on two of the necessary first order conditions—those with respect to l_2 and t_2 , the farm and enterprise labor supply of the second household member. We do this to draw attention to the intra-household consequences of health shocks and their corresponding

¹⁵Ours is a simple variant of the basic constrained optimization problem of the agricultural household, described, for example, in Bardhan and Udry (1999). We modify the model to include multiple sectors, multiple household members and a role for health. For similar characterizations of the collective household as they apply to the developing country context, see, e.g., Chiappori (1992), Chiappori (1997), Udry (1996), Duflo and Udry (2004).

treatment, as below, we examine the case in which household member 1 experiences a health shock but household member 2 does not. The first order conditions for these two choice variables are as follows (letting λ and δ denote the Lagrange multipliers for the budget constraint and the time constraint, respectively):

$$(l_2): -\lambda \left(-p^f \frac{\partial f}{\partial l_2} \right) - \delta = 0 \quad (6)$$

$$(t_2): -\lambda \left(-p^e \frac{\partial e}{\partial t_2} \right) - \delta = 0 \quad (7)$$

Combining, we get

$$p^e \frac{\partial e}{\partial t_2} = p^f \frac{\partial f}{\partial l_2}. \quad (8)$$

An analogous condition holds for household member 1. Intuitively, at an optimum, each household member must equate the ratio of marginal productivities across sectors to the inverse price ratio.

A.3 Labor adjustments to shocks as evidence of complementarities in production

Our first goal is to study the pattern of labor adjustments after a health shock. In the model, variation in individual i 's acute sickness may derive from variation in the health shock σ_i and/or the variation in healthcare investment Q_i . In empirical settings, σ_i is very difficult to measure, and exogenous variation in σ_i is difficult to observe because health shocks are likely jointly determined with health endowments and health preferences, which are unobserved to the econometrician. Though Q_i is by construction an endogenous choice of the household, variations in the exogenous price of healthcare quality p_Q may be used as an exogenous shifter of sickness in order to explore its effects on the household's reallocation of resources.

Differentiating equation 8 with respect to p^Q , we obtain:

$$\begin{aligned} p^e \left(\frac{\partial^2 e}{\partial t_2 \partial t_1} \frac{\partial t_1}{\partial p^Q} + \frac{\partial^2 e}{\partial t_2^2} \frac{\partial t_2}{\partial p^Q} + \frac{\partial^2 e}{\partial t_2 \partial t^o} \frac{\partial t^o}{\partial p^Q} + \frac{\partial^2 e}{\partial t_2 \partial h_1} \frac{\partial h_1}{\partial p^Q} + \frac{\partial^2 e}{\partial t_2 \partial h_2} \frac{\partial h_2}{\partial p^Q} \right) \\ = p^f \left(\frac{\partial^2 f}{\partial l_2 \partial l_1} \frac{\partial l_1}{\partial p^Q} + \frac{\partial^2 f}{\partial l_2^2} \frac{\partial l_2}{\partial p^Q} + \frac{\partial^2 f}{\partial l_2 \partial h_1} \frac{\partial h_1}{\partial p^Q} + \frac{\partial^2 f}{\partial l_2 \partial h_2} \frac{\partial h_2}{\partial p^Q} \right) \end{aligned} \quad (9)$$

The above equation indicates that the way in which household members adjust labor allocations following an acute health shock (or, as expressed above, a shift in the price of curative care) depends crucially on the shapes of the farm and enterprise production

functions. We use this equation to predict production and labor decisions in the presence of complementarity of household labor in one or both of these production functions.

We are interested in particular in the labor responses of households with both sick and non-sick members. Thus, let us examine equation 9 for the case in which $\sigma_1 = 1$ and $\sigma_2 = 0$ (that is, only household member 1 is acutely ill). The fourth terms within parentheses

$(\frac{\partial^2 e}{\partial t_2 \partial h_2} \frac{\partial h_2}{\partial p^Q} \text{ and } \frac{\partial^2 f}{\partial l_2 \partial h_2} \frac{\partial h_2}{\partial p^Q})$ on both sides of the equation equal 0 in this case, since $\frac{\partial h_2}{\partial p^Q} = 0$ when $\sigma_2 = 0$. Further, the third terms within parentheses $(\frac{\partial^2 e}{\partial t_2 \partial h_1} \frac{\partial h_1}{\partial p^Q} \text{ and } \frac{\partial^2 f}{\partial l_2 \partial h_1} \frac{\partial h_1}{\partial p^Q})$ are also 0, since we have imposed that the health of i does not *directly* affect the marginal productivity of $-i$ (i.e. $\frac{\partial^2 e}{\partial t_2 \partial h_1} = \frac{\partial^2 f}{\partial l_2 \partial h_1} = 0$). Equation 9 can thus be written as

$$p^e \left(\frac{\partial^2 e}{\partial t_2 \partial t_1} \frac{\partial t_1}{\partial p^Q} + \frac{\partial^2 e}{\partial t_2^2} \frac{\partial t_2}{\partial p^Q} + \frac{\partial^2 e}{\partial t_2 \partial t^o} \frac{\partial t^o}{\partial p^Q} \right) = p^f \left(\frac{\partial^2 f}{\partial l_2 \partial l_1} \frac{\partial l_1}{\partial p^Q} + \frac{\partial^2 f}{\partial l_2^2} \frac{\partial l_2}{\partial p^Q} \right) \quad (10)$$

The above equation forms the basis of the model's predictions for labor allocations under

labor complementarities. The objects of interest are the cross-partials $\frac{\partial^2 e}{\partial t_2 \partial t_1}$, $\frac{\partial^2 f}{\partial l_2 \partial l_1}$, and

$\frac{\partial^2 e}{\partial t_2 \partial t^o}$. Note that $\frac{\partial^2 e}{\partial t_2^2} < 0$ and $\frac{\partial^2 f}{\partial l_2^2} < 0$ by the assumption of concavity of the production functions. The remaining four derivatives constitute the extent of labor adjustments to

shocks across household members and activities (i.e., $\frac{\partial k_j}{\partial p^Q}$ for $k \in \{t, l\}$ and $j \in \{1, 2\}$).

Assuming complementarity or substitutability of farm and enterprise labor would yield predictions on the signs of these labor adjustments. Conversely, estimating these adjustment terms and signing them imposes restrictions on the signs of the cross partials. Following the latter approach, estimating the labor adjustments to health shocks across sectors allows us to (partially) determine the complementarity or substitutability of household labor.

A.4 Interpretation of Estimates

Using the estimates described in section 4 above and equation 10, we examine the case in

which $\frac{\partial l_1}{\partial p^Q}, \frac{\partial l_2}{\partial p^Q} < 0$ (decrease in farm labor), $\frac{\partial t_1}{\partial p^Q}, \frac{\partial t_2}{\partial p^Q} > 0$ (increase in enterprise labor), and $\frac{\partial t^o}{\partial p^Q} > 0$:

$$p^e \left(\frac{\partial^2 e}{\partial t_2 \partial t_1} \underbrace{\frac{\partial \hat{t}_1}{\partial p^Q}}_{>0} + \underbrace{\frac{\partial^2 e}{\partial t_2^2}}_{<0} \underbrace{\frac{\partial \hat{t}_2}{\partial p^Q}}_{>0} + \frac{\partial^2 e}{\partial t_2 \partial t^o} \underbrace{\frac{\partial t^o}{\partial p^Q}}_{>0} \right) = p^f \left(\frac{\partial^2 f}{\partial l_2 \partial l_1} \underbrace{\frac{\partial \hat{l}_1}{\partial p^Q}}_{<0} + \underbrace{\frac{\partial^2 f}{\partial l_2^2}}_{<0} \underbrace{\frac{\partial \hat{l}_2}{\partial p^Q}}_{<0} \right) \quad (11)$$

Plugging these signs into equation 10, we obtain the following inequality:

$$\frac{\partial^2 e}{\partial t_2 \partial t_1} + \gamma \frac{\partial^2 f}{\partial l_2 \partial l_1} + \eta \frac{\partial^2 e}{\partial t_2 \partial t^o} > 0, \quad (12)$$

where $\gamma \equiv \left(-p^f \frac{\partial \hat{l}_1}{\partial p^Q} \right) / \left(p^e \frac{\partial \hat{t}_1}{\partial p^Q} \right)$ and $\eta \equiv \left(\frac{\partial \hat{t}^o}{\partial p^Q} \right) / \left(\frac{\partial \hat{t}_1}{\partial p^Q} \right)$ are positive constants. We

conclude that $\frac{\partial^2 e}{\partial t_2 \partial t_1}$, $\frac{\partial^2 f}{\partial l_2 \partial l_1}$, and $\frac{\partial^2 e}{\partial t_2 \partial t^o}$ cannot all be negative; that is, production in *at least one sector* must exhibit complementarities in household labor.

Thus our results suggest that at least one, and perhaps more, of the productive activities in which members of the agricultural households in our sample engage must exhibit complementarities among the labor inputs of various members of the household. This is potentially an important result, given the frequency with which previous studies of the agricultural household have assumed that family labor inputs are at least imperfectly substitutable. The pattern of empirical results in this study suggests that the substitutability of family labor inputs in the agricultural household model is not necessarily an appropriate assumption in all settings.

B Additional Results

B.1 Sample Selection

In Table B.1, we report results from sample selection regressions of dummies for inclusion in the sample used in the main analysis on the interaction instrument, the main effects of the facility non-existence dummy and days of rainfall in the month of survey, and the full set of controls used in the preferred first and second stage regressions. Column 1 reports results from the specification checking for selection into the sample of households with one sick and one non-sick member above the age of 7 on the basis of the instrument with no sampling weights applied. Column 2 reports results from the same check for selection with sampling weights applied. Across both checks, we find no evidence that the instrument predicts selection into the sample.

B.2 Collinearity Between Instrument and Resource Access Controls

To the degree that general remoteness strongly predicts the presence of all resources in the community, including health facilities, we might be worried about collinearity between the health facility non-existence dummy and the dummies for the presence of other resources in

the community such as daily market, motorable road, post office or telephone, etc. Table B.2 reports results from the regression of the No Facility dummy on the resource dummies included in set of controls of the preferred specifications from the analysis. The results show significant correlations, but sufficient residual variation in the No Facility dummy. The R-squared is only 0.299, indicating that over two-thirds of the variation in the No Facility dummy is orthogonal to the various resource access controls. Therefore, collinearity is not an issue.

B.3 Testing for Health Spillovers Within Household

Our interpretation of the results is predicated on enterprise activity and labor supply of non-ill members of the household being affected by the illness of fellow household members only through the production technologies and time allocations. However, if there are health spillovers within the household such that illness among some members affects the health of other household members, either through contagion or some public goods element of healthcare for the acutely-ill, then the illness among some members could affect the productivity and time use of other members more directly. We test for this possibility by regressing dummies for chronic illnesses among non-acutely ill members of the household on our instrument for healthcare choice in a reduced form. The results in Table B.3 do not suggest evidence of large health spillovers within the household.

B.4 Hours Spent Caring for Acutely Ill Household Members

Another way that time allocations of non-acutely ill household members might reflect illness in the household outside of the production technologies is an externality to time spent off the farm in terms of caring for ill household members. That is, time spent off the farm by non-acutely ill members can be used to care for ill household member, we might find that illness in the household drives non-ill members to leave the farm even in the absence of explicit labor complementarities. To explore this possibility, we separate time spent on domestic chores by non-acutely ill household members into sub-categories including time spent caring for ill. We then use these sub-categories as independent variables in our usual labor supply regressions. The results reported in Table B.4 show no significant effects speedy recovery amongst acutely ill members of the household on time spent caring for the ill by non-acutely ill household members.

B.5 Falsification on Non-Sick Households

A crucial assumption for the validity of the empirical strategy used in the analysis is the excludability of the interaction instrument from second stage regressions. In order for this assumption to hold, we must believe that the instrument affects second stage outcomes only through its effects on formal healthcare use.

As a falsification exercise to check the appropriateness of this assumption, we run our usual enterprise activity and labor supply regressions in reduced form on households with no sick members. If in fact the instrument has no effect on enterprise activity and labor supply except through its effects on the formal care use of sick members of the households, we

should expect to find no effects of the instrument on labor outcomes of members of households with no sick members. In Table B.5, results from these reduced form regressions confirm that the instrument does not predict business ownership of any type nor labor allocations across productive activities of members of entirely non-sick households.

B.6 Test of Endogeneity

We run the endogenous OLS specifications corresponding to the main second stage IV results reported in the paper and calculate the Hausman test statistics and corresponding p-values for each outcome (reported in Table B.6). We find that we can indeed reject the null hypothesis of equivalence for all outcomes for which the main results show significant effects. These results verify that the care-seeking is endogenous and support the validity of the proposed instrument.

B.7 Full Regression Results

In Table B.7, we replicate the main results, reporting all coefficients for variables used in the baseline regression specifications (excluding the coefficients are fixed effects, which are too numerous to report). To address for the potentially confounding variation in remoteness of households' locations, we controlled for all distance variables available in the data that showed non-trivial variation. These are binaries for the presence of the following in the household's village: a daily market; a periodic market; a motorable road; public transportation; a secondary school; a bank; and a post or telephone. (In addition, a crucial part of our empirical strategy is to control for the effect of each these indicators interacted with rainfall in the month of survey.)

We also address the potential confounding variation in rainfall by controlling for the historical mean and standard deviation of rainfall in the household's location. Finally, we control for the maximum educational attainment in the household, the mean age of household members, and total household size. We chose maximum education to embody the idea that the most educated member(s) of the household likely has a large say in household decision-making. Total household size and age of household members were included to control for demographic structure.

C Construction of Variables

The following list describes the construction of variables used in analysis:

C.1 Illness, Healthcare Choice, Instrument, and Controls

- *sick* = 1 if the individual reported being sick with an illness that began 14 days or less prior to the date of survey; then these binaries are summed within the household to create a number (*hhsick*) of the members of the household who reported being acutely ill
- *care* = 1 if sick individual visited hospital, health center or dispensary (government, NGO or private); *h* = 0 otherwise; then these binaries are summed

within the household to create a number (*hhcare*) of the sick members of the household who visited a formal-sector care facility

- *stillill* = 1 if the individual reported being sick with an illness that began 14 days or less prior to the date of the survey AND reported being ill at the time of the survey; then these binaries are summed within the household to create a number (*hhstillill*) of the members of the household who reported being still ill at the time of survey.
- *raindays* equals the number of days of rainfall at the rainfall station closest to the household's sample cluster, in the month and year that the household was surveyed
- *histmean* of rainfall is the number of days of rainfall in the month of survey averaged over all years in which rainfall data are recorded for that cluster in the particular month
- *histsd* is calculated as the standard deviation of the historical distribution of days of rainfall in the month of survey, across all years in which rainfall data are recorded for that cluster in the particular month
- *histmeansq* and *histsdsq* are smooth polynomials to the second degree in historical mean days of rainfall and historical standard deviation of days of rainfall, respectively
- *raindayslast* equals the number of days of rainfall at the rainfall station closest to the household's sample cluster, in the month *before* that in which the household was surveyed of the same year
- *decraindays* and *decrainfall* are categorical variables reporting which decile of the rain days and rainfall distributions, respectively, the rain in the survey month falls; fixed effects for each decile are included in all specifications
- *nofacilityt* is a binary variable which takes value *nofacilityt* = 1 if neither hospital, health center, nor dispensary of (government, NGO or private) exists in the community, and *nofacilityt* = 0 otherwise (Note: for waves in which these data were missing, the values were filled first using the minimum from the waves in which the data were not missing for that cluster, and second using the minimum of non-missing values from clusters matched to the same rain station in the same wave; that is, if a facility of these types ever existed in that cluster or in very proximate clusters before or after the year in which the data are missing, we assumed it existed during this wave as well)
- For the following facilities/attributes (*x*), we calculate distances as $dist(x) = 0$ if the facility/attribute exists in the same village as the household; *dist(x)* equals the distance to the nearest such facility/attribute outside the household's village if one does not exist in the village (Note: for waves in which these data were missing, the values were filled first using the mean from the waves in which the data were not missing, and second using non-missing data from clusters matched to the same rain station in the same wave)

- Hospital
- Health center
- Dispensary
- Daily market
- Periodic market
- Motorable road
- Public transportation
- Secondary school
- Bank
- Post office/telephone booth

- Categorical variables for the quintiles of the distributions of the above defined distances to hospital, health center, and dispensary were created and included in all specifications
- *dist*, *distsq*, and *distcub* are smooth polynomials up to the third degree in the minimum distance to either a hospital, health center, or dispensary
- *hhsizesq*, *hhsizesq*, and *hhsizesq* are smooth polynomials up to the third degree in the number of members of the household
- *age* is the mean age of the respondents in the household
- *assets* is a categorical variable measuring the value of all assets of the household; fixed effects for these categorical values are included in all specifications
- *adult*, *kid*, *male*, *female*, *man*, *woman*, *boy*, and *girl* reflect the number of members of the household of each gender, age, and gender/age combination; where *adult* is defined $age > 15$ and $kid = adult$
- *educ* is the maximum value within the household of a categorical variable for how much education the respondents have completed; fixed effects for each of these values are included in all specifications
- *chronicfever*, *chronicrash*, *chronicwtloss* are 1 if the individual reported being chronically ill (for longer than 1 month) with each ailment, and 0 otherwise; then these are maxed across the subset of non-acutely ill household members

C.2 Enterprise-level extensive margin variables

- 1(Business Owned): equals 1 if the individual reported owning business in the 6 months (12 months for the first wave) prior to survey, 0 otherwise; then these are maxed across the whole household, the ill members of the household, and the non-ill members of the household to make binaries for *any* business owned among each subset of the household.

- 1(Business type $\times$ Owned): equals 1 if the individual reported owning business of type $\times$ (Fish, Merchant, High Skilled including education and health, and High Capital including transport and construction) in the 6 months (12 months for the first wave) prior to survey, 0 otherwise; then these are maxed across the whole household, the ill members of the household, and the non-ill members of the household to make binaries for *any* business owned of type $\times$ among each subset of the household.

C.3 Enterprise-level intensive margin variables

- 1(Business Assets Owned): equals 1 if the enterprise owns at least one of the following category of assets: a) buildings and land, b) vehicles or boats, c) tools, equipment or machinery, or d) other durable assets for use in the enterprise, 0 otherwise.
- 1(Business Assets Bought or Sold): equals 1 if any asset described above was bought for the enterprise or divested from the enterprise.
- Number of Household Members Helping in the Business: The number of household-members who helped in the enterprise, including those were unpaid.
- Number of Hired Workers: The number of hired workers working in the enterprise.

C.4 Labor supply and allocation variables

- Total Labor Hours equals the number of hours the individual reported spending in any productive activities (farm, self-employment, domestic chores) in the 7 days prior to survey; then these are summed across the whole household, the ill members of the household, and the non-ill members of the household to make totals for all labor hours among each subset of the household.
- Enterprise Labor Hours equals the number of hours the individual reported spending in non-farm self-employment activities in the 7 days prior to survey; then these are summed across the whole household, the ill members of the household, and the non-ill members of the household to make totals for enterprise labor hours among each subset of the household.
- Farm Labor Hours equals the number of hours the individual reported spending in farm labor activities (including own farm and, though negligible, wage labor on other farms in the village) in the 7 days prior to survey; then these are summed across the whole household, the ill members of the household, and the non-ill members of the household to make totals for farm labor hours among each subset of the household.
- Domestic Chore Hours equals the number of hours the individual reported spending on domestic chores (caring for ill, fetching water, home production, gathering firewood) in the 7 days prior to survey; then these are summed across the whole household, the ill members of the household, and the non-ill members

of the household to make totals for domestic chore hours among each subset of the household.

Appendix

Table B.1

Sample Selection Checks

<i>Effects of Instrument on Indicators for Inclusion in Sample Used in Main Analysis</i>		
Sample Restriction:	1(>0 Sick, >0 Non-Sick Productive Members)	
Rainy days × No facility (Normalized)	−0.0351 (0.0217)	−0.0224 (0.0733)
1(No formal sector health facility in cluster)	0.0394 (0.0566)	−0.327** (0.146)
Number of rainy days in month of survey	−0.0133 (0.0156)	0.0601 (0.0451)
Observations	2,960	2,960
Mean of Dependent Variable	0.641	0.641
Sample Weights	No	Yes

Notes: Robust standard errors in parentheses

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

Dependent variables are binaries for whether the household is included in each sample. We control for the main effects of days of rainfall and existence of formal-sector health facility in cluster in all regressions. See Table 2 for additional comments and full list of controls.

Table B.2

Partial Correlations of Access Variables

<i>Dependent var: 1(No Formal Sector Health Facility in Cluster)</i>	
1(Daily market in cluster)	−0.107*** (0.0193)
1(Periodic market in cluster)	0.0901*** (0.0205)
1(Motorable road in cluster)	−0.188*** (0.0430)
1(Public transport in cluster)	−0.102*** (0.0252)
1(Secondary school in cluster)	−0.341*** (0.0368)
1(Bank in cluster)	0.0282 (0.0345)
1(Post or public telephone in cluster)	−0.697*** (0.0354)
Observations	1,932
R-Squared	0.299

Notes: Robust standard errors in parentheses

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

Table B.3

Testing for Health Spillovers within the Household

Effects of Instrument on Indicators for Self-reported Chronic Illness (conditions lasting >6 months) in Non-acutely Ill Household Members

	Chronic Fever	Chronic Weight Loss	Chronic Rash
Rainy days × No facility (Normalized)	−0.0151* (0.00870)	0.0291 (0.0196)	−0.0182 (0.0154)
Observations	1932	1932	1932
Mean of Dependent Variable	0.0396	0.110	0.0478

Notes: Robust standard errors in parentheses

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

We control for the main effects of days of rainfall and existence of formal-sector health facility in cluster in all regressions. See Table 2 for additional comments and full list of controls.

Table B.4

Effect of Formal-Sector Care on Breakdown of Domestic Chores of Non-Acutely Ill Household Members (Second Stage IV)

Dependent vars: Hours spent on each type of domestic chore per non-ill household member

	Caring for Ill	Home Production	Gathering Firewood	Fetching Water
No. of acutely ill household members who received formal sector healthcare	0.979 (0.762)	−4.202* (2.388)	−1.052 (1.128)	−1.263 (0.928)
Observations	1,932	1,932	1,932	1,932
Mean of Dependent Variable	0.855	7.435	1.824	2.227

Notes: Robust standard errors in parentheses

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

The first stage of IV estimates is reported in column 2 of Table 2. F-stat on excluded instrument is 20.83 (p-value < 0.001). We control for the main effects of days of rainfall and existence of formal-sector health facility in cluster in all regressions. See Table 2 for additional comments and full list of controls.

Table B.5

Falsification Tests Using Households with Zero Acutely Ill Members

Panel A: Enterprise Activity

Enterprise Activity		Type of Business: 1(>0 household members engage in enterprise activity of each type)			
		Fish	Merchant	High Skilled	High Capital
Rainy days × No facility (Normalized)	−0.0447 (0.0384)	−0.00192 (0.00682)	−0.0286 (0.0345)	0.0270 (0.0219)	−0.00376 (0.0102)
Observations	906	906	906	906	906

Panel A: Enterprise Activity					
Enterprise Activity		Type of Business: 1(>0 household members engage in enterprise activity of each type)			
		Fish	Merchant	High Skilled	High Capital
Mean of Dependent Variable	0.178	0.00662	0.117	0.0298	0.0188

Panel B: Labor Supply				
Labor Supply (Hours per household member in week before survey)				
	Self-Employment	Farm	Domestic Chores	Total
Rainy days $\times$ No facility (Normalized)	-1.082 (1.724)	1.495 (1.482)	1.280 (0.875)	1.694 (1.990)
Observations	906	906	906	906
Mean of Dependent Variable	3.163	16.09	14.83	34.09

Notes: Robust standard errors in parentheses

p<0.01,

**
p<0.05,

*
p<0.1.

We control for the main effects of days of rainfall and existence of formal-sector health facility in cluster in all regressions. See Table 2 for additional comments and full list of controls.

Table B.6

Hausman Tests of Coefficient Equivalence with Endogenous OLS Specifications

Enterprise Activity		Type of Business: 1(>0 household members engage in enterprise activity of each type)				Labor Supply (Hours per household member in week before survey)		
		Fish	Merchant	High Skilled	High Capital	Self-Employment	Farm	Domestic Chores
No. of acutely ill household members who received formal sector healthcare (OLS)	-0.0235 (0.0159)	-0.00627 (0.00434)	-0.0126 (0.0143)	-0.00516 (0.00779)	-0.000959 (0.00531)	-0.0613 (0.288)	-0.0317 (0.308)	-0.320 (0.200)
Hausman: Chi squared	5.60	11.20	2.79	0.47	0.41	5.19	1.70	3.62
Hausman: p-value	0.02	0.00	0.09	0.49	0.52	0.02	0.19	0.06
Observations	1,932	1,932	1,932	1,932	1,932	1,932	1,932	1,932

Notes: Robust standard errors in parentheses

p<0.01,

**
p<0.05,

*
p<0.1.

We control for the main effects of days of rainfall and existence of formal-sector health facility in cluster in all regressions. See Table 2 for additional comments and full list of controls.

Table B.7

Full Regression Output from Main Results

	Enterprise Activity	Type of Business: 1(>0 household members engage in enterprise activity of each type)				Labor Supply (Hours per household)	
		Fish	Merchant	High Skilled	High Capital	Self-Employment	Farm
Num Seeking Care in HH	−0.460*** (0.146)	−0.174* (0.0909)	−0.289** (0.120)	−0.0672 (0.0854)	−0.0405 (0.0521)	−7.654** (3.864)	4.612 (3.908)
1(No Facility)	−0.0509 (0.0892)	−0.0641 (0.0481)	−0.0275 (0.0663)	0.00475 (0.0350)	−0.0293 (0.0224)	−1.139 (1.945)	1.589 (2.320)
Rain Days in Month of Survey	0.00589 (0.0255)	0.00229 (0.00963)	−0.0288 (0.0197)	0.00501 (0.0126)	−0.00373 (0.00733)	1.177*** (0.454)	0.191 (0.507)
Num Sick in HH	0.115*** (0.0363)	0.0339* (0.0177)	0.0750** (0.0303)	0.0213 (0.0175)	0.0134 (0.0118)	1.776** (0.871)	−1.167 (0.855)
Rain Days Last Month × No Facility	−0.000407 (0.00373)	0.000947 (0.00158)	−0.00383 (0.00293)	−0.000635 (0.00171)	0.00195 (0.00132)	0.112 (0.0889)	0.0588 (0.0975)
Rain Days Last Month	−0.00823 (0.00569)	−0.00321 (0.00208)	−0.00583 (0.00512)	−0.00505* (0.00292)	0.000325 (0.00190)	−0.109 (0.102)	0.0747 (0.142)
Historical Mean of Rain Days	0.0455*** (0.0138)	0.0112* (0.00655)	0.0201 (0.0129)	0.00945 (0.00884)	0.00692 (0.00523)	0.207 (0.422)	0.232 (0.372)
Historical SD of Rain Days	0.00246 (0.0233)	−0.0127 (0.0101)	0.00399 (0.0169)	−0.00467 (0.0119)	0.00609 (0.00721)	−0.593 (0.505)	0.683 (0.441)
Rain Days × 1(Daily Market)	−0.0173*** (0.00637)	−0.00221 (0.00212)	−0.000663 (0.00500)	−0.00809*** (0.00228)	−0.000135 (0.00133)	−0.248** (0.109)	0.0569 (0.0963)
Rain Days × 1(Periodic Market)	−0.00368 (0.00607)	−0.00196 (0.00195)	0.00359 (0.00470)	−0.00257 (0.00285)	−0.00183 (0.00146)	−0.110 (0.104)	−0.166 (0.109)
Rain Days × 1(Motorable Road)	−0.0209** (0.00994)	0.00187 (0.00420)	−0.0132 (0.00899)	−0.00438 (0.00485)	0.00171 (0.00243)	−0.220 (0.194)	−0.0357 (0.234)
Rain Days × 1(Public Transportation)	−0.00120 (0.00902)	−0.00560 (0.00439)	0.00919 (0.00605)	0.00239 (0.00406)	−0.00129 (0.00212)	−0.174 (0.186)	0.314** (0.144)
Rain Days × 1(Secondary School)	−0.00480 (0.00834)	−0.00907 (0.00732)	0.00843 (0.00704)	0.000567 (0.00484)	−0.00542** (0.00246)	−0.282 (0.220)	−0.0629 (0.110)
Rain Days × 1(Bank)	0.00832 (0.00769)	0.00888* (0.00476)	0.00399 (0.00530)	−0.00168 (0.00331)	0.00151 (0.00260)	−0.0204 (0.192)	0.195 (0.180)
Rain Days × 1(Post or Telephone)	−0.0144* (0.00767)	−0.000265 (0.00321)	−0.0254*** (0.00613)	0.00363 (0.00320)	−0.00176 (0.00287)	0.167 (0.182)	−0.276* (0.166)
1(Daily Market)	0.169*** (0.0624)	0.0277 (0.0282)	0.00256 (0.0417)	0.0708*** (0.0225)	0.00812 (0.0148)	3.763*** (1.207)	0.745 (0.899)
1(Periodic Market)	−0.0480 (0.0426)	−0.00213 (0.0180)	−0.0729*** (0.0268)	0.0139 (0.0234)	0.0188 (0.0120)	−0.237 (0.902)	2.273** (1.007)
1(Motorable Road)	0.235*** (0.0890)	−0.0571* (0.0342)	0.108 (0.0661)	0.0752* (0.0433)	−0.00618 (0.0266)	4.055** (1.874)	1.952 (1.590)
1(Public Transportation)	0.124 (0.0876)	0.100 (0.0637)	−0.0750 (0.0588)	−0.0191 (0.0456)	0.0499** (0.0252)	3.769* (2.266)	−4.990*** (1.493)
1(Secondary School)	−0.0926 (0.0833)	0.147 (0.0917)	−0.222*** (0.0772)	−0.0865* (0.0480)	0.0567** (0.0238)	0.709 (2.271)	6.154*** (1.395)
1(Bank)	−0.0820 (0.0636)	−0.0334 (0.0415)	0.0486 (0.0517)	−0.0397 (0.0359)	−0.0466** (0.0224)	0.980 (1.621)	−2.016 (1.421)
1(Post or Telephone)	0.144* (0.0835)	−0.0461 (0.0521)	0.257*** (0.0666)	−0.0218 (0.0425)	−0.00104 (0.0320)	−2.107 (1.965)	5.700*** (1.567)
Maximum Education in HH	−0.00840 (0.0104)	−0.00246 (0.00383)	−0.00282 (0.00898)	−0.00317 (0.00602)	−0.000790 (0.00343)	−0.236 (0.164)	−0.0710 (0.171)

	Enterprise Activity	Type of Business: 1(>0 household members engage in enterprise activity of each type)				Labor Supply (Hours per household per survey)	
		Fish	Merchant	High Skilled	High Capital	Self-Employment	Farm
Mean Age in HH	-0.00472 *** (0.00134)	-0.000302 (0.000478)	-0.00383 *** (0.00113)	-0.000326 (0.000583)	-0.000853 ** (0.000391)	-0.0968 *** (0.0273)	0.0307 (0.0293)
HH Size	0.00348 (0.00733)	0.00198 (0.00243)	0.00565 (0.00607)	0.00460 (0.00317)	-0.00437 (0.00269)	-0.775 *** (0.197)	-0.342 ** (0.136)
Distance to Health Facility (if outside village)	-0.00734 (0.00826)	-0.000960 (0.00401)	0.00158 (0.00608)	-0.00866 *** (0.00277)	0.00147 (0.00175)	0.130 (0.157)	0.213 (0.157)
Observations	1,932	1,932	1,932	1,932	1,932	1,932	1,932

Notes: Robust standard errors in parentheses

p<0.01,

**

p<0.05,

*

p<0.1.

See Table 2 for additional comments and full list of controls. Specifications also include fixed effects for assets, district, weather station, quintiles of distributions of distances to nearest health facility and hospital, deciles of distributions of rain days and accumulation in month of survey, and year, month, and day of survey. These coefficients are not reported for the sake of parsimony.

References

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Figure 1.
Difference in Care by Rain Days (No Facility - Facility)

Table 1

Summary Statistics

	<i>Households with > 0 sick and > 0 non-sick members</i>		<i>Households with no sick members</i>	
	Mean	SD	Mean	SD
Number of household-year observations				
<i>Healthcare and health outcomes</i>				
# of HH members who reported being acutely ill	1.845	1.140		
# of sick HH members who visited formal-sector healthcare	0.398	0.695		
# of sick HH members still ill on day of survey	0.758	0.870		
<i>Costs of Healthcare</i>				
# of days of rain in month of survey	7.931	5.256	8.123	5.086
No health facility in community	0.658	0.475	0.698	0.460
<i>Resources in Community</i>				
Daily market	0.580	0.494	0.532	0.499
Periodic market	0.335	0.472	0.362	0.481
Motorable road	0.951	0.215	0.969	0.173
Public transport	0.258	0.438	0.292	0.455
Secondary school	0.070	0.255	0.066	0.249
Bank	0.120	0.325	0.118	0.323
Post office/telephone booth	0.103	0.304	0.103	0.304
<i>Demographic Characteristics</i>				
Age	28.248	9.318	33.794	14.854
Household size	5.126	2.279	3.650	2.015
# of female HH members	2.692	1.584	1.902	1.333
Household assets (Deciles)	5.051	2.807	4.418	2.809
<i>Enterprise Activity</i>				
Any Enterprise	0.280	0.449	0.178	0.382
# of household members helping in the business	1.028	2.515	0.413	1.420
# of household members paid to help	0.230	1.316	0.070	0.624
# of hired workers from outside of the household	0.364	1.511	0.193	0.950

Number of household-year observations	Households with > 0 sick and > 0 non-sick members		Households with no sick members	
	1932		906	
	Mean	SD	Mean	SD
Assets owned	1.793	2.981	0.891	1.957
Assets bought	0.564	1.900	0.227	1.038
Assets sold	0.021	0.366	0.004	0.133
	Sick Members		Non-Sick Members	
	Mean	SD	Mean	SD
<i>Enterprise Activity I (>0 members of household own business)</i>				
Any Enterprise	0.135	0.342	0.189	0.392
Fish	0.003	0.051	0.012	0.108
Merchant	0.095	0.294	0.133	0.339
High Skilled	0.022	0.148	0.028	0.165
High Capital	0.009	0.096	0.014	0.120
<i>Time use per member of household (hours in week before survey)</i>				
Total Labor	29,076	20,551	28,885	17,922
Enterprise	2,868	11,618	3,103	11,639
Farm	13,429	12,353	13,441	10,638
Home	12,779	10,420	12,341	8,778
			14,833	8,325

Notes: Sample used in analysis is made up of households with at least one member with illness that began in the two weeks prior to survey.

Table 2

Effect of Instrument on Use of Formal Sector Healthcare

	<i>Dependent variable: Number of acutely ill household members who received formal sector healthcare</i>				
	Additional Controls	Main Specification	Specification with Sample Weights	No Interactions of Resource Main Dummies and Days of Rainfall	No Rain Interactions
Rainy days $\times$ No facility (Normalized)	-0.220 *** (0.0464)	-0.214 *** (0.0463)	-0.387 *** (0.0850)	-0.0762 ** (0.0351)	
1(No formal sector health facility in cluster)	-0.272 (0.201)	-0.0738 (0.151)	-0.494 (0.309)	-0.131 (0.130)	-0.242 ** (b)/(0.109)
Number of rainy days in month of survey	0.0479 (0.0317)	0.0424 (0.0319)	0.234 *** (0.0856)	0.0181 (0.0314)	0.0230 (0.0340)
Rainy days $\times$ Distance to Facility (Normalized)					0.0522 (0.0368)
					-0.132 *** (0.0422)
F-stat	22.52	21.34	20.80	4.70	9.71
p-value	2.08E-06	3.85E-06	5.10E-06	0.03	1.83E-03
Observations	1,932	1,932	1,746	1,932	1,932
Mean of Dependent Variable	0.398	0.398	0.391	0.398	0.398

Notes: Robust standard errors in parentheses

*** p<0.01,

** p<0.05,

* p<0.1.

Standard errors are clustered at the level of the primary sampling unit: the enumeration "cluster". The instrument (Days of rainfall $\times$ No Facility) is normalized by its standard deviation. All specifications additionally include assets, highest education in household, district, rain station, and survey fixed effects for year, month, and day of survey; as well as continuous controls for average age in household, no. of household sick and household size, and distance to nearest health facility if one does not exist in community. Specifications also include deciles of days of rainfall and levels of rainfall as well as quintiles for distance to nearest hospital, healthcare facility, and dispensary. Dummies for the existence of a daily market, periodic market, motorable road, public transport, secondary school, bank and post office/telephone are included; along with interactions of these dummies with days of rainfall (in columns 1 and 2). Other controls include historical means and standard deviations of days of rainfall, as well as days of rainfall in month prior to survey and its interaction with "No Facility." Column 1 includes additional controls such as quadratic terms in historical mean and standard deviation of days of rainfall; third degree polynomials in distance to health facility, average age of household members, household size; as well as gender/age composition of the household. All samples in the analyses, unless otherwise stated, are restricted to households with at least one member with an illness that began in the two weeks prior to survey and at least one member that did not report such an illness.

Table 3

Effect of Formal-Sector Care on Recovery from Acute Illness

<i>Dependent variable: Number of acutely ill household members who are still ill on day of survey</i>		
	OLS (Reduced Form)	Second Stage IV
Rainy days $\times$ No facility (Normalized)	0.124 ** (0.0593)	
No. of acutely ill household members who received formal sector healthcare		−0.579 * (0.305)
1 (No formal sector health facility in cluster)	−0.267 ** (0.125)	−0.310 ** (0.154)
Number of rainy days in month of survey	0.109 *** (0.0387)	0.134 *** (0.0448)
Rainy days last month $\times$ No facility	−0.00726 (0.00949)	0.00647 (0.00800)
Rain days last month	−0.000697 (0.0121)	−0.0151 (0.0118)
Observations	1,932	1,932
Mean of Dependent Variable	0.758	0.758

Notes: Robust standard errors in parentheses

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

The first stage of column 2 IV estimates is reported in column 2 of Table 2. F-stat on excluded instrument is 20.83 (p -value < 0.001). We control for the main effects of days of rainfall and existence of formal-sector health facility in cluster in all regressions. See Table 2 for additional comments and full list of controls.

Table 4

Effect of Formal-Sector Care on Entry into Enterprise Activity (Second Stage IV)

<i>Dependent vars: 1(>0 household members engaged in enterprise activity)</i>			
	All Household Members	Acutely Ill Members	Non-ill Members
No. of acutely ill household members who received formal sector healthcare	-0.460 *** (0.146)	-0.280 ** (0.112)	-0.390 ** (0.166)
1(No formal sector health facility in cluster)	-0.0509 (0.0892)	0.0140 (0.0664)	-0.0541 (0.0712)
Number of rainy days in month of survey	0.00589 (0.0255)	0.00783 (0.0200)	-0.00377 (0.0220)
Rainy days last month × No facility	-0.000407 (0.00373)	-0.00217 (0.00319)	-0.00119 (0.00319)
Rain days last month	-0.00823 (0.00569)	-0.000791 (0.00514)	-0.00849 (0.00578)
Observations	1,932	1,932	1,932
Mean of Dependent Variable	0.280	0.135	0.189

Notes: Robust standard errors in parentheses

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

The first stage of IV estimates is reported in column 2 of Table 2. F-stat on excluded instrument is 20.83 (p-value < 0.001). We control for the main effects of days of rainfall and existence of formal-sector health facility in cluster in all regressions. See Table 2 for additional comments and full list of controls.

Table 5

Effects of Formal-Sector Care on Household Labor Supply Across Sectors (Second Stage IV)

	Enterprise	Farm	Domestic chores	Total
Panel A: Labor Supply of All Household Members				
<i>Dependent vars: Hours spent in activity per household member in week before survey</i>				
No. of acutely ill household members who received formal sector healthcare	-7.654 ^{**} (3.864)	4.612 (3.908)	-4.717 [*] (2.724)	-7.758 (5.641)
Observations	1932	1932	1932	1932
Mean of Dependent Variable	3.043	13.46	12.58	29.09
Mean of Dependent Variable, if >0	10.95	13.96	12.59	29.10
Panel B: Labor Supply of Acutely Ill Household Members				
<i>Dependent vars: Hours per acutely ill household member in week before survey</i>				
No. of acutely ill household members who received formal sector healthcare	-7.645 (5.563)	9.683 (6.347)	-9.511 ^{**} (4.243)	-7.473 (7.380)
Observations	1932	1932	1932	1932
Mean of Dependent Variable	2.868	13.43	12.78	29.08
Mean of Dependent Variable, if >0	21.31	15.79	14.03	30.55
Panel C: Labor Supply of Non-ill Household Members				
<i>Dependent vars: Hours per non-ill household member in week before survey</i>				
No. of acutely ill household members who received formal sector healthcare	-8.849 [*] (4.932)	3.061 (3.933)	-5.538 [*] (3.194)	-11.33 [*] (6.603)
Observations	1932	1932	1932	1932
Mean of Dependent Variable	3.103	13.44	12.34	28.88
Mean of Dependent Variable, if >0	16.65	14.78	12.96	29.61

Notes: Robust standard errors in parentheses

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

The first stage of IV estimates is reported in column 2 of Table 2. F-stat on excluded instrument is 20.83 (p-value < 0.001). We control for the main effects of days of rainfall and existence of formal-sector health facility in cluster in all regressions. See Table 2 for additional comments and full list of controls.

Table 6

Effects of Formal-Sector Care on Enterprise Activity by Type of Business (Second Stage IV)

	Fish	Merchant	High Skilled	High Capital
Panel A: Enterprise Activity of All Household Members by Type of Business				
<i>Dependent vars: 1(>0 household members engage in enterprise activity of each type)</i>				
No. of acutely ill household members who received formal sector healthcare	-0.174 [*] (0.0909)	-0.289 ^{**} (0.120)	-0.0672 (0.0854)	-0.0405 (0.0521)
Observations	1932	1932	1932	1932
Mean of Dependent Variable	0.0150	0.195	0.0471	0.0212
Panel B: Enterprise Activity of Acutely Ill Household Members by Type of Business				
<i>Dependent vars: 1(>0 acutely ill household members engage in enterprise activity of each type)</i>				
No. of acutely ill household members who received formal sector healthcare	-0.00125 (0.0145)	-0.208 ^{**} (0.0948)	0.0416 (0.0565)	-0.0492 (0.0411)
Observations	1932	1932	1932	1932
Mean of Dependent Variable	0.00311	0.0952	0.0223	0.00932
Panel C: Enterprise Activity of Non-ill Household Members by Type of Business				
<i>Dependent vars: 1(>0 non-ill household members engage in enterprise activity of each type)</i>				
No. of acutely ill household members who received formal sector healthcare	-0.177 [*] (0.0973)	-0.249 ^{**} (0.113)	-0.0883 (0.0641)	0.0171 (0.0372)
Observations	1932	1932	1932	1932
Mean of Dependent Variable	0.0124	.133	0.0280	0.0145

Notes: Robust standard errors in parentheses

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

The first stage of IV estimates is reported in column 2 of Table 2. F-stat on excluded instrument is 20.83 (p-value < 0.001). We control for the main effects of days of rainfall and existence of formal-sector health facility in cluster in all regressions. See Table 2 for additional comments and full list of controls.

Table 7

Effects of Formal-Sector Care on Inputs in Enterprises (Second Stage IV)

Panel A: Labor, <i>Dependent vars: 1(>0 workers in each category)</i>			
	Household Members Helping with Business	Household Members Paid to Help	Hired Help for Business
No. of acutely ill household members who received formal sector healthcare	−0.339 *** (0.115)	−0.0501 (0.0614)	−0.150 ** (0.0745)
Observations	1932	1932	1932
Mean of Dependent Variable	0.171	0.0357	0.0678
Mean # of workers, if >0	6	6.449	5.366
Panel B: Capital, <i>Dependent vars: 1(>0 assets in each category)</i>			
	Assets Owned	Assets Bought	Assets Sold
No. of acutely ill household members who received formal sector healthcare	−0.271 ** (0.124)	−0.258 ** (0.107)	−0.0212 (0.0198)
Observations	1932	1932	1932
Mean of Dependent Variable	0.321	0.0968	0.00362
Mean # of assets, if >0	5.580	5.824	5.857

Notes: Robust standard errors in parentheses

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

The first stage of IV estimates is reported in column 2 of Table 2. F-stat on excluded instrument is 20.83 (p-value < 0.001). We control for the main effects of days of rainfall and existence of formal-sector health facility in cluster in all regressions. See Table 2 for additional comments and full list of controls

Table 8
Effects of Formal-Sector Care on Value of Inputs in Enterprises (Second Stage IV)

	Labor			Capital Assets		
	Total	Daily Wage to Household Worker	Daily Wage to Hired Worker	Value of Assets Owned	Value of Assets Bought	Value of Assets Sold
<i>Units: ln(Tanzanian Shillings)</i>						
Panel A: Log Value of Inputs in Enterprises of All Household Members						
No. of acutely ill household members who received formal sector healthcare	-4.204*** (1.614)	-0.0834 (0.293)	-0.416 (0.512)	-3.400** (1.493)	-1.980* (1.022)	-0.343 (0.277)
Observations	1932	1932	1932	1932	1932	1932
Mean of Dependent Variable in Levels	63569.1	26.3	107.2	882574.4	56554.9	312696.6
Panel B: Log Value of Inputs in Enterprises of Acutely Ill Household Members						
No. of acutely ill household members who received formal sector healthcare	-3.550** (1.431)	-0.0732 (0.242)	-0.313 (0.426)	-2.888** (1.352)	-1.658* (0.895)	-0.324 (0.255)
Observations	1932	1932	1932	1932	1932	1932
Mean of Dependent Variable in Levels	19401	8.099	39.32	396121	14304	155694
Panel C: Log Value of Inputs in Enterprises of Non-ill Household Members						
No. of acutely ill household members who received formal sector healthcare	-4.268*** (1.547)	-0.0770 (0.268)	-0.384 (0.482)	-3.377** (1.437)	-1.876* (0.975)	-0.329 (0.268)
Observations	1932	1932	1932	1932	1932	1932
Mean of Dependent Variable in Levels	44168	18.22	67.89	486453	42251	157002

Notes: Robust standard errors in parentheses

p<0.01,

**
p<0.05,

*
p<0.1.

The first stage of IV estimates is reported in column 2 of Table 2. F-stat on excluded instrument is 20.83 (p-value < 0.001). We control for the main effects of days of rainfall and existence of formal-sector health facility in cluster in all regressions. See Table 2 for additional comments and full list of controls.