Assessing the impact of HIV and AIDS mortality on household welfare in KwaZulu-Natal South Africa

Alessandra Garbero
LSHTM

BSPS
September 2009
Outline

- Aim
- Context of research
- Theory
- Results
- Conclusion
Aim

- Quantify the impact of adult mortality on (survivors) household welfare in KZN
- Household welfare proxied by consumption per capita
- Is AIDS different from other causes of deaths?
- Is there a gender impact?
- How about temporal dimension of impact in panel data?
- Can we measure dynamics accurately?
Context of research: South Africa HIV/AIDS Pandemic & Poverty

- HIV/AIDS is now the leading cause of death in South Africa.

- **KwaZulu-Natal one of the most impacted provinces:** By 2004 the prevalence of HIV infection among pregnant women had risen to 29.5% nationally and 41% in KwaZulu-Natal.

- **Not just HIV/AIDS:** Apartheid policies, by creating a situation of inequitable access to employment, services and resources to the African population, have resulted in poverty being characterised by a strong racial dimension.
AIDS-related deaths present HHs with a protracted shock characterised by a series of events that occur as illness progresses.

Theoretical and qualitative studies: multifaceted loss to rural households

Loss of:

- on-farm labour,
- off-farm income from wage labour or own-business activities
- technical knowledge of agricultural production and marketing,
- access to land, liquidation of livestock,
- farm equipment or other assets

Medical expenses during the illness period and funeral expenses after death

Large and representative socio-economic surveys find that impacts vary considerably conditional on characteristics of:

- the deceased individual (household position and gender)
- the household (ex ante asset or poverty status)

Drimie, 2002; Yamano and Jayne, 2004; Chapoto, 2006
Why is it difficult to measure impact of AIDS mortality on survivors’ welfare?

- AIDS is multidimensional
- Also its impacts
- Effects are conditional/brought about by:
  - the status of being affected
  - AIDS-related morbidity+mortality

What are the channels of impact?:

- **Labor Supply / Income** → Primary Impact ("Gross Impact")
- HH composition
- Unearned income: Grants/ remittance income
- Saving / Sale of Assets / Borrowing
- **Expenditure** → Final Impact ("Net Impact")

Coping strategies
Difficulties in measuring impact

“Deaths due to AIDS may be endogenous to outcomes (welfare) but most of the studies treat mortality as exogenous” (Ainsworth and Dayton, 2000; Beegle, 2005; Booysen, 2003; Yamano and Jayne, 2004)

More recent research has indicated heterogeneous mortality effects across HHs (Gillespie 2006)

- mortality attributable to AIDS is influenced by behavioral choices rather than random event
  - Accidents and AIDS deaths different?

**Endogeneity=simultaneity**

- death could be endogenous (jointly determined) to consumption, since the latter may influence health and mortality (i.e. AIDS deaths may occur in poorer households that resort to risky sexual behavior as coping strategy)

**Endogeneity=unobserved heterogeneity:**

- Limited form of endogeneity: AIDS mortality correlated with unobserved characteristics (or “unobserved heterogeneity”) that affect changes/levels of consumption/welfare (fixed over time)
- Wider form of endogeneity: AIDS mortality correlated with unobserved characteristics that change over time (time varying)
Heterogeneity

1) Conditional heterogeneity
On Household and individual specific characteristics:
- effects more severe in the case of the death of a male head of household and for households that were relatively poorer ex ante (Michigan Group)
- But not in Tanzania (Beegle)

→ observed heterogeneity
→ control for initial conditions that affect changes and future levels in consumption

2) Context-country specific:
- Extant results also suggest that the magnitude and type of household effects may vary across countries (and regions within some countries).

3) Responses: explanations for heterogeneous impacts include:
- differences in household responses as well as differences in what assets the household lost when the individual died.

4) Temporal heterogeneity of impact
Time: does the temporal dimension of the impact matter? i.e. do deaths that occur at different points in time affect consumption differentially i.e. welfare?
- Evidence: mostly short-term evidence
- Beegle: no evidence of “long-term impact” i.e. adult mortality shocks are not persistent
- households do recover from deaths occurring “further away” in the past (no significant effect of mortality after 5 years)
**Data: ACDIS**

Africa Centre Demographic Information System (ACDIS)

- Provides data on more than 11,000 households and 85,000 individuals in part of the Umkhanyakude district of KwaZulu-Natal since the beginning of 2000 (Solarsh et al. 2002; Hosegood and Timaeus 2005 in press).

- Households are visited every 6 months to obtain reports of births, deaths, migration and changes in household membership.

- Detailed **socioeconomic data**, including household expenditure data, are collected on alternate visits (HSE).

- **Verbal autopsies** are used to determine causes of death.

- Study population includes both non-resident and resident household members.
Table 1: Household socio-economic waves, visit dates, rounds and number of households.

<table>
<thead>
<tr>
<th></th>
<th>Visit date</th>
<th>Rounds</th>
<th>HH</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSE1</td>
<td>Feb-Sep2001</td>
<td>3 or 4</td>
<td>10839</td>
</tr>
<tr>
<td>HSE2</td>
<td>Feb 2003-Aug 2004</td>
<td>8,9,10</td>
<td>10815</td>
</tr>
<tr>
<td>HSE3</td>
<td>Jan-Sep 2005</td>
<td>12</td>
<td>9736</td>
</tr>
<tr>
<td>HSE4</td>
<td>Jan-Aug 2006</td>
<td>14</td>
<td>9338</td>
</tr>
<tr>
<td>HSE5</td>
<td>Jul-Dec 2007</td>
<td>17</td>
<td>10290</td>
</tr>
</tbody>
</table>
Transition matrices by cause of adult death
Is HIV-related mortality associated with “income” mobility?

<table>
<thead>
<tr>
<th>Tertiles</th>
<th>No deaths</th>
<th>1+ deaths</th>
<th>Number of Households</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>HIV-related including TB*</td>
<td>0.589</td>
<td>0.280</td>
<td>0.131</td>
</tr>
<tr>
<td></td>
<td>0.324</td>
<td>0.427</td>
<td>0.249</td>
</tr>
<tr>
<td></td>
<td>0.134</td>
<td>0.317</td>
<td>0.549</td>
</tr>
<tr>
<td>Non-communicable</td>
<td>0.596</td>
<td>0.283</td>
<td>0.121</td>
</tr>
<tr>
<td></td>
<td>0.333</td>
<td>0.430</td>
<td>0.237</td>
</tr>
<tr>
<td></td>
<td>0.143</td>
<td>0.322</td>
<td>0.535</td>
</tr>
</tbody>
</table>

Results
1. Mortality due to AIDS and other communicable diseases is associated both with downward mobility among the better-off and the failure of the poor to improve their income.
2. Mortality from non-communicable diseases and injuries affect the rich but do not prevent upward mobility among the poor.

Total no. of HH          8378

Chi-square sig. at 0.05 level.
Regression model

\[ PCE_{h,t} = \alpha + \beta PCE_{h,t-1} + \delta Z_{h,t} + \gamma \text{AIDSdeaths}_{h,t} + \xi \text{Otherdeaths}_{h,t} + \phi X_h + \varepsilon_{h,t} + u_h \]

\( h \) for household \( (h=1, \ldots, 12032) \) and \( t \) for time \( (t=1, 2, 3) \) i.e. HSE 2, 3, 4.

\( PCE_{h,t-1} \) lagged values of dep. var. endogenous to the model

\( Z_{h,t} \) time-variant hh characteristics (i.e. hh size, proportion employed, proportion aged 15-65, proportion of females, number of assets).

\( \text{Other deaths}_{h,t} \) of time-variant mortality variables by cause (excluding AIDS deaths) and are considered exogenous (i.e. adult deaths from injuries, non-communicable and communicable diseases)

\( X_h \) vector of time-constant household characteristics

\( \varepsilon_{h,t} \) \( \rightarrow \) \( t \) and hh specific error term, normally distributed and uncorrelated with the regressors across hh and \( t \) and uncorrelated with \( u_h \),

\( u_h \) \( \rightarrow \) hh and t-constant error component, normally distributed with zero mean and variance. It may be correlated with all or part of the regressors.
Issues with the model of interest

Most of the regressors are potentially endogenous (adult deaths, hhsize, prop of adults)

Possible endogeneity of AIDS deaths (and others)
- Fixed effect estimator (FE): is a solution if probability of AIDS mortality correlated with (unobserved) unchanging characteristics
- Otherwise seek for instruments (IV) & use panel-FE2SLS (with IV=sexual behaviour variables)
- (An instrument is a variable that is correlated with the endogenous variable and uncorrelated with error term \( \varepsilon_{ht} \); should not enter the main equation i.e., does not explain \( y \))

Need to control for initial level of welfare PCE
- Possible bias (autocorrelation bias) as PCE correlated with error term \( u_h \)
- FE biased because, after FE transformation, \((PCE_{h,t-1} - \text{mean } PCE_{h,-1})\) is correlated with \((\varepsilon_{ht} - \text{mean } \varepsilon_h)\)
Model specification

- I fitted different estimators (OLS, FE, FE/2SLS, SYS-GMM)

  1. OLS/FE biased due to lagged dependent variable -> dynamic panel bias
  2. 2SLS: Instruments (Sexual behaviour) partially valid in 2SLS (weak identification); male and female AIDS deaths found to be exogenous
  3. Solution to lagged dep PCE$_{h, t-1} \rightarrow$ System GMM to increase efficiency

- Instrument first differences with t-2 of endogenous var (PCE, no. of assets, proportion of adults, % employed), and t-1/t-2 of other regressors (adult deaths). The latter $\rightarrow$ exogenous from 2SLS.
- For the equation in levels I use: t-2 of endogenous var (PCE, number of assets, proportion of adults, % employed), and lagged differences of adult deaths vars.
- I also use additional IV instruments (external excluded instruments (maximum educ. level in the hh; crude death rate in the fieldworker area - excluding the sexual behaviour variables as diagnostics for validity indicate not fully endogenous).
- I control for time specific effects; robust SE to heteroskedasticity & AR
## Results

<table>
<thead>
<tr>
<th></th>
<th>OLS_rob</th>
<th>FE_rob</th>
<th>2SLS</th>
<th>SYS-GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCE t-1</td>
<td>0.141</td>
<td>-0.290</td>
<td>-0.288</td>
<td>0.185</td>
</tr>
<tr>
<td>No. Assets</td>
<td>0.089</td>
<td>0.066</td>
<td>0.067</td>
<td>0.000</td>
</tr>
<tr>
<td>hhsize</td>
<td>-0.067</td>
<td>-0.076</td>
<td>-0.083</td>
<td>-0.059</td>
</tr>
<tr>
<td>hhsize t-1</td>
<td></td>
<td></td>
<td></td>
<td>0.044</td>
</tr>
<tr>
<td>Prop females</td>
<td>0.039</td>
<td>0.018</td>
<td>0.059</td>
<td></td>
</tr>
<tr>
<td>% Employed</td>
<td>0.157</td>
<td>0.079</td>
<td>0.103</td>
<td>0.985</td>
</tr>
<tr>
<td>Prop. of Adults</td>
<td>1.113</td>
<td>1.045</td>
<td>1.088</td>
<td></td>
</tr>
<tr>
<td>F Comm.</td>
<td>0.025</td>
<td>0.005</td>
<td>0.078</td>
<td>0.043</td>
</tr>
<tr>
<td>F. Non-comm.</td>
<td>-0.082</td>
<td>-0.087</td>
<td>-0.079</td>
<td>-0.027</td>
</tr>
<tr>
<td>F. Injuries</td>
<td>0.151</td>
<td>0.182</td>
<td>0.111</td>
<td>-0.008</td>
</tr>
<tr>
<td>F. AIDS</td>
<td>0.024</td>
<td>0.017</td>
<td>-0.653</td>
<td>-0.031</td>
</tr>
<tr>
<td>F. AIDS t-1</td>
<td></td>
<td></td>
<td></td>
<td>-0.001</td>
</tr>
<tr>
<td>M. Comm.</td>
<td>0.042</td>
<td>0.103</td>
<td>-0.009</td>
<td>0.018</td>
</tr>
<tr>
<td>M. Non-comm.</td>
<td>-0.009</td>
<td>0.005</td>
<td>-0.095</td>
<td>-0.016</td>
</tr>
<tr>
<td>M. Injuries</td>
<td>-0.018</td>
<td>-0.036</td>
<td>-0.032</td>
<td>-0.062</td>
</tr>
<tr>
<td>M. AIDS</td>
<td>-0.043</td>
<td>-0.021</td>
<td>-0.477</td>
<td>-0.064</td>
</tr>
<tr>
<td>M. AIDS t-1</td>
<td></td>
<td></td>
<td></td>
<td>-0.079</td>
</tr>
<tr>
<td>TIME</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>
Male adult deaths

- OLS_rob
- FE_rob
- 2SLS
- SYS-GMM


0.04  -0.02  0.10  0.01  -0.02
-0.01  -0.04  -0.02  -0.09  -0.01
-0.02  -0.03  -0.02  -0.06  -0.48
-0.08  -0.6  -0.5  -0.4  -0.3  -0.2  -0.1  0.0  0.1  0.2
Female adult deaths

ADaPT
AIDS, Demographic and Poverty Trends

OLS_rob    FE_rob    2SLS    SYS-GMM

F Comm.    F. Non-comm.    F. Injuries    F. AIDS    F. AIDS t-1

0.02 0.15 0.02 0.18 0.02 0.08 0.11 0.04 -0.01 0.00

-0.08 0.00 0.00 -0.09 -0.08 -0.65 -0.03 -0.03
Results

- AIDS deaths are not endogenous to consumption.
- In the final model previous consumption has a positive effect on current consumption indicating divergence (poor get poorer & richer get richer)
- This is in line with OLS but in contrast with FE + 2SLS models, which indicate instead convergence
- Recent male deaths due to AIDS have a negative effect on current consumption of 2% to 6%, while earlier adults death, decrease current consumption by 8 to 7% → suggestive of non recovery
- Female deaths due to AIDS do not significantly affect consumption (negative coefficient)
Impact of AIDS mortality on HH welfare: evidence

How do my results compare with the existing literature?

- Adult death → reduction in HH wealth but increase in consumption during 3/5 years following the death.

- Carter & May (1993/1998/2004), suggested that immediate impact of PAM death is more severe for better off households, also find that recovery occurs with time.

- Bachmann & Booysen (3 years follow-up) control for endogeneity; results vary according to methodology.
- BA models: AIDS death associated with 23% decline in expenditure over 3 years; (MSM) current/previous AIDS illness associated with 34% lower expenditure. AIDS deaths not associated with expenditure.
- Also reverse causality, HH with current or previous poverty more likely to experience current AIDS death and illness (74% and 94%) respectively.
Conclusion

- Added value of my paper: estimates effects of adult mortality by cause of death and gender; short & medium-term impact; corrects for auto-correlation bias
- Substantive results indicate that recent and earlier adult men’s deaths have a negative effect on household consumption
- Lack of impact of women’s deaths could reflect characteristics of the area
- Methodologically: difficult to obtain unbiased estimates of impact of AIDS mortality on welfare
- Complexity not adequately taken into account in standard models (OLS/FE/2SLS)
- Issues: endogenous regressors (reverse causality, measurement error, omitted variable bias), AR of initial conditions (welfare)
Caveats and extensions

- This is a homogenous model that assumes all effects are the same across all households.
- Possible to stratify analysis to capture heterogeneity of mortality and initial conditions a la Carter.
- Will take into account demographic and economic responses a la Grimm in final model.
- Explore proxy variables that may offset the impact of mortality, and variables that could capture the impact of coping strategies that develop overtime.