Fraying of the Ties that Bind: HIV/AIDS and Informal Contract Enforcement in KwaZulu Natal, South Africa

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Abstract

This paper provides a theoretical and empirical investigation of the effects of HIV/AIDS on community-level informal financial institutions such as rotating savings and credit associations. Our theoretical model illustrates that the mortality risk implied by the HIV/AIDS pandemic can put a significant strain on such institutions by shortening time horizons and weakening expectations of reciprocity on the part of participants. Mortality thus implies a community-wide externality, as even households that are not directly impacted by the disease are nonetheless adversely affected by living in high prevalence communities. Using panel data from the high-prevalence area of KwaZulu Natal, South Africa, we investigate the effects of community-level mortality on the rate of participation in community level financial and other types of groups. We find that mortality at the community level substantially reduces the prevalence of group membership, and that the differential impacts of mortality on different types of groups are consistent with the predictions of our theoretical model.

JEL Codes: D02, D71, O10, O12, O17

1. Introduction

For many of the world's poor, community-level informal arrangements provide an important source of access to financial services. A vivid illustration of the important role of these institutions and the wide variety of needs they serve for the poor is provided by Collins et. al. (2009). Village-based savings clubs and lending groups provide not only credit for investment or other large purchases, but also play a crucial role in facilitating insurance and consumption smoothing in the face of fluctuating incomes for the poorest of the poor.

These types of institutions share a common rationale that explains their existence and sometimes persistence even in the face of formal alternatives. In particular, the sanctioning power and informational advantages of the community can serve as a basis for effectively enforcing agreements. Community-level punishments such as ostracism or loss of reputation incurred from breach of an informal agreement can serve as powerful deterrents. Particularly where the state is weak, these informal sanctions may be more effective than the legal recourse available to formal service providers. Similarly, community members may have access to information (e.g., creditworthiness) about one another through repeated interactions or networks that would be costly or impossible for impersonal entities to obtain.

This paper will argue that a heretofore unexplored impact of the HIV/AIDS pandemic in sub-Saharan Africa is that it reduces access to informal financial services by weakening the basis for community-level contract enforcement. The central argument is that premature mortality constitutes a risk of informal contractual non-compliance- an individual who has agreed to repay a loan or fulfill some other obligation is unable to do so if he or she dies unexpectedly. This risk of default is one that the community cannot mitigate via the threat of sanctions. This is of particular concern as the viability of these institutions may in some cases depend on the deterrent power of such sanctions ensuring very high rates of compliance.

We find empirical support for the assertion that mortality weakens community-level financial institutions using panel data from KwaZulu Natal, South Africa, an area of high HIV prevalence. Our data show that high mortality is associated with less participation in the types of community groups that involve informal contracts. However, mortality does not inhibit participation in other types of community groups, which is consistent with the hypothesis that mortality acts on community institutions by weakening informal contract enforcement.

In the next section, we discuss conceptual issues and provide a review of the relevant literature. We then provide a theoretical model that illustrates the effects of community-level mortality on community-level institutions. We present our empirical results in the next section, followed by policy implications and recommendations for further research.

2. Community Level Contracting and Mortality

2.1 Community level institutions and mortality

The informal institutions that are the subject of this paper are underpinned by rules that are made and enforced at the level of the community, as opposed to formal, legal institutions underpinned by rules at the level of the state. As Bowles and Gintis

(2002) elaborate, institutions based on community-level rules may be more effective or efficient than formal alternatives in circumstances where circumstances where formal contracting is difficult or costly, or where private information is important. They identify three characteristics of communities in particular that can put them at an advantage in these situations. First, transactions that take place within communities can entail the scope for repeated interactions. This gives rise to a particular set of incentives to cooperate over time that would not exist in a perfectly anonymous market. The potential benefit to future cooperation or the threat of terminating the relationship or retaliation can thus add an element of self-enforcement to contracts. This has been observed by Maher (1995), who notes that among a sample of European firms that extend supplier credit, many report that they would not pursue legal action in the event of default.

Secondly, repeated interactions allow community members to have information about one another that might not be available publically. For example, community members may be able to assess one another's creditworthiness more effectively than a credit bureau could. Monitoring costs and principle-agent problems can also be reduced by information that may be available to the community, but not the market.

Finally, communities imply a scope for imposing punishments to enforce rules. Ostracism and the threat of social sanctions or loss of social status can be powerful deterrents to opportunistic behavior. Contracts enforced by community level sanctions may thus be advantageous when formal contracting is poorly enforced, costly, or inflexible. The importance of social sanctions has been observed by other authors as well. Fehr and Gachter (2000) find experimental evidence that introducing the ability to punish free riders improves cooperation in coordination games. In a study of rural Kenya, Miguel and Gugerty (2005) find that communities with a greater scope for imposing social sanctions on members experience improved public goods provision.

Where HIV/AIDS introduces a substantial mortality risk to the members of the community, all three of these advantages of community governance structures are undermined. The risk of mortality to one's transaction partner means that repeated interaction is less likely- the expected number of interactions with a given transaction partner is smaller than it would otherwise be. The associated costs and benefits that would occur as a result of future interactions are consequently reduced, and hence the incentive to behave opportunistically in the present is increased.

Similarly, the community's advantage in terms of information becomes less valuable. In the context of credit, for example, high mortality introduces a risk of default that is unrelated to one's trustworthiness or other characteristics that can be assessed by the community. To the extent that mortality is unpredictable, the community's relative advantage over a formal financial institution in assessing creditworthiness is thus reduced.

The sanctioning power of the community is also affected by high levels of mortality. Informal punishments often imply a time dimension- the costs of social ostracism, for example, are experienced over a period of time rather than instantaneously. In addition, in the case of contracts that entail some action to be taken by the participants in some future state, mortality introduces a risk of non-compliance that sanctions cannot deter. This is potentially significant, as in many cases the threat of sanctions is sufficient to ensure high levels of compliance- for example, a number of authors have noted that default in the context of rotating savings and credit associations in exceedingly rare (e.g., van den Brink and Chavas 1997). To the extent that the rationale behind these institutions depends on high levels of compliance, their viability could be threatened by introducing a risk of non-compliance where none had existed before.

2.2 ASCAs and ROSCAs

An important function that these community-level institutions have been observed to serve is in the provision of financial services to community members. Two types of these institutions that have received significant attention in the literature and are the focus of the empirical analysis in this paper are Accumulated Savings and Credit Associations (ASCAs), and Rotating Savings and Credit Associations (ROSCAs). In an ASCA, members contribute savings to a common fund, which is then lent out at interest. The responsibility for disbursing and collecting loans typically falls to the individual members, and the proceeds are divided up among the members. Hence, the ASCA acts as an interest-bearing savings vehicle.

ROSCAs are a community-level institution that have been observed in a wide variety of contexts in the developing world (Armendairiz and Morduch 2007). The basic structure of a ROSCA is that a group of individuals commit to gathering at regular intervals and contribute a predetermined amount of money into a fund. At each meeting, the fund is allocated to single member of group, the meetings continue until each member has been allocated the pot once. ROSCAs may repeat over several cycles, and the method of choosing the order of allocation varies. A number of motivations for joining ROSCAs have been noted in the literature, including financing the purchase of lumpy consumer durables (Besley, Coate, and Loury 1993), shielding savings from claims by relatives (Anderson and Baland 2002), and as a commitment device to overcome time-inconsistent preferences (Ambec and Treich 2007, Gugerty 2007).

Both of these institutions imply a scope for opportunistic behavior and hence an important role for community level sanctions as a deterrent. In an ASCA, where debt collection falls to individual members, they have a pecuniary incentive to withhold repayments from the group. Similarly, in a ROSCA, once an individual has been allocated the pot, they can profit by failing to attend and contribute at subsequent meetings of the group. Anderson et. al. (2009) demonstrate theoretically that a ROSCA structure cannot be incentive compatible for all members in the absence of some form of sanctioning to deter this behavior.

2.3 Empirical literature on HIV/AIDS and community spillovers and social capital

The effects of HIV/AIDS on these types of institutions has yet to receive explicit attention in the literature. However, two recent empirical studies find evidence that is consistent with our central thesis. Jayne et. al. (2006) consider the impacts of mortality (to which HIV/AIDS is a major contributor) at the level of the community in Zambia. They find that with higher rates of mortality exhibit lower productivity, income, and area under cultivation. However, they do not investigate the mechanisms by which this might occur. Intriguingly, they also find that the reduction in income associated with mortality is of greater magnitude in communities that have experienced greater rainfall variability. An interpretation of their results that is consistent with the approach here is that mortality weakens informal risk sharing networks, leading to greater vulnerability to rainfall shocks.

Similarly suggestive cross-country evidence is provided by David (2007). Controlling for a variety of factors, he finds that incidence of HIV/AIDS has a strong inverse relationship with subjective measures of trust. He thus concludes that mortality acts to weaken social capital, and hypothesizes that a mechanism by which this occurs is through the strain on traditional social networks that mitigate economic shocks- i.e., by reducing the strength of informal agreements such as those enforced at the community level.

3. Theoretical Model

In this section, we present a model of community-level institutional formation that allows us to incorporate the effects of community level-mortality. The basic structure of our model is that some subset of the members of a community may choose to form a group G for the purpose of facilitating institutional arrangements between members. Members of the group play a two-stage game: the first stage follows a Prisonner's Dilemma, in which players choose to Cooperate or Default, while in the second stage those who played Defect in the first period incur an informal punishment. Individuals discount second period outcomes according to heterogeneous discount rates. The group is selective, and chooses its members to maximize the payoff to Cooperating according to the information that is available to it. Individuals may opt out of participating in the group if their expected payoff is negative. Our focus in on the existence of Nash equilibria in which the group size is non-zero, and the size of the group in equilibrium.

3.1 Set-Up

A community consists of N individuals $\{1,...,N\}$ who are assumed to have homogeneous preferences, with the exception of heterogeneous discount factors $\delta_i \in [0,1]$. Some subset of these individuals may choose to form a group G. Each $i \in G$ chooses between two strategies, Cooperate (C) and Default (D). As in the standard Prisoner's Dilemma, players obtain a benefit from Cooperating but face an additional incentive to Default. The payoffs to each strategy are as follows:

$$f_i(C) = (1-q)B(n) - q\gamma - c$$
$$f_i(D) = (1-q)\left(B(n)+\varepsilon\right) - \delta_i P - c$$

Where:

q is the proportion of Defaulters in the group,

$B(n)$ is the benefit that is derived from participating in the group, with B an increasing function of the number of group members n that is continuous, concave, and everywhere twice differentiable,

γ is the cost to Cooperators of other Defaulting group members,

c is a cost associated with participating,

ε is the premium associated with Defaulting, and

P is a punishment imposed on Defaulters in the second period,

With A, γ, ε, P, c ≥ 0.

We can thus write the difference in payoffs between Cooperate and Default as

$$f_i(D) - f_i(C) = (1-q)\varepsilon + q\gamma - \delta_i P$$

It follows that an individual's optimal strategy depends on the proportion of defaulters in the group as well as her discount rate; in particular the optimal strategy is to Cooperate iff:

$$\delta_i \geq \frac{(1-q)\varepsilon + q\gamma}{P}$$

The distribution of discount factors is assumed to be such that there is a probability mass of k at 0, and elsewhere the distribution is uniform on [0,1]. Thus, the probability distribution of the discount rates is given by

$$g(\delta_i) = \begin{cases} k \text{ if } \delta_i = 0 \\ \delta_i(1-k) \text{ if } 0 < \delta_i \leq 1 \\ 0 \text{ if } \delta_i > 1 \end{cases}$$

This implies that there is some proportion k of the population who completely discount period two, and thus have only a one-period time horizon. We take this parameter k to represent the level of mortality within the community. Conceptually, an individual who suffers premature mortality is not able to live up to the terms of her informal contract. From the standpoint of the group, this is equivalent to Defaulting.

We assume perfect information except with regard to discount factors. While the distribution g is public information, each individual's discount factor is assumed to be private information. Associated with each individual is a publically observable "indicator" $\hat{\delta}^*$. This indicator is characterized by a parameter $0 \leq \theta \leq 1$ such that

$$\Pr\left(\delta_i = \hat{\delta}_i\right) = \theta + (1-\theta)\, g\left(\hat{\delta}_i\right)$$

Thus, the nature of the indicator is such that it "correctly" indicates and individual's true discount factor with probability θ, and "incorrectly" returns a random draw from the community's distribution g with probability 1- θ[1]. In the case where $\theta = 1$, for example, the indicator is perfectly accurate and discount factors are in effect publically observable. Conversely, where $\theta = 0$, the indicator conveys no information about an individual's discount rate beyond knowledge of g. For intermediate values of θ, we can say that $1 > \Pr\left(\delta_i = \hat{\delta}_i\right) > \Pr\left(\delta_i = a\right)$ for all $a \in [0,1], a \neq \hat{\delta}_i$.

Our solution concept is what we term a "cooperative equilibrium." We conceptualize cooperative equilibria in terms of an optimal decision rule for inclusion into the group G. The optimal decision rule is expressed in terms of a threshold indicator level $\hat{\delta}^*$, where any member i of the community for whom $\hat{\delta}_i \geq \hat{\delta}^*$ is accepted, and others are rejected. We define a cooperative equilibrium as one for which the optimal decision rule generates a subset G that maximizes the average first-period payoff to each member of G who plays Cooperate, such that the expected payoff for all participants in the group is greater than zero. Thus, in a cooperative equilibrium the threshold indicator level $\hat{\delta}^*$ is chosen to maximize the benefits to the group, subject to the constraint that all the invited members wish to play. If no decision rule can produce an expected payoff greater than zero, we term the result an "autarky equilibrium."

We can write the optimal decision rule problem as follows:

$$\max_{\hat{\delta}^*} \; (1-q)B(n) - q\gamma - c$$

$$s.t.$$

$$(3) \quad i. n = (N)\Pr\left(\hat{\delta}_i \geq \hat{\delta}^*\right)$$

$$ii. \; \mathrm{q} = \Pr\left(\delta_i < \frac{(1-q)\varepsilon + q\gamma}{R} \mid \hat{\delta}_i \geq \hat{\delta}^*\right)$$

$$iii. \; (1-q)B(n) - q\gamma - c \geq 0$$

[1] Note that an "incorrect" indicator may still in fact correspond to the individual's true discount rate δ_i if the random draw from g happens to be δ_i.

Where a solution to (3) exists, it is the Cooperative Equilibrium. If no solution exists, the autarky equilibrium obtains. We can write n and q as functions of $\hat{\delta}^*$, so that (3) becomes:

$$\max_{\hat{\delta}^*} \left(1-q\left(\hat{\delta}^*\right)\right)B\left(N\left(1-\hat{\delta}^*\right)(1-k)\right)-q\left(\hat{\delta}^*\right)\gamma-c$$
$$s.t.\ \left(1-q\left(\hat{\delta}^*\right)\right)B\left(N\left(1-\hat{\delta}^*\right)(1-k)\right)-q\left(\hat{\delta}^*\right)\gamma-c\geq 0$$

So that if a Cooperative Equilibrium exists, $\hat{\delta}^*$ must satisfy the conditions:

(4.i) $$\frac{\partial B\left(N\left(1-\hat{\delta}^*\right)(1-k)\right)}{\partial n}\left(N(1-k)\right)\left(1-q\left(\hat{\delta}^*\right)\right)=\frac{\partial q\left(\hat{\delta}^*\right)}{\partial\hat{\delta}^*}\left(\gamma-B\left(N\left(1-\hat{\delta}^*\right)(1-k)\right)\right)$$

(4.ii) $$\left(1-q\left(\hat{\delta}^*\right)\right)B\left(N\left(1-\hat{\delta}^*\right)(1-k)\right)-q\left(\hat{\delta}^*\right)\gamma-c\geq 0$$

3.2 Assumptions

For analytical tractability and simplicity, we make a number of assumptions.

Assumption 1a: $P>\varepsilon$

Assumption 1b: $\gamma>\varepsilon$

Assumption 1a is needed to guarantee that the second-period punishment can potentially deter Default behavior. Without Assumption 1a, even the most patient player would always prefer Default to Cooperate, and no Cooperative Equilibrium could exist.

Proposition 1[2]: At k = 0, there exists some $\bar{N}$ such that for $N\geq\bar{N}$, a unique Cooperative equilibrium exists for any value of θ.

[2] Proofs of all propositions and lemmas are provided in the appendix

Assumption 2a: $N \geq \overline{N}$

Assumption 2b: $B(1) < c$

Lemma 1: For any allowable parameterization of the model, there is some critical value $k^C \in (0,1)$ such that for any $k \leq k^C$ the Cooperative Equilibrium exists, while for $k \geq k^C$ the Autarky Equilibrium prevails.

Assumption 3: $\frac{\partial B(n)}{\partial n} \leq \frac{B(n)+\gamma}{N}$ for all $0 \leq n \leq N$

Lemma 2: Assumption 3 is sufficient to guarantee that adding Defaulters to the group always reduces the payoff to the Cooperating group members.

Where information is imperfect, the optimal decision rule may nonetheless result in admission of some Defaulters to the group. However, Assumption 3 guarantees that inclusion of these Defaulters is always a welfare loss for the group.

3.2 Cooperative Equilibria

In this section, we characterize the nature of Cooperative Equilibria under different information regimes; i.e., under different assumptions regarding the indicator accuracy parameter θ. First, we consider the case where individuals have no information about each other's discount factors so that θ = 0. Next, we consider the case where θ = 1, so that discount rates are in effect public information. Finally, we look at solutions for intermediate values of θ. Throughout, our focus is on the dynamics of the model as k increases. The main theoretical results are presented as a series of propositions with proofs provided in the Appendix. We discuss the intuition and interpretation in the context of graphical results presented in Figures 1 and 2.

Proposition 2a: Where θ = 0, let $k^{C1} = \frac{(B(N)-c)(P+\varepsilon-\gamma)-(B(N)+\gamma)\varepsilon}{(B(N)-c)(\varepsilon-\gamma)-(B(N)+\gamma)(\varepsilon-P)}$. For $k \le k^{C1}$k a Cooperative Equilibrium exists with group size N, while for $k > k^{C1}$ no Cooperative Equilibrium exists.

Proposition 2b: Over the range k < k^{C1}, the threshold indicator $\hat{\delta}^* = 0$

Proposition 3a: Where θ = 1, let $k^{C2} = 1 - \left(\frac{P}{(P-\varepsilon)N} B^{-1}(c) \right)$, where B^{-1} is the inverse of B. For $k \le k^{C2}$, a Cooperative Equilibrium exists with a group size n* that is decreasing in k at a rate of $\left(1-\frac{\varepsilon}{P}\right)N$. For $k > k^{C2}$ no cooperative equilibrium exists.

Proposition 3b: Over the range k < k^{C2}, the threshold indicator is $\hat{\delta}^* = \frac{\varepsilon}{P}$

Proposition 3c: $k^{C2} > k^{C1}$

Proposition 4a: Where 0 < θ < 1, let k^{C3} be the value of k such that at the $\hat{\delta}^*$ that satisfies (4.1), constraint (4.i) holds with equality. For $k \le k^{C3}$ a Cooperative Equilibrium exists with group size n* that is weakly decreasing in k. For $k > k^{C3}$ no cooperative equilibrium exists.

Proposition 4b: Over the range 0 < k < k^{C3}, the threshold indicator is weakly increasing in k.

Proposition 4c: $k^{C2} > k^{C3} > k^{C1}$

3.2 Graphical Interpretation

Figures 1 and 2 illustrate these results under a parameterized version of the model. Figure 1 shows the threshold $\hat{\delta}^*$ and the default rate q as k increases for each of the three cases, while Figure 2 shows the optimal group size n. In the θ = 0 case, the group faces no tradeoff in its choice of $\hat{\delta}^*$ - increasing $\hat{\delta}^*$ does not have the effect of reducing the rate of Default, since a lower $\hat{\delta}^*$ is not associated with higher propensity to Default. Hence the group cannot improve on a fully inclusive decision rule where $\hat{\delta}^* = 0$ and the group size consists of all N members of the community. As k increases, the payoff for group members decreases as more and more Default occurs. Once the payoff for group members is negative, there is no longer a Cooperative Equilibrium and the group size falls to zero.

Conversely, where θ = 1 so that discount factors are publically observable, the optimal decision rule is to exclude any member of the community whose incentive is to Default and accept all other members. Hence, there is no Default in the group, and the threshold indicator $\hat{\delta}^* = \frac{\varepsilon}{P}$, the discount factor at which an individual will Default when all other group members cooperate. As k increases, the community members whose discount factors fall to zero are excluded, so that the group size decreases in k. At some point, the group size becomes small enough that fixed costs c of participating exceed the benefits for even the most patient group members, and there is no longer a Cooperative Equilibrium.

An intermediate information regime such that θ = 0.5 is also illustrated in Figures 1 and 2: Unlike the previous two cases, $\hat{\delta}^*$ is increasing in k. The intuition is as follows: at a given threshold $\hat{\delta}^*$, an increase in k causes an exogenous increase in the Default rate q. This is because accepted group members whose indicators are inaccurate are now more likely to be Defaulters. In turn, an increase in k serves to further increase the Default rate by reducing the Cooperation threshold. A greater proportion of Defaulters in the group increases the incentive to Default, so that the marginal group member's optimal strategy shifts from Cooperate to Default. Thus, it is optimal to increase the threshold indicator. As k increases, the optimal group size thus shrinks as the rate of Default increases, so as in the previous two cases there is some point at which a Cooperative Equilibrium can no longer be sustained. As one might expect, the more accurate the signal, the closer the dynamics correspond to perfect information case.

Note that the contours of the model are consistent with the structure of both ASCAs and ROSCAs described in the previous section. Both institutions imply an informal contract with a pecuniary incentive to default that is deterred by informal sanctions, and the efficacy of this mechanism is threatened by mortality within the community. In an ASCA, the contract arises from the fact that individual members collect payments for loans they have made with the group fund. Thus, there is an incentive to withhold the repayments on loans that they have collected from the rest of the group, while the premature death of a member can adversely affect the group if that member has made outstanding loans that have not yet been collected. In addition, high mortality in the community may result in lower repayment rates on the loans of the central fund my group members.

In the context of a ROSCA, once an individual has been allocated the fund, she has a pecuniary incentive stop attending meetings and contributing to the fund. Such default is costly to the rest of the group, as it reduces the size of the pot for remaining members and may threaten the group with dissolution. Anderson et. al. (2009) demonstrate that social sanctions to deter such behavior are necessary for a ROSCA to be viable. Thus, as a source of default that is immune to sanctions, mortality threatens these institutions.

4. Data and Econometric Approach

The data requirements for a definitive empirical analysis of our theoretical model are formidable. To do so, we would need detailed time series data on membership at the level of the informal institutions themselves, which would also have to drawn from a location and timeframe over which the rate of mortality varies significantly across communities. To our knowledge, such data do not exist. However, an existing dataset, the KwaZulu Natal Income Dynamics Study (KIDS), has a number of desirable features for our purposes. It is a panel survey that spans a timeframe over which the rate of HIV/AIDS increased dramatically, resulting in substantial variation in community mortality rates. In addition, it contains information on informal institutions and both the household and community levels. Thus, we employ the KIDS dataset to investigate some of the implications of our theoretical model.

4.1 Data: general description

The KIDS dataset is a panel study collected in the province of KwaZulu Natal, South Africa over the period 1993-2004. It contains a range detailed socioeconomic and demographic information intended to facilitate policy-relevant research, particularly in terms of the dynamics of poverty. The initial 1993 round surveyed 1,354 households drawn from 67 communities; representatives of 74% of the original sample were successfully re-interviewed in both 1998 and 2004. Where core members of the 1993 households split off and formed or joined new households, these new households were also tracked and incorporated into the later rounds. The 1998 and 2004 surveys include questions on membership in a variety of community groups.[3] Since we are interested in the impact of community-level mortality and we can only identify households with their original communities, we omit households that have relocated to new communities during the survey. The implications of omitting these households are discussed below. After adjusting for this and other data irregularities, we are left with 673 households distributed over 62 communities.

The location and timeframe are ideal for studying the effects of HIV/AIDS-related mortality on community level institutions. The pandemic induced a massive increase in adult mortality over this period; the probability that a 15-year-old in KwaZulu Natal would not survive to age 49 increased from 27.9% in 1998 to 70.8% in 2004 (Dorrington et. al. 2002). While we do not observe group sizes directly, the data do contain information on membership in informal institutions at the household level, as well as the number of different types of institutions in each community. We thus estimate the impact of community level-mortality on the likelihood that a household belongs to an informal institution. We further estimate a proxy for average group size,

[3] The 1998 survey also obtains retrospective data on group membership in 1993. However, recall bias appears to be a significant problem for investigating the dynamics of group membership here. For example, only 1 household restrospectively reported membership in stokvels in 1993 that it had left in 1998. Conversely, there were 100 cases of households reporting membership in stokvels in 1998 that they had left by 2004. Hence, we omit the recall data from our analysis.

and estimate the effect on the total number of groups and the average groups size at the level of the community.

For each community, we calculate the rate of mortality among adults aged 15-49 in the sample over the periods 1993-1998 and 1998-2004. The results confirm a dramatic increase in mortality after 1998, as prime age mortality nearly triples. Summary statistics for community level mortality and other variables of interest are reported in table 1.

4.2 Data: Informal institutions

Our data contain information on membership in a stokvels, a South African term for a general category of informal financial institution. Stokvels can take a variety of forms- ASCAs and ROSCAs are two of the most commonly noted in the literature but the term encompasses a wide variety of arrangements. Stokvels are widespread in the study area; 25.1 % of households in our sample reported membership in at least one.

4.3 Household level econometric approach and estimation results

At the level of the household, our empirical strategy is to estimate the probability that at least one member of a household belongs to a particular type of group as a function of the level of mortality in the community. We would like to control for both household and other community-level characteristics to the greatest extent possible, and hence employ panel data methods. This presents an econometric difficulty in terms of how to eliminate unobserved heterogeneity in the context of a binary response dependent variable. Our preferred approach is fixed effects conditional logit proposed by

Chamberlain (1980). We prefer the conditional logit model to a probit specification because the latter implies a number of assumptions that are problematic given our data[4].

The empirical approach is to condition the observed pattern of responses over time on the total number of responses within the panel unit. In our case, there are only two time periods, so that the model is:

$$P(g_{i2} = 1 \mid X, Z, g_{i1} + g_{i2} = 1) = \frac{\exp\left(\beta_1 \left(X_{i2} - X_{i1}\right) + \beta_2 \left(Z_{j2} - Z_{j1}\right)\right)}{1 + \exp\left(\beta_1 \left(X_{i2} - X_{i1}\right) + \beta_2 \left(Z_{j2} - Z_{j1}\right)\right)}$$

and

$$P(g_{i1} = 1 \mid X, Z, g_{i1} + g_{i2} = 1) = 1 - \frac{\exp\left(\beta_1 \left(X_{i2} - X_{i1}\right) + \beta_2 \left(Z_{j2} - Z_{j1}\right)\right)}{1 + \exp\left(\beta_1 \left(X_{i2} - X_{i1}\right) + \beta_2 \left(Z_{j2} - Z_{j1}\right)\right)}$$

Where:

g_{it} is an indicator of whether household i belonged to group type g at time t,

X_{it} is a vector of household-level time varying characteristics,

Z_{jt} is a vector of cluster-level time varying characteristics including mortality,

β_1 and β_2 are vectors of parameters to be estimated.

In effect, the approach is to restrict attention to households that were members of a group in one period but not the other. We then compare households that joined a group between 1998 and 2004 to those that exited groups between 1998 and 2004 in order to see whether community level mortality and our other controls is associated with group exit.

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[4] Using probit necessitates a random as opposed to fixed effects panel approach, as parameters cannot be estimated consistently under a probit specification with fixed effects. The main disadvantage of the random effects probit model is that it requires the assumption of independence of the unobservables and the explanatory variables (Wooldridge 2001). In our case, this is particularly problematic: for example, the household level incidence of prime-age mortality variable (PAM) is almost certainly related to unobserved household characteristics.

The main disadvantage to this approach is that it omits households that were members of a group in either both periods or neither period. This gives rise to concern that our results might be biased because we are considering only a subset of the observations. To allay this concern, we also estimate a linear probability model, which allows to incorporate the entire sample. Though linear probability models are problematic for statistical inference, parameter estimates are nonetheless consistent and unbiased. Thus, this model presents a useful robustness check on the conditional logit results.

Estimation results with stokvel participation as the group type using conditional logit are presented in the first row of table 2. Cluster level mortality is negative and significant. The linear probability model estimates shown in the second row confirm this result. The only other control variable that is significant is household level expenditure growth. Since we have controlled for cluster level expenditure growth, the interpretation is that households that have done well relative to other households in their community are more likely to join stokvels.

Our results show that living in a high-mortality community reduces stokvel participation. This consistent with our theoretical prediction that mortality leads to higher default rates and hence greater selectivity on the part of the institutions. It is worth noting that in terms of the incentive structure in our model, these results can be thought of as a lower bound on the true impact of mortality, since as noted not all of the institutions classified as stokvels conform to our theoretical set-up.

4.4 Alternative Explanations

Here, we consider two alternative explanations for the findings in the previous section. First, while model pertains to the "supply" of institutional arrangements, it could be that demand side factors are in fact driving the results. If living in a high mortality community reduces demand for the services that stokvels provide, this could explain the observed relationship between mortality and participation.

We argue that we can reject this explanation because of the lack of significance of the household-level PAM coefficient in model 1. If mortality were acting on stokvel participation by reducing demand, we would expect to see households that have suffered deaths to be less likely to be stokvel members than those that have not. As this is not the case, we can rule out this type of demand-side effect.

Secondly, our findings could be driven by other time-varying omitted variables. That is, there may be some unaccounted-for factor not captured by our panel data that is correlated with cluster-level mortality and leads to reduced participation in stokvels. For example, mortality in the community may imply an increase in the marginal value of time as community members care for the sick, which could lead to lower rates of participation in group activities such as stokvels. While we cannot completely rule out this possibility, we can investigate an important category of this type of effect by estimating our equation using other types of groups as the dependent variable.

We observe a variety of non-financial community institutions. These include trade associations and farmer's organizations, as well as civic groups such as school, water, and development committees. Also included are groups with a social or recreational purpose such as music and sports clubs. 20.2% of the study households belonged to these types of groups in 1998, this increased to 26.2% in 2004. A final category of community-level institutions comprises religious groups such as churches. Membership in these groups increased dramatically over the study period, from 52.3% of the sample in 1998 to 97.9% in 2004[5].

Models 3-8 show the results of estimating our models with burial societies, non-financial secular groups, and religious groups respectively. In no case does community-level mortality lead to lower participation rates. We can thus rule out any time-varying unobserved variable that leads to reduced participation in community-level institutions in general, as opposed to stokvels in particular. We note that household expenditure growth is significant in all of the regressions, suggesting that relatively fortunate households are more likely to join groups in general.

Interestingly, model (7) shows that cluster level mortality is positively associated with religious group membership. An intriguing (though speculative) explanation for this result that is consistent with our analysis relates to the potential substitutability of social capital. Participation in a community-level institution may be motivated not only by the specific purpose of that institution, but also by the desire to deepen social relationships more broadly- that is, to build social capital. This motivation has been cited in research on stokvels (Verhoef 2001). In communities where mortality causes contracting institutions such as stokvels to become more exclusive and risky, individuals may try to build social capital through more accepting and potentially less costly types of institutions such as religious groups.

A final concern that we address here is the potential for bias due to attrition and/or migration. To the extent that households that move or drop out of the sample have

[5] A slight change in format of the questionnaire may account for part of this difference

systematically different propensities for mortality or joining groups compared to our sample, this would We re-estimate models 1 and 2 with additional variables for cluster-level attrition and outmigration. We omit the results, but in none of the estimations were any of these variables significant, nor does their inclusion substantially alter the statistical significance of the cluster-level mortality coefficient.

4.4 Further Evidence on the Relationship Between Mortality and Stokvel Participation

In the previous section, we showed that households in high-mortality communities are less likely to be members of stokvels. According to the theoretical model in section 3, this could potentially occur in two ways. Stokvels may become gradually more exclusive, as the optimal threshold for inclusion increases with mortality. Alternatively, at high enough levels of k a cooperative equilibrium may cease to exist and the group may dissolve. The KIDS dataset includes information on the number of groups of various types that serve each of the 62 communities in the survey. We thus estimate the effects of mortality on the number of stokvels at the community level.

The results of our community-level fixed effects regression appear in table 3. Our sample size is small, as we have only 124 data points upon which to rely. Nonetheless, the community fixed effects explain a substantial portion of the variation, and the coefficients of the model are jointly significant at .05. The coefficient on prime age mortality is positive and insignificant. Thus, higher mortality communities do not appear to have fewer stokvels. The implication, then, is that our household-level results are driven by existing stokvels admitting fewer members, rather than dissolving.

5 Conclusions and Suggestions for Further Research

Our findings suggest a heretofore unexplored impact of the HIV/AIDS pandemic that has important implications for policy. In high prevalence areas, programs designed to mitigate the effects of the HIV/AIDS pandemic must consider not only those directly affected by the disease, but the broader community as well. Even for those who are not directly affected by disease, the pandemic may weaken the informal institutional arrangements upon which many poor households rely. Access to credit, insurance, and other financial services may suffer as a result.

Our results also have implications for the study of institutional change. A number of authors have pointed out that social relations in developing countries are complex and interconnected. While this is undoubtedly the case, our results demonstrate that an analysis of the underlying incentives of a particular type of institutional arrangement can nonetheless provide useful insights.

Finally, our results suggest that further empirical study of these issues is warranted. While our empirical evidence has focused on rotating savings and credit associations, a broad range of institutional arrangements such as mutual insurance networks and informal lending are liable to be subject to the same effects. More detailed data at the level of the institutions themselves would allow for the theoretical findings in this paper to be tested explicitly, and the magnitude and economic implications of the effects of HIV/AIDS on weakening community-level contract enforcement to be more precisely understood.

Appendix: Proofs

Proposition 1:

To show existence, we must show that there exists some $\hat{\delta}^*$ that simultaneously satisfies constraints 3. i., 3.ii., and 3.iii. We can write this as:

$n = N\left(1-\hat{\delta}^*\right)$ and

$\mathrm{q} = \Pr\left(\delta_i \neq \hat{\delta}_i\right) \cup \Pr\left(\hat{\delta}_i > \hat{\delta}^*\right) \cup \Pr\left(\delta_i < \dfrac{(1-q)\varepsilon + q\gamma}{P}\right)$. Our assumptions imply that each of these events is independent, so we can write:

$$\mathrm{q} = (1-\theta)\left(\frac{(1-q)\varepsilon + q\gamma}{P}\right)\left(1-\delta^*\right)$$

Which simplifies to

$$\mathrm{q} = \left(\frac{(1-\theta)\left(1-\delta^*\right)\varepsilon}{P - \left[(1-\theta)\left(1-\delta^*\right)(\gamma-\varepsilon)\right]}\right)$$

Re-writing our non-negativity constraint iii. in terms of q and substituting x., the condition becomes:

$$\frac{B\left(N\left(1-\hat{\delta}^*\right)\right)-c}{B\left(N\left(1-\hat{\delta}^*\right)\right)+\gamma} \geq \left(\frac{(1-\theta)\left(1-\delta^*\right)\varepsilon}{P - \left[(1-\theta)\left(1-\delta^*\right)(\gamma-\varepsilon)\right]}\right)$$

Note that at δ^* = 1, the left hand side is negative and the condition cannot be satisfied. Meanwhile, at $\hat{\delta}^* = 0$, the condition becomes

$$\frac{B(N)-c}{B(N)+\gamma} \geq \left(\frac{(1-\theta)\varepsilon}{P - \left[(1-\theta)(\gamma-\varepsilon)\right]}\right)$$

Noting that the right hand side is decreasing in θ, so it will suffice to consider the case where θ = 0. Thus we must have:

$$\frac{B(N)-c}{B(N)+\gamma} \geq \frac{\varepsilon}{P-\gamma+\varepsilon}$$

Since the limit of the left hand side as n goes to infinity is one, and the right hand side cannot be greater than one, we have shown that for large enough N there is some $\hat{\delta}^*$ at which the payoff is non-negative given the resulting equilibrium values of n and q.

Lemma 1: For any allowable parameterization of the model, there is some critical value $k^C \in (0,1)$ such that for any $k \leq k^C$ the Cooperative Equilibrium exists, while for $k \geq k^C$ the Autarky Equilibrium prevails.

It follows from Proposition 1 and Assumption 1 that a Cooperative Equilibrium must exist for k = 0, thus we must show that there exists some k^C above which there is no Cooperative Equilibrium. Thus we must show that there is no $\hat{\delta}^*$ that simultaneously satisfies constraints 3.i, 3.ii, and 3.iii.

The non-negativity constraint is:

$$(1-q)B(n)-q\gamma-c\geq 0$$

We consider the case where θ = 1 (i.e., discount factors are observable and there is no Default). Substituting constraints 3.i and 3.ii as well the result from the proof of Proposition 3b below that in the θ = 1 case $\hat{\delta}^*=\frac{\varepsilon}{P}$, we have

$$B\left(N\left(1-\frac{\varepsilon}{P}\right)(1-k)\right)\geq c$$

Using Assumption 2, the non-negativity constraint is not satisfied iff

$$N\left(1-\frac{\varepsilon}{P}\right)(1-k)\leq 1$$

Or

$$k\geq 1-\frac{1}{N\left(1-\frac{\varepsilon}{P}\right)}$$

Since by assumption $P>\varepsilon$, the right hand side is between 0 and 1 and there is some $k^C\in(0,1)$ that satisfies this requirement. Thus, the non-negativity constraint cannot be satisfied for $k\geq k^C$ in the θ = 1 case. For other values of θ, note that the payoff cannot exceed that of the θ = 1 case, so any $k\geq k^C$ will result in the Autarky Equilibrium for these cases as well.

Lemma 2: $\frac{\partial B(n)}{\partial n}\leq\frac{B(n)+\gamma}{N}$ for all $0\leq n\leq N$ is sufficient to guarantee that adding Defaulters to the group always reduces the payoff to the Cooperating group members.

Suppose there are n1 Defaulting group members and n2 Cooperating group members. We can then write the maximand U as:

$$U=\left(1-\frac{n1}{n1+n2}\right)B(n1+n2)-\frac{n1}{n1+n2}\gamma-c$$

Now consider the effect of exogenously adding Defaulting group members. We require that the effect of increasing n1 decreases U, so we need to find the conditions under which:

$$\frac{\partial U}{\partial n1} < 0$$

Taking the derivative and using the fact that $q = \frac{n1}{n1+n2}$ and $N = n1+n2$ gives

$$(1-q)\left(\frac{\partial B}{\partial n} - \frac{B(n)+\gamma}{N}\right) < 0$$

Which holds iff

$\frac{\partial B}{\partial n} < \frac{B(n)+\gamma}{N}$, as was to be shown

Proposition 2a: Where θ = 0, Let $k^{C1} = \frac{\left(B(N)-c\right)\left(P+\varepsilon-\gamma\right)-\left(B(N)+\gamma\right)\varepsilon}{\left(B(N)-c\right)\left(\varepsilon-\gamma\right)-\left(B(N)+\gamma\right)\left(\varepsilon-P\right)}$. For $k \le k^{C1}$ k a Cooperative Equilibrium exists with group size N, while for $k > k^{C1}$ no Cooperative Equilibrium exists.

Proposition 2b: Where θ = 0, over the range $k \le k^{C1}$ the threshold indicator $\hat{\delta}^* = 0$

Since in this case $\hat{\delta}$ is a random draw from the population, the only effect of increasing $\hat{\delta}^*$ is to reduce n*, lowering the payoff. Thus, the payoff is maximized at $\hat{\delta}^* = 0$.

Constraint 3.ii. now becomes:

$$q = k + (1-k)\frac{(1-q)\varepsilon + q\gamma}{P}$$
$$= \frac{Pk + (1-k)\varepsilon}{P - (\gamma-\varepsilon)(1-k)}$$

Substituting into constraint 3.iii and rearranging, we obtain:

$$k \le \frac{\left(B(N)-c\right)\left(P+\varepsilon-\gamma\right)-\left(B(N)+\gamma\right)\varepsilon}{\left(B(N)-c\right)\left(\varepsilon-\gamma\right)-\left(B(N)+\gamma\right)\left(\varepsilon-P\right)}$$

Thus for k greater than this critical value, the non-negativity constraint is violated and no Cooperative Equilibrium exists.

Proposition 3a: Where θ = 1, Let $k^{C2} = 1 - \left(\frac{P}{(P-\varepsilon)N} B^{-1}(c) \right)$, where B^{-1} is the inverse of B. For $k \le k^{C2}$, a Cooperative Equilibrium exists with a group size n* that is decreasing in k at a rate of $\left(1 - \frac{\varepsilon}{P}\right)N$. For $k > k^{C2}$ no cooperative equilibrium exists.

Proposition 3b: Where θ = 1, over the range $k \le k^{C2}$ the threshold indicator is $\hat{\delta}^* = \frac{\varepsilon}{P}$

First, note that for $\hat{\delta}^* \ge \frac{\varepsilon}{P}$, q = 0. Since n* is decreasing $\hat{\delta}^*$, the payoff at $\hat{\delta}^* = \frac{\varepsilon}{P}$ exceeds the payoff for any other $\hat{\delta}^* > \frac{\varepsilon}{P}$. Meanwhile, assumption x guarantees that $\hat{\delta}^* \le \frac{\varepsilon}{P}$.

The threshold $\hat{\delta}^* = \frac{\varepsilon}{P}$ gives a value of n of $n^* = N(1-k)\left(1 - \frac{\varepsilon}{P}\right)$. Using the fact that q = 0, we can substitute into constraint 3.iii. to obtain:

$$B\left(N(1-k)\left(1 - \frac{\varepsilon}{P}\right) \right) \ge c$$

So that the critical value of k where the payoff becomes negative is

$$k^{C2} = 1 - \left(\frac{P}{(P-\varepsilon)N} B^{-1}(c) \right)$$

Where B^{-1} is the inverse of B.

We can find the change in the optimal group size as k increases by differentiating n* with respect to k:

$$\frac{\delta n^*}{\delta k} = -\left(1 - \frac{\varepsilon}{P}\right)N$$

Proposition 3c: $k^{C2} > k^{C1}$

First note that the first round payoff in the θ = 0 case at k^{C1} is zero. Suppose that in this case there are n1 Defaulting group members and n2 Cooperating group members. We can then write

$$\left(1 - \frac{n1}{n1+n2}\right) B(n1+n2) - \frac{n1}{n1+n2}\gamma - c = 0.$$

Now consider the case where θ = 1. Since all Defaulters are excluded, the payoff at k^{C1} is $B(n2)-c$

Note that the only difference is that the n1 Defaulters have been excluded. By assumption 2, including Defaulters is always a net loss, which gives us

$$B(n2)-c > \left(1-\frac{n1}{n1+n2}\right)B(n1+n2)-\frac{n1}{n1+n2}\gamma - c$$

Thus, at k^{C1} the first round payoff in the θ = 1 case is greater than zero, so there is Cooperative Equilibrium at this value of k and the critical value k^{C2} at which constraint 3.iii fails to hold must be greater than k^{C1}.

Proposition 4a: Let k^{C3} be the value of k such that at the $\hat{\delta}^*$ that satisfies (4.1), constraint (4.i) holds with equality. For $k \le k^{C3}$ a Cooperative Equilibrium exists with group size n* that is weakly decreasing in k. For $k > k^{C3}$ no cooperative equilibrium exists.
Proposition 4b: Over the range $0 < k < k^{C3}$, the threshold indicator is weakly increasing in k.

Where 4.i holds with equality, the optimal choice of $\hat{\delta}^*$ yields zero first round payoff. Since an increase in k must increase the number of Defaulters in the community, such an increase must either increase the Default rate in the group, reduce the group size as these Defaulters are excluded by increasing $\hat{\delta}^*$, or both. Since any of these outcomes would reduce the first round payoff, increasing k beyond this point means that the first round payoff must be negative and there is no Cooperative Equilibrium.

Proposition 4c: $k^{C2} > k^{C3} > k^{C1}$

The proof is analogous to the proof of Proposition 3c.

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Figure 1. Threshold $\hat{\delta}^*$ and Default rate q

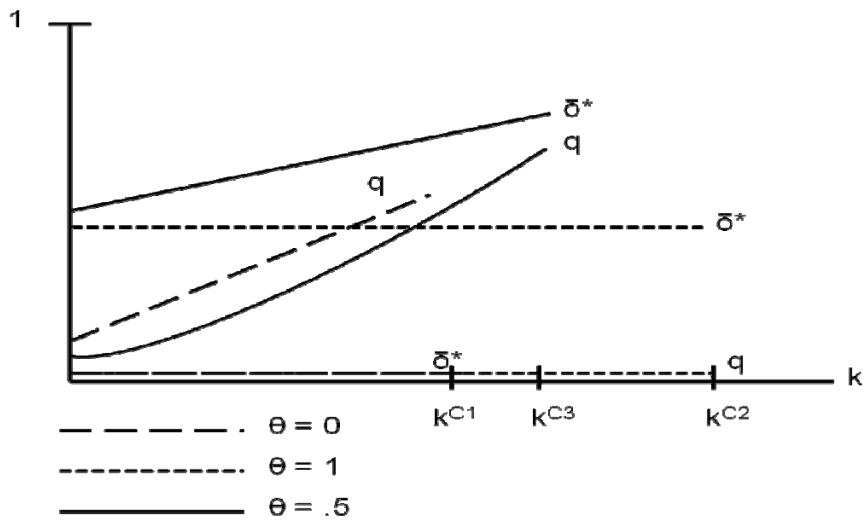

Figure 2. Optimal Group Size

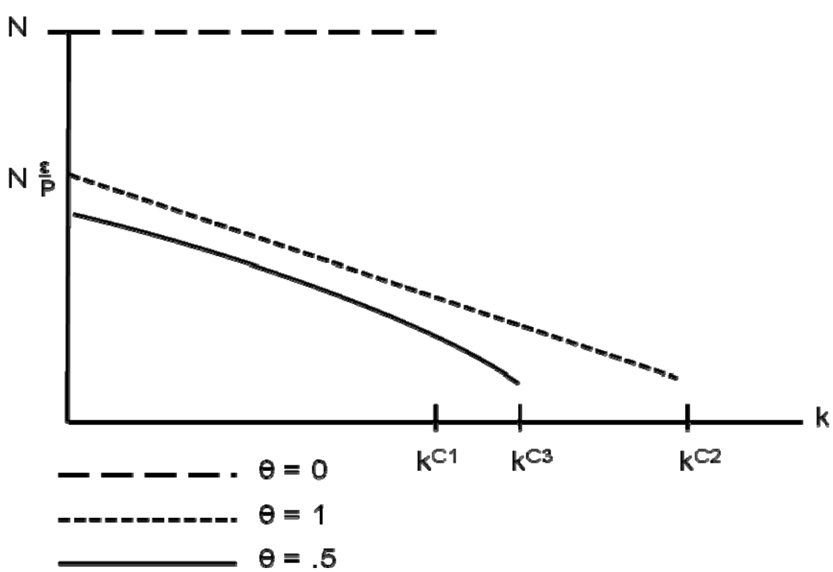

Table 1. Summary Statistics

	1993-1998	1998-2004
Prime age population		
Average (Std. dev.)	70.9 (39.0)	86.6 (48.5)
Minimum	10	14
Maximum	180	214
25th percentile	38	44
50th percentile	67	80
75th percentile	92	123
Prime Age Mortality Rate		
Average (Std. dev.)	1.6% (1.97)	4.5% (3.26)
Minimum	0.0%	0.0%
Maximum	8.0%	13.0%
25th percentile	0.0%	1.7%
50th percentile	1.0%	4.6%
75th percentile	3.0%	6.9%
Cluster level per capita income growth	-4.3%	32.6%
Household level per capita income growth	-14.1%	5.3%
Change in household size	0.09	-0.82
Incidence of Prime Age Mortality	12.0%	29.4%
Membership in:		
Stokvels	23.1%	22.6%
Burial Societies	38.1%	32.3%
Non-Financial Secular Groups	20.2%	26.2%
Religious Groups	52.3%	96.2%

Table 2. Household Level Empirical Results

Group Type	Stokvel		Burial Society		Non-Fin. Secular		Religious	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Model	CL	LP	CL	LP	CL	LP	CL	LP
Cluster level mortality	−5.986	−1.128	−2.565	−0.623	2.437	0.213	28.793	−0.602
	(2.31)**	(2.79)*	−0.88	−1.21	0.77	0.35	(3.06)*	−1.11
Cluster level per capita exp. gr.	0.172	0.021	−0.12	−0.038	0.369	0.028	3.94	−0.027
	(0.65)	(0.47)	(0.4)	(0.7)	(1.07)	(0.42)	(2.95)*	(−0.48)
Change in household size	−0.014	−0.002	0.05	0.006	0.008	0.001	−0.02	0.002
	(−0.33)	(−0.44)	(2.66)*	(1.70)	(0.33)	(0.21)	(−0.72	(0.39)
Household per capita exp. gr.	0.653	0.081	0.317	0.054	0.583	0.079	0.373	0.069
	(4.78)*	(4.76)*	(2.50)**	(2.34)**	(3.06)*	(3.52)*	(2.32)**	(3.03)*
Household prime age mortality	0.046	0.02	−0.272	−0.026	−0.19	−0.059	1.226	0.014
	(0.17)	(0.54)	(−1.18)	(−0.66)	(−0.74)	(−1.41)	(3.23)*	(0.4)
Year		0.011		0.02		0.036		0.476
		(0.33)		(0.62)		(0.92)		(13.25)*
Constant		0.279		0.411		0.214		0.55
		(15.69)*		(16.90)*		(7.66)*		(20.68)*
Observations	392	1346	466	1346	460	1346	630	1346
R-squared		0.04		0.02		0.04		0.46

** significant at 5%; * significant at 1%

Table 3. Community Level Fixed Effects Results

Group type	Stokvel
	(9)
Cluster level mortality	20.94
	(1.00)
Cluster level per capita exp. gr.	2.125
	(1.14)
Year	1.104
	(0.62)
Constant	2.926
	(3.70)*
Observations	124
R-squared	0.08