The dynamics of household dissolution and change in socio-economic position: A survival model in a rural South Africa

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This paper investigates household dissolution and changes in asset wealth (socio-economic position) in a rural South African community containing settled refugees. Survival analysis applied to a longitudinal dataset indicated that the covariates increasing the risk of forced household dissolution were a reduction in socio-economic position (asset wealth), adult deaths and the permanent outmigration of more than 40% of the household. Conversely, the risk of dissolution was reduced by bigger households, state grants and older household heads. Significant spatial clusters of former refugee villages also showed a higher risk of dissolution after 20 years of permanent residence. A discussion of the dynamics of dissolution showed how an outflow/inflow of household assets (socio-economic position) was precipitated by each of the selected covariates. The paper shows how an understanding of the dynamics of forced household dissolution, combined with the use of geo-spatial mapping, can inform inter-disciplinary policy in a rural community.

Keywords: household dissolution; rural

JEL codes: Z13, O12, P25

1. Introduction

Household stability in rural South Africa has been influenced by a series of long-term, medium-term and short-term historical legacies such as the 1913 Land Act, the creation of separate homelands and dual economic policy that have influenced high levels of rural poverty, income inequality, corruption and poor service delivery (Bryceson, 2004; Kessides, 2005; Mertz et al., 2005; Klasen & Woolard, 2008; Sherbinin et al., 2008). More recently, the HIV/AIDS epidemic has also reduced the number and productivity of household adults in rural South Africa (Hosegood et al., 2004; Hosegood, 2009).

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A combination of these legacies has also influenced household characteristics such as their geographic location, initial asset status, family size, education, health, mortality, outmigration and employment (Wu & Pretty, 2004; Barrett, 2005). These household characteristics, in turn, have influenced the ability to generate future assets (Sartorius et al., 2011), and assets underpin the lifespan (stability) of a household (Hosegood et al., 2004). A lack of assets has a destabilising effect because it results in an inability to fund household expenses. In addition, it forces households to adopt low-return survival strategies that perpetuate household instability because of an inability to generate future assets (Sen, 2003; Barrett et al., 2005; Lay et al., 2008). A combination of factors has therefore destabilised many rural households in South Africa, and development initiatives have had little impact on alleviating poverty (Landau, 2006; Klasen & Woolard, 2008) because destabilised households have been unable to participate in these projects (Barrett, 2005). What is not clear, however, is knowledge of the process and dynamics of household destabilisation.

The objective of the paper was to investigate the dynamics and spatial dispersion of household stability and changes in socio-economic position (SEP; asset wealth) in a rural South Africa community containing former refugees. Household stability, in this paper, was quantified as the risk of forced dissolution. The study addressed three research questions. First, how do changes in SEP influence the risk of forced household dissolution and what are its other predictors? Second, do former refugee household characteristics, and their risk of forced dissolution, differ significantly from the host community. Third, are there any significant spatial–temporal trends in household dissolution in the site?

The Agincourt Health and Socio-Demographic Surveillance Site (AHDSS), situated in the Bushbuckridge area of Mpumalanga, South Africa, is a rural community that contains a settled former refugee population. High levels of poverty and unemployment have destabilised many households on the site. In addition, the refugee community has been further compromised because of an inability to access state facilities and integrate into the limited economy of the community (Polzer Ngwato, 2011). Former refugee households are still (mostly) situated in separate villages that have higher levels of poverty and mortality than the villages of their host community (Collinson, 2010; Sartorius et al., 2011).

The problem of destabilised households has a wider context in sub-Saharan Africa (SSA), which has similar historical legacies to South Africa. SSA has a long history of wars, colonialism, dualist economic policy, poor government, corruption and perverse agro-climatic conditions that have shaped household stability and characteristics including their size, education, health and income (Bryceson, 2002a, 2002b, 2004; Mertz et al., 2005; Banjo, 2009). These characteristics combined with the more recent HIV/AIDS pandemic have fundamentally affected household stability in the region (Hosegood et al., 2004; Kessides, 2005; Stover & Bollinger, 2006; Collins & Burns, 2007; Hosegood, 2009). Many rural communities in SSA, moreover, have refugee populations that have had difficulty integrating into their host communities (Chambers, 2006; O'Brien et al., 2009).

The results of this study would therefore, in general, inform discussions related to the relationship between asset wealth and household stability in South Africa, as well as other African countries. The paper makes four specific significant contributions. First, the paper demonstrates how policy development in a rural community can be differentiated even within a small spatial area using advanced geo-spatial analysis. Second, the paper illustrates how rural policy can be integrated across multiple

local–provincial government departments. Third, the paper makes a contribution to the literature by providing a financial explanation for forced household dissolution (instability) to extend the findings of other studies (Hosegood et al., 2004). Fourth, the paper is the first to make use of survival analysis in a rural sociology setting (to the best of our knowledge) using a Bayesian survival model to track household duration (Gelfand & Smith, 1990; Smith & Roberts, 1993; Diggle et al., 1998).

The remainder of the study is sequenced as follows. Section 2 develops a conceptual framework to explain household dissolution, as well as guide the analysis and interpretation of data. Section 3 outlines the data and choice of survival modelling techniques. Sections 4 and 5 explain and discuss the results respectively. Section 6 concludes the paper and makes some recommendations.

2. A conceptual framework

The conceptual framework, illustrated in Figure 1, develops a causal explanation to show how a range of historical, medium-term and short-term factors influence the characteristics of a rural household and its likelihood of dissolution (stability).

2.1 Household stability (risk of dissolution)

The risk of forced household dissolution was used as a proxy for household stability. In this study, a household dissolution occurred when the household ultimately dissolves

Figure 1: Dynamics of household stability

(ceases to exist) because its last member either dies or migrates permanently out of the area (Hosegood et al., 2004). The paper has taken an insular perspective to explain forced (negative) household dissolution, and therefore does not explain voluntary (positive) reasons for household dissolution like marriage or relocation in response to an opportunity (see Section 3).

2.2 Historical legacies and household characteristics

Household characteristics in rural South Africa have been shaped by centuries of colonial rule (1913 Land Act) and apartheid (Separate Development Policy) that determined where black people could live and work. Other medium-term and short-term influences include recessions, economic policy, climate change and shocks like HIV/AIDS that have influenced the SEP (asset wealth), as well as the morbidity and mortality of households (Bryceson, 2004; Mertz et al., 2005; Sherbinin et al., 2008; Hosegood, 2009). Household characteristics that have influenced the welfare of rural households include health status, deaths, outmigration, household size, the household head, ethnic origin and education, as well as access to services and institutions (Urassa et al., 2001; Hosegood et al., 2004; McIntyre et al., 2005; Elmquist & Olsson, 2006; Malmberg & Tegenu, 2007). Household characteristics of former refugees (from Mozambique) living in rural South Africa (Mpumalanga) have been further affected by the nature of their relocation, as well as their difficulties obtaining legal status and integrating into their host communities (Polzer, 2007; Rodgers, 2008).

2.3 Household characteristics, socio-economic position and strategy

A combination of historical legacies, as well as medium-term and short-term events, has influenced household characteristics, including their geographic location, social networks, nationality, legal status, size, choice of household head, education and health (Barrett et al., 2001; Sen, 2003). A household's SEP is, in the long term, affected by inter-generational transfers that include natural, social, human, physical and financial assets (Wu & Pretty, 2004; Barrett, 2005). In this study, we measured household SEP using a composite basket of household assets that was recorded in the AHDSS dataset (see Section 3). Initial SEP, in particular, was a critical factor that perpetuated a household's strategies (Barrett, 2005) and determined its future wealth (Schwarze & Zeller, 2005; Anriquez & Valdes, 2006; Vermeulen et al., 2008; Xiangxing et al., 2008).

Household characteristics influence household strategies. Wealthier households employ different strategies to poorer households (Barrett, 2005) because they have the option of adopting pull-led strategies that generate higher returns, as well as funding migrant opportunities, healthcare and education expenses (Barrett et al., 2001; Barrett, 2005; Ardington et al., 2009). Conversely, poorer households have fewer assets to invest in high-return options, higher dependency ratios, lower levels of education and poorer social networks. These households are forced into adopting income-stabilising, low-risk, low-return coping strategies that are less likely to cover expenses and the cost of shocks such as death, disease and drought (Sen, 2003; Elmquist & Olsson, 2006; Krishna, 2006; Liyama et al., 2008; Lay et al., 2008; Mendola, 2008; Wouterse & Pieterse, 2008).

2.4 Household strategy, socio-economic position and dissolution

Household characteristics influence a household's current assets and strategy. A combination of a household's assets and strategy influences its ability to increase its future SEP, thus directly influencing the risk of forced dissolution (Hosegood et al., 2004). Typically, bigger and better educated households (in rural South Africa) are less likely to dissolve because they have more working adults who can secure high-return income opportunities. Conversely, smaller less educated households contain limited working adults that are forced into adopting low-return options (Maitra & Ray, 2003; Klasen & Woolard, 2008). In general, the death of household adults (especially due to HIV/AIDS) increases the risk of dissolution because it increases costs, in addition to reducing income (Hosegood et al., 2004; Hosegood, 2009). In South Africa (and SSA), the HIV/AIDS epidemic, in particular, has significantly increased mortality and destabilised households because the protracted illness is very costly and targets working-aged adults (Schatz & Ogenmefun, 2007). These points suggest that forced household dissolution is more likely to be associated with low SEP (poorer households) because financial security is a key element of the lifespan of a household (Hosegood et al., 2004).

3. Data and methods

3.1 Study area

The AHDSS is situated in the Bushbuckridge area of Mpumalanga, South Africa that borders Mozambique and was demarcated by the University of the Witwatersrand in 1992. According to the most recent census (2012), the AHDSS covers an area in excess of 400 km² that incorporates 25 villages, 13 500 households and a population of some 84 000 people.

The site is largely populated by two distinct groups of Shangaan-speaking people that originated in Mozambique. In this paper, the first group has been classified as South African because they have been settled in South Africa from the time of the colonial or succession wars in Mozambique (1830–90). This initial influx of refugees assimilated themselves into the then predominantly Sotho-speaking South African communities in the site. In 1970, the Shangaan leadership assumed formal control of the area when the South African government established a homeland (Bantustan) in this area as part of their separate development policy. The second group, classified as former refugees, fled more recently from Mozambique as a result of a civil war (1975–92) and were given permission to establish additional villages in the site (Tollman et al., 1999). All 21 villages in the site (2008 census) contained some proportion of former refugee households. Certain former refugee villages were spatially separate from South African villages and contained a majority of former refugee households. Many former refugee households, however, were located in separate areas of predominantly South African villages. The identity of a household, however, is increasingly being determined by its legal status (citizenship), as well as its spatial location rather than the dataset classification (Polzer, 2004; Polzer Ngwato, 2011).

3.2 Data

A full geographic information system exists for the households within the site and this database is updated annually. The data comprised all households in the site during the period 1993–2008. A baseline household census for the AHDSS was conducted in the

same year as the Agincourt site boundaries were demarcated. This dataset system involves the annual updating of household registers to include a record of all vital events (new households, births, deaths, immigrations and outmigrations). Four additional asset counts were also recorded between 2001 and 2008 (2001/2003/2005/2007) that were employed to calculate SEP (Tollman et al., 1999; Kahn et al., 2007).

3.3 Definition of household, dissolution and socio-economic position

A household was registered in the study period if its residence was within the AHDSS and at least one family member was present. One-person households were excluded from the study throughout the time period. Conversely, households that contained more than one member, and reduced to a sole surviving member over time were recorded. The definition of a household incorporated all members who resided together and shared a daily common evening meal, as well as those classified as temporary migrants; namely, household members who spend more than six months away from the household and who retain strong bonds with it.

Forced household dissolution was defined as a situation that occurred when all household members or the last household member either died or permanently out-migrated. Permanent outmigration terminated the membership of a given individual in the household and the household size was reduced by one. A household merely relocating within the site was tracked to its new location (using identity numbers) and was not regarded as a dissolution because this would have overestimated the phenomenon.

SEP was calculated from a weighted composite set of assets⁵ using multiple correspondence analysis (Blasius & Greenacre, 2006; Booysen et al., 2008; Howe et al., 2008). This summed score of SEP was divided into five categories and an unknown category (most poor, very poor, poor, less poor, least poor, unknown). SEP of households was based on their living conditions and assets that included the building materials of the main dwelling, water and energy supply, the ownership of modern appliances and livestock, and their means of transport. These assets were aggregated to construct an SEP quintile index using multiple correspondence analysis. The multiple correspondence analysis quintile index was selected because it requires few assumptions about the underlying distributions of the indicator variables and was more suitable because of the categorical nature of the data. We also calculated a poverty line index to differentiate households that lacked an adequate standard of living that included a radio, bicycle, cement floor, public water and a pit latrine (Booyesen et al., 2008).

The outcome in this study was defined as the time (number of days) contributed by a household until censoring or failure, the day on which the last household member died or permanently outmigrated. The explanatory variables included the household head demographics (age, gender, refugee status–nationality), household deaths and HIV-related deaths,⁶ and a range of household-level factors such as household size, age and

⁵All household assets were counted in 2001, 2003, 2005 and 2007. These assets included the type of household structure, including its construction, access to electricity, water and sanitation. The asset set also included household transport, communication, power, appliances, livestock and equipment.

⁶Data obtained through verbal autopsies conducted on every recorded death in the study site. The verbal autopsy cannot reliably distinguish deaths to HIV and tuberculosis (poor sensitivity and specificity). Therefore, in our analysis, an adult death from HIV or tuberculosis is classified as a death due to 'HIV and AIDS'.

structure (e.g. the number of individuals of pension age). Other explanatory variables included the education status of households, SEP of households, the average residence months per year by the occupants (e.g. resident versus migrant months) and the cause of death of family members.

3.4 Risk factor analysis

A preliminary non-parametric Cox survival analysis was initially conducted to assess the relationship between household dissolution and each covariate. The dependent variable – namely, the time of household duration in days – was split into discrete continuous segments to incorporate any time-varying covariates. Covariates significant at the 10% level (without substantial missing values) were then incorporated into the multivariate model. The assumption of proportional hazards in this model was not upheld in the multivariate model and various parametric survival models were tested in order to provide a model of best fit. Many households are fluid because certain individuals either resided in multiple households or certain households dissolved and reformed within the site with similar individuals (not a true dissolution). We therefore built a cluster variable linking these households and adjusted for this in the univariate and multivariate risk factor analysis so as not to overestimate significance of the predictor variables.

A Bayesian hierarchical geostatistical parametric model, assuming a Weibull distribution for the underlying hazard, was used to examine the multivariate association between the significant covariates and household dissolution. A spatial random effect at the village level was also included to take into account spatial correlation that was modelled using a multivariate Gaussian distribution with a covariance matrix expressed as a parametric function of the distance between pairs of village centroids points (Diggle et al., 1998). Furthermore, a household-level random effect was included to take into account multiple household observations incorporating any time-varying covariates. Markov chain Monte Carlo simulation (Gelfand & Smith, 1990; Smith & Roberts, 1993) was employed to estimate the model parameters.

The use of a Bayesian model was specifically influenced by the following relationships within the data. Objects like households in close proximity are often more alike, and common exposures (measured or unmeasured) may influence household dissolution similarly in households of the same geographical area, introducing spatial correlation in these outcomes. Standard statistical methods assume independence of outcome measures (e.g. mortality data). Ignoring correlation introduces bias in the analysis as the standard error of the covariates are underestimated, thereby overestimating the significance of the risk factors. Geostatistical models relax the assumption of independence (e.g. they assume that spatial correlation is a function of distance between locations). They are highly parameterised models and their full estimation has only become possible in the last decade by formulating them within a Bayesian framework (Diggle et al., 1998) and estimating the parameters via Markov chain Monte Carlo simulation.

3.5 Model assessment

Survival model comparison in Stata was based on the Akaike Information Criterion. We also graphically examined model fit in Stata using Cox–Snell residual plots. The Deviance Information Criterion was used to assess the various multivariate models in

WinBUGS (Spiegelhalter et al., 1999). The smaller the Akaike Information Criterion/Deviance Information Criterion values, the better the fit of the model.

Simulation-based Bayesian kriging (Gelfand et al., 1999) at gridded prediction points within the site was used to produce smoothed maps of household dissolution risk within the whole AHDSS. Baseline Weibull models were used that included no covariates except for a constant and spatial random effect. Model estimates were exponentiated to hazard ratios.

Data extraction and management was performed using Microsoft SQL Server and Stata 12.0 SE. The analysis was carried out in STATA 12.0 SE and WinBUGS. The predictions of the fitted spatial models were mapped in Map Info Professional 9.5.

4. Results

4.1 Descriptive analysis

The dataset contained 20 436 households that included 176 591 individuals with a median household size of seven. Approximately 61.9% ($n = 12\ 608$) of households were male headed whilst the mean age of the household head was 40.3 years. A total 66.8% ($n = 13\ 407$) of households were headed by an individual of South African nationality, with the remainder ($n = 6661$) mostly headed by former refugees (Mozambican). Furthermore, there were 9760 deaths among the households that ranged between zero and seven deaths within one household. During 1992–2006 (for which years the verbal autopsies were currently complete at the time of this analysis) there were 7184 deaths, and approximately 1931 (26.9%) of these were attributed to HIV/AIDS or tuberculosis.⁷

During the period 1992–2008 there were 5878 (28.7%) household dissolutions out of a total of 20 436 households. On average, the household duration was 3432.1 days (median 3249 days), with a minimum of 3 days and a maximum 6774 days reflecting surviving households that were first registered in 1992. A Kaplan–Meier survivor function, moreover, suggests a 25% chance of a household dissolving after 2784 days.

4.2 Variables influencing the risk of household dissolution

The results, illustrated in Table 1, show a range of household variables that influenced the risk of household dissolution (hazard ratio > 1).

The univariate results first demonstrated that the risk of a forced household dissolution was reduced by five ascending levels of SEP, with the least poor category of household having a 96% reduced possibility of dissolving.

This protective effect of higher levels of SEP was illustrated in the Kaplan–Meier graph (Figure 2). The most poor households had less than a 40% chance of surviving > 6000 days (17 years), compared with the 90% or more chance for the least poor households.

Other protective factors included a household size of more than four family members. In fact, households with more than 10 members had a 91% reduced chance of dissolution.

⁷The AHDSS implementing verbal autopsies combine HIV and tuberculosis in high HIV prevalence settings because the verbal autopsy cannot reliably distinguish between the two, thus affecting sensitivity and specificity.

Table 1: Variables influencing household dissolution

Factor	Univariate (Stata)			Multivariable (Bayesian geostatistical model) (WinBUGS)		
	N (% ^a)	HR	95% CI	p value	HR	95% CI
Highest household SEP (MCA quintile)						
Most poor	1 867 (0.48)	1.00			c	
Very poor	2 097 (0.28)	0.38	0.34 to 0.42	<0.001		
Poor	2 404 (0.13)	0.19	0.17 to 0.21	<0.001		
Less poor	3 135 (0.07)	0.09	0.08 to 0.10	<0.001		
Least poor	4 947 (0.03)	0.04	0.03 to 0.04	<0.001		
Unknown	5 986 (0.62)	1.21	1.12 to 1.30	<0.001		
Household head demographics						
Nationality						
South African	13 406 (0.24)	1.00			1.00	
Mozambican	6 661 (0.33)	1.69	1.60 to 1.79	<0.001	1.85	1.70, 2.00
Gender						
Female	7 670 (0.26)	1.00			1.00	
Male	12 397(0.3)	1.12	1.06 to 1.19	<0.001	1.04	0.98, 1.11
Age						
<40 years	11 692 (0.3)	1.00			1.00	
≥40 years	8 657 (0.27)	0.85	0.81 to 0.90	<0.001	1.15	1.07, 1.24
Alive						
	19 105 (0.27)	1.00			1.00	
Died (non to HIV/AIDS)	1 214 (0.53)	1.53	1.40 to 1.67	<0.001	1.63 ^d	1.46, 1.81
Died (HIV/AIDS) ^b	117 (0.98)	4.67	4.07 to 5.38	<0.001		
Household size (continuous)	20 436 (0.29)	0.82	0.81 to 0.82	<0.001	0.83	0.82, 0.83

(Table continued)

Table 1: Continued

Factor	Univariate (Stata)				Multivariable (Bayesian geostatistical model) (WinBUGS)		
	N (% ^a)	HR	95% CI	p value	HR	95% CI	Significance ^a
1 to 4	6 043 (0.47)	1.00					
5 to 9	7 236 (0.29)	0.36	0.33 to 0.38	<0.001			
10+	7 157 (0.13)	0.09	0.08 to 0.10	<0.001			
Number of individuals of pension age (65+) ^b							
No males 65+, females 60+	14 071 (0.31)	1.00			1.00		
At least one male 65+ or female 60+	4 831 (0.24)	0.52	0.49 to 0.55	<0.001	0.65	0.60, 0.71	*
Both male and female 65+	1 534 (0.15)	0.27	0.23 to 0.30	<0.001	0.48	0.41, 0.55	*
Total number of education years achieved by occupants	20 436 (0.29)	0.97	0.97 to 0.97	<0.001	1.29 ^c	1.15, 1.44	*
Household education years categorical							
0 to 25	6 883 (0.55)	1.00					
26 to 87	6 744 (0.27)	0.21	0.20 to 0.23	<0.001			
88+	6 794 (0.04)	0.01	0.01 to 0.02	<0.001			
Skip to generational household	385 (0.65)	4.24	3.82 to 4.72	<0.001	1.46	1.22, 1.73	*
Migration patterns							
Percentage of occupants that permanently migrated out of site							
None	11 673 (0.26)	1.00					
<10	1 236 (0.06)	0.12	0.09 to 0.15	<0.001	6.27 ^f	5.69, 6.95	*
10 to 19	2 054 (0.09)	0.18	0.16 to 0.21	<0.001			
20 to 29	1 466 (0.14)	0.30	0.26 to 0.35	<0.001			
30 to 39	840 (0.21)	0.43	0.37 to 0.50	<0.001			
≥40	3 167 (0.71)	2.45	2.31 to 2.59	<0.001			
Household mortality indicators							
Percentage of household adults (18+) that died	19 881	1.60	1.34 to 1.91	<0.001	g		
Percentage of household adults (18+) that died of HIV/AIDS	19 881	3.43	2.51 to 4.68	<0.001	1.98	1.38, 2.73	*

Household HIV death proportion (tertiles)^b

0 to 16%	8 159 (0.20)	1.00		
17 to 21%	6 645 (0.30)	1.32	1.23 to 1.41	<0.001
22+%	5 632 (0.37)	1.86	1.74 to 1.99	<0.001

Multivariable model parameters

B0	—	—	—	—3.15	—3.55, —2.87	—
Range (m)	—	—	—	6975	1 877, 20 740	—
Shape parameter (ρ)	—	—	—	1.14	1.11, 1.18	—
σ^2 (spatially structured)	—	—	—	0.53	0.25, 1.10	—
σ^2 (household unstructured)	—	—	—	0.39	0.29, 0.56	—

Notes: CI, confidence interval; HR, hazard ratio; MCA, multiple correspondence analysis. ^aPercentage of households in this category that dissolved. ^bBased on data prior to 2007 because verbal autopsies currently complete up to 2006. ^cSEP was not included due to missing data prior to 2001. ^dHousehold death due to any cause included in the multivariable analysis. ^eNo household education used in the multivariable analysis. ^fPercentage of household permanently outmigrated used in the multivariable analysis. ^gNot included in the multivariable analysis as collinear with deaths due to HIV/AIDS.

Figure 2: Predicted household dissolution by household SEP quintile using Kaplan–Meier analysis

The presence of pensioners was also noted as protective, showing a reduction in risk of 73% if a household included both one male and one female of pensionable age. Cumulative education years also showed that households with the highest levels of education in the site had a 99% less chance of a forced household dissolution.

Conversely, the risk of dissolution increased 69% and 53% respectively if the household was headed by a former refugee (Mozambican) or the household head died. Furthermore, the risk of dissolution increased 4.7-fold if the household head died of HIV/AIDS-related causes. Households with a higher percentage of adult deaths, especially adults over the age of 18 years, showed a 60% higher risk of dissolution that increased 3.43-fold if these adults died of HIV/AIDS. Skip-generational households – namely, those households containing only children and elderly individuals – had a 4.24-fold higher probability of dissolution. The number of family members that permanently migrate out of the site also had a significant impact on the risk of dissolution. The results indicated that when more than 40% of household members permanently outmigrated, the risk of dissolution increased 2.5-fold. However, when the proportion of permanent outmigration was under 40%, this had a protective effect.

4.2.1 Multivariate analysis

The results of the multivariate analysis, also presented in Table 1, indicate similar findings for both the classical and the Bayesian approaches. The confidence intervals for the spatial model, however, were larger due to the adjustment for spatial correlation (see Section 3). After multivariate adjustment, the male household head was no longer a statistically significant risk factor for household dissolution. The most prominent risk factor influencing household dissolution was still the percentage of the household that had permanently outmigrated, followed by former refugee-headed households. Other major risk factors were the death of the household head, especially

due to HIV/AIDS, as well as when the proportion of household deaths from HIV/AIDS exceeded the 22% threshold. Skip-generational households and households with no education were also more at risk. Conversely, households with pensioners were less at risk of dissolving, especially if they contained both a male and a female family member.

4.3 Do dissolution, socio-economic position and household characteristics differ across the two groups?

The multivariable model, illustrated by Table 1, indicated that the risk of dissolution was increased by 1.6-fold if the household head was a former refugee ($p < 0.001$). Further analysis, illustrated in Figure 3, indicated that the risk of dissolution for former refugee households was consistently higher than for South African households for the entire period.

The risk of household dissolution, however, was not static and appeared to increase for both sets of households between 1992 and 2003 before dropping steadily between 2004 and 2008. Additional analysis of the data using two-sample *t* tests for each of the four census years (see Section 3), also confirmed a highly significant ($p < 0.001$) difference between the asset wealth (SEP) levels of the two sets of households that was constant for the entire period. There was no difference in the proportion of household head death between the two groups ($p = 0.934$), but former refugee (Mozambican) households indicated a significantly higher overall mortality rate. South African households also demonstrated higher mean education years ($p < 0.001$) than former refugee households, as well as a greater number of temporary migrants ($p < 0.001$). The results, therefore, confirmed that former refugee households had lower levels of SEP, a higher risk of dissolution and significant differences in household characteristics.

4.4 Spatial-temporal risk of household dissolution

The projected spatial odds of dissolution at distinct village loci, illustrated in Figure 4, were mapped for three time periods. Each of the three maps in Figure 4 shows

Figure 3: Comparative household dissolution risk (1992–2008)

1992–97^a (12, 17 to 20, former refugee villages; 13, South African village)

1998–2003^a (17, 19, 20, former refugee villages; 15, ~40% former refugee village)

2004–08^a (21, RDP village – South African; 20, former refugee village)

Figure 4: Spatial risk of household dissolution (1992–2008) in the AHDSS.
Note: ^aHigh risk of dissolution indicated by village number 21 (RDP – Rural Development Program)

high-risk villages. The first spatial map indicated a high risk of dissolution for a cluster of former refugee villages in the south-east sector (Villages 12, 17, 19 and 20) for the period 1992–97. If these households relocated in the site, this was not recorded as a dissolution,

and evidence exists to suggest that a number of former refugee households moved from poorer areas in the site to more affluent areas (Polzer Ngwato, 2011). This (very) high-risk area (hazard ratios > 1.50) became smaller by 2003 to include only two of these villages (Villages 19 and 20). Conversely, a majority of South African villages (Villages 1 to 11, 13, 14, 16 and 21) demonstrated lower levels of dissolution throughout the study period. Even those South African villages in close proximity to the former refugee villages in the south-east sector (Villages 5, 8, 11 and 15) demonstrated lower levels of dissolution, except for Village 15, in a single period (1998–2003).

Village 21, a low-cost housing project only for poorer South African residents and containing a highly mobile population, also demonstrated a very high risk of dissolution in the period 2004–08. The level of absolute poverty by village, illustrated in Table 2, show some relationships with the spatial pattern of household dissolution. The absolute poverty levels indicated that the former refugee villages situated in the south-east sector (Villages 12, 17 to 20) all had absolute poverty levels of above 50% in 2001 and 2003. In 2001 all of these villages (except Village 18) had a very high risk of dissolution. However, this high-risk area became smaller in 2003 (Villages 19 and 20) despite the fact that all of these villages retained the same absolute poverty levels. In 2007 only two former refugee villages (Villages 18 and 19) had absolute poverty levels above 75%; however, the risk of dissolution was lower to moderate for the entire south-east sector.

Table 2: Village demographics showing the absolute poverty line by village

Village	Number of households ^a	Mozambican (%) ^a	2001 (%)	2003 (%)	2005 (%)	2007 (%)
1	1 347	16.3	33.9	32.7	25.1	17.6
2	605	20.0	35.8	29.2	21.1	21.7
3	1 172	15.9	40.4	28.8	27.3	17.7
4	684	8.9	38.3	25.7	26.4	17.8
5	622	28.0	31.5	37.2	31.2	21.3
6	723	25.3	30.7	32.4	22.9	23.6
7	438	40.2	42.5	39.8	32.0	28.0
8	1 138	47.7	28.8	31.0	31.6	25.3
9	933	12.0	28.4	23.7	21.2	17.6
10	896	48.5	30.5	27.8	27.2	17.9
11	1 253	31.5	21.7	25.9	15.5	15.0
12	463	77.1	57.2	60.7	32.0	25.1
13	658	10.9	33.8	30.3	23.0	19.4
14	404	4.0	42.9	35.5	27.2	21.4
15	608	38.8	39.3	52.1	33.4	21.7
16	857	5.5	38.4	35.7	30.2	25.7
17	468	97.6	65.0	68.7	41.8	37.7
18	242	95.0	88.6	80.0	82.9	81.4
19	262	96.6	55.2	66.0	74.1	76.4
20	218	81.7	56.0	63.3	50.4	35.7
21	703	7.3	74.6	52.1	39.4	28.9

Note: ^aBased on estimates for 2001–07.

5. Discussion

Three primary questions were tested that included investigating whether SEP and other covariates influenced a forced household dissolution, whether there were differences in household characteristics between the South African and former refugee households, and whether there was a spatial pattern to the risk of dissolution in the site. The question remains, however, as to exactly how household characteristics influence dissolution as a result of their inter-related nature with SEP.

5.1 Household characteristics, socio-economic position and forced household dissolution

The results confirmed a range of variables that influenced household dissolution. In many instances, these variables had a close relationship with a change in household SEP and the number of working adults. Household shocks, for instance, increase the risk of dissolution because they trigger an outflow of assets. Adult deaths, particularly due to HIV/AIDS, raise household costs at the same time because there is a loss of productivity and income (Sartorius et al., 2013). This initial asset outflow acts as the primary destabilising force, especially for the poorer households like those of the former refugees. These households are therefore initially squeezed by a combination of an SEP outflow and a smaller number of working adults. In order to cope with an adult death, poorer households are forced to adopt survival strategies such as removing their children from school to care for the sick or perform household chores (Bennell, 2005). This strategy, however, perpetuates low levels of education that limit future options and compromise healthcare practices (Urassa et al., 2001; Schatz & Ogenmefun, 2007).

The results further illustrated the importance of sufficient working adults by demonstrating that the permanent outmigration of adults not only reduced household size but was also associated with an increased risk of dissolution (Wittenberg & Collinson, 2007; Collinson, 2010). The dynamics of dissolution, however, indicate that the initial permanent outmigration of household members (<40%) is beneficial because the risk of dissolution drops. This positive outcome may be due to the fact that the first to leave are often unemployed dependents. Thereafter, higher levels of outmigration signal more limited strategic options that force the affected household into adopting push-led (low-income) survival strategies that increase the risk of dissolution (Bryceson, 2002a, 2002b; Schatz & Ogenmefun, 2007; Goudge et al., 2009a, 2009b).

The increased vulnerability of skip-generational households was also strongly linked to the absence of working-adult household members because of death or permanent outmigration. Adult deaths (especially HIV/AIDS related) and the permanent outmigration of working adults have promoted the emergence of skip-generational households in rural South Africa. These households are more likely to be poorer (Sartorius et al., 2011) and the results indicated a significant increase in the risk of dissolution. Skip-generational households that are headed by children are the most vulnerable and the presence of the elderly has a protective effect, especially if these household members receive a state grant (Schatz & Ogenmefun, 2007; Hosegood, 2009; Schatz, 2009).

The results indicated that greater wealth (SEP) reduces the risk of a forced household dissolution. The risk of dissolution was reduced because wealthier households can select high-return (pull-led) strategies (Giannecchini et al., 2007) as a result of being

better educated, as well as being able to afford considerable barriers of entry such as education, travel and set-up expenses. These opportunities, in turn, translated into more substantial remittances, as well as new knowledge and skills imported into the household strategy (Barrett, 2005; Liyama et al., 2008; Wouterse & Pieterse, 2008; Ardington et al., 2009). The results showed that SEP appears to have an important role in household dissolution, as well as being inter-related with other household characteristics like adult deaths, education, permanent outmigration and skipped generational households. In many instances, these household variables appeared to influence SEP because they influenced the number of working adults in a household. The results, in turn, suggested that households with more working adults have a significantly reduced risk of dissolution.

5.2 The space–time nature of forced dissolution and socio-economic position

The results indicated that there was a spatial element to the risk of dissolution, as well as poverty at a village level. Former refugee villages, in particular, displayed higher absolute poverty levels (Table 2) for the full period, as well as an overall higher risk of household dissolution (Figure 4) in 2008. These villages (Villages 12, 17 to 20) were mostly clustered in the drier south-east sector of the site, except Village 18 that borders a national park with Mozambique. Not surprisingly, the former refugee villages also demonstrated significantly higher levels of mortality (Wittenberg & Collinson, 2007; Collinson, 2010). On their arrival, the former refugees were allocated land in the more marginal areas to the south-east. The drier conditions in these marginal areas are more suited to cattle and goats and there is little potential for intensive agriculture. Furthermore, these villages are established further away from shopping centres, health facility infrastructure and services. Conversely, wealthier South African villages, located further to the west and north, enjoyed better natural resources, rainfall and access to infrastructure, facilities and services (Collinson, 2010). These villages also had a (relatively) lower risk of household dissolution in all three periods. Certain South African villages that were also located in the drier south-east sector (Villages 7, 8 and 11), however, had low absolute poverty levels, as well as a low risk of dissolution to indicate that spatial location alone could not explain the comparatively disadvantaged status of neighbouring former refugee villages. Former refugee households continued to be compromised nearly 20 years after their arrival by a reduced access to assets, legal status, state grants, employment, facilities and social networks (Hargreaves et al., 2004; Hunter et al., 2007; Polzer, 2007; Twine et al., 2007; Howe et al., 2008; Schatz, 2009).

6. Conclusion and recommendations

The paper creates a better understanding of household stability in a rural South African community using forced household dissolution as a proxy for stability. The results indicated that SEP and a range of other household characteristics were significantly associated with the risk of forced dissolution. The results also demonstrated that former refugee household characteristics and stability were different to those of their host community and that former refugees still lived in poorer villages in the south-east sector of the site.

Rural development programmes are unlikely to succeed unless more vulnerable households, like those of the former refugees, are targeted as an initial step to stabilise

these households. In particular, the paper demonstrated how Bayesian spatial kriging can be used to accurately map the risk of dissolution in a rural community as a precursor to any development initiative. These households can initially be geographically targeted and stabilised by short-term interventions such as the provision of basic services and feeding schemes. Longer term interventions are then required to ensure the provision of legal status and access to facilities for former refugee households as precursors to the introduction of any rural development initiative.

The recent prioritisation of rural development in South Africa is a welcome state-led intervention. However, the results suggest that the success of these programmes will require policy configuration across a number of government departments to stabilise more vulnerable households if they are to participate. Multiple household characteristics, like education and mortality, must be addressed in parallel in order to ensure the success of rural development programmes. The success of the recent anti-retroviral therapy rollout in South Africa is encouraging but must be matched by the improvement of rural education, the provision of infrastructure and a wide range of local services, suggesting the need for inter-disciplinary policy across multiple government departments.

Finally, a limitation of this study is that we have only investigated forced household dissolution. We acknowledge that dissolution can also be triggered by positive factors like marriage and pull-led opportunities. As indicated earlier in this paper, there is some evidence to suggest that more mobile former refugee households in the site have relocated to South African villages in the site and that the dataset may not have tracked the relocation (Wittenberg & Collinson, 2008; Polzer Ngwato, 2011). Our results, however, do demonstrate that an overwhelming majority of dissolution in the site was attributed to poorer households.

Further research is required to see whether the dynamics of household dissolution (as we explain them) can be more generalised across South Africa and SSA. An increasing availability of data in SSA combined with advanced geo-spatial analysis can be used to further investigate household stability and develop policy that is more (locally) acute, as well as integrated across multiple departments.

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References

- Anriquez, G & Valdes, A, 2006. Determinants of farm revenue in Pakistan. *Pakistan Development Review* 45(2), 281–301.
- Arington, C, Case, A & Hosegood, V, 2009. Labour supply responses to large social transfers: Longitudinal evidence from South Africa. *American Journal of Applied Economics* 1(1), 22–48.
- Banjo, A, 2009. A review of poverty studies, drivers and regressive strategies in Southern Africa. *Journal of Sustainable Development in Africa* 10(4), 1–21.
- Barrett, CB, 2005. Rural poverty dynamics: Development policy implications. *Agricultural Economics* 32, 45–60.

- Barrett, CB, Lee, DR & McPeak, JG, 2005. Institutional arrangements for rural poverty reduction and resource conservation. *World Development* 33(2), 193–7.
- Barrett, CB, Reardon, T & Webb, P, 2001. Non-farm income diversification and household livelihood strategies in rural Africa: Concepts, dynamics and policy implications. *Food Policy* 26(4), 315–31.
- Bennell, P, 2005. The Impact of the AIDS epidemic on the schooling of orphans and other directly affected children in sub-Saharan Africa: Preview. *Journal of Development Studies* 41(3), 467–88.
- Blasius, J & Greenacre, M (Eds), 2006. *Correspondence Analysis and Related Methods in Practice*. Chapman & Hall, London.
- Booyesen, F, Van Der Berg, S, Burger, R, Von Maltitz, M & Du Rand, G, 2008. Using an asset index to assess trends in poverty in seven Sub-Saharan African countries. *World Development* 36(6), 1113–30.
- Bryceson, DF, 2002a. Multiplex of livelihoods in rural Africa: Recasting the terms and conditions of gainful employment. *Journal of Modern African Economics* 40(1), 1–28.
- Bryceson, DF, 2002b. The scramble in Africa: Re-orientating rural livelihoods. *World Development* 30(5), 725–39.
- Bryceson, DF, 2004. Agrarian vista or vortex: African rural livelihood policies. *Review of African Political Economy* 31(102), 617–29.
- Chambers, R, 2006. Vulnerability, coping and policy. *IDS Bulletin* 37(4), 33–40.
- Collins, RO & Burns, JM, 2007. *A History of Sub-Saharan Africa*. Cambridge University Press, Cambridge, UK.
- Collinson, M, 2010. Striving against adversity: The dynamics of migration, health and poverty in rural South Africa. *Global Health Action*. DOI: 10.3402/gha.v3i10.5080
- Diggle, P, Moyeed, R & Tawn, J, 1998. Model-based geostatistics: Methods and applications in spatial epidemiology. *Applied Statistics* 48, 299–350.
- Elmqvist, B & Olsson, L, 2006. Livelihood diversification: Continuity and change in the Sahel. *GeoJournal* 67, 167–80.
- Gelfand, A & Smith, A, 1990. Sampling-based approaches to calculating marginal densities. *Journal of the American Statistical Association* 85, 398–409.
- Gelfand, A, Ravishanker, N & Ecker, M (Eds), 1999. *Modelling and inference for point-referenced binary spatial data*. Marcel Dekker, New York.
- Giannecchini, M, Twine, W & Vogel, C, 2007. Land-cover change and human environment interactions in a rural cultural landscape in South Africa *The Geographical Journal* 173(1), 26–42.
- Goudge, J, Gilson, L, Russell, S, Gumede, T & Mills, A, 2009a. The household costs of health care in rural South Africa with free primary care and hospital exemptions for the poor. *Tropical Medicine and International Health* 14(4), 458–67.
- Goudge, J, Russell, S, Gilson, L, Molyneux, C & Hanson, K, 2009b. Household experiences of ill health and risk protection mechanisms *Journal of International Development* 21(2), 159–68.
- Hargreaves, J, Collinson, M, Kahn, K, Clark, SJ & Tollman, S, 2004. Childhood mortality among former Mozambican refugees and their hosts in rural South Africa. *International Journal of Epidemiology* 33, 1271–8.
- Hosegood, V, 2009. The developing impact of HIV/AIDS across family household lifecycle implications for efforts to strengthen families in sub-Saharan Africa. *Aids Care* 21(1), 13–21.
- Hosegood, V, McGrath, N, Herbst, K, & Timaeus, IM, 2004. The impact of adult mortality on household dissolution and migration in rural South Africa. *AIDS* 18(11), 1585–90.
- Howe, L, Hargreaves, J & Huttly, S, 2008. Issues in the construction of wealth indices for the measurement of socio-economic position in low-income countries. *Emerging Themes in Epidemiology* 5(3). DOI:10.1186/1742-7822-5-3
- Hunter, L, Twine, W & Patterson, L, 2007. Locusts are now our beef: Adult mortality and household dietary use of local environmental resources in rural South Africa *Scandinavian Journal of Public Health* 35, 165–74.

- Liyama, M, Kariuki, P, Kristjansen, P, Kaitibie, S & Maitima, J, 2008. Livelihood diversification strategies and soil management strategies: A case study from Kerio Valley, Kenya. *Journal of International Development* 20, 380–97.
- Kahn, K, Tollman, S, Collinson, M, Clark, S, Twine, R, Clark, B. D, Gómez-Olive, F, Shabangu, M, Mokoena, O & Garenne, M, 2007. Research into health, population and social transitions in rural South Africa: Data and methods of the Agincourt Health and Demographic Surveillance System *Scandinavian Journal of Public Health* 35, 8–20.
- Kessides, C, 2005. The urban transition in Sub-Saharan Africa: Implications for economic growth and poverty deduction. World Bank Africa Region, Washington, DC.
- Klasen, S & Woolard, I, 2008. Surviving unemployment without state support: Unemployment and household formation in South Africa. *Journal of African Economies* 18(1), 1–51.
- Krishna, A, 2006. Pathways out of and into poverty in 36 villages of Andhra Pradesh, India. *World Development* 34(2), 271–88.
- Landau, L, 2006. Protection and dignity in Johannesburg: Shortcomings of South African urban refugee policy. *Journal of Refugee Studies* 19(3), 308–27.
- Lay, J, Mahmoud, T & M'Mukaria, G, 2008. Few opportunities, much desperation: The dichotomy of non-agricultural activities and inequality in Western Kenya. *World Development* 36(12), 2713–32.
- Maitra, P & Ray, R, 2003. The effect of transfers on household expenditure patterns and poverty in South Africa. *Journal of Developing Economics* 71(1), 23–49.
- Malmberg, B & Tegenu, T, 2007. Population pressure and dynamics of household livelihoods in an Ethiopian Village: An elaboration of the Boserup–Chayanovian framework. *Population Environment* 29, 39–67.
- McIntyre, D, Thiede, M, Dahlgren, G & Whitehead, M, 2005. What are the economic consequences for households of illness and of paying for healthcare in low and middle income country contexts? *Social Science and Medicine* 62(4), 858–65.
- Mendola, M, 2008. Migration and technological change in rural households: Complements or substitutes? *Journal of Development Economics* 8, 150–75.
- Mertz, O, Wadley, R & Christensen, A, 2005. Local land use strategies in a globalizing world: Subsistence farming, cash crops and income diversification. *Agricultural Systems* 85(3), 209–15.
- O'Brien, K, Quinlan, T & Ziervogel, G, 2009. Vulnerability interventions in the context of multiple stressors: Lessons from the Southern African Vulnerability Initiative (SAVI). *Environmental Impact and Policy* 12, 23–32.
- Polzer, T, 2004. We are all South Africans now: The integration of Mozambican refugees in rural South Africa. Forced Migration Studies Programme, University of the Witwatersrand.
- Polzer, T, 2007. Adapting to changing legal frameworks: Mozambican refugees in South Africa. *International Journal of Refugee Law* 19(1), 22–50.
- Polzer Ngwato, T, 2011. Together apart: Migration, integration and spatialised identities in South African border villages. *Geoforum* 43(3), 561–72.
- Rodgers, G, 2008. Everyday life and the political economy of displacement on the Mozambique–South Africa borderland. *Journal of Contemporary African Studies* 26(4), 385–99.
- Sartorius, K, Sartorius, B, Tollman, S, Schatz, E, Kirsten, J & Collinson, M, 2011. Rural poverty dynamics and refugee communities in South Africa: A spatial–temporal model. *Population, Space and Place* 19(1), 103–23.
- Sartorius, B, Kahn, K, Collinson, MA, Sartorius, K & Tollman, SM, 2013. Dying in their prime: Determinants and space-time risk of adult mortality in rural South Africa. *Geospatial Health* 7(2), 237–49.
- Schatz, E, 2009. Reframing vulnerability: Mozambican refugees access to state funded pensions in rural South Africa. *Journal of Cross Cultural Gerontology* 24(3), 241–58.
- Schatz, E & Ogenmefun, C, 2007. Caring and contributing: The role of older women in multi generational households in the HIV/Aids era. *World Development* 35(8), 1390–403.
- Schwarze, S & Zeller, M, 2005. Income diversification of rural households in Central Sulawesi, Indonesia. *Quarterly Journal of International Agriculture* 44(1), 61–73.

- Sen, B, 2003. Drivers of escape and descent: Changing household fortunes in rural Bangladesh. *World Development* 31(3), 513–34.
- Sherbinin, A, Van Wey, W, McSweeney, K, Aggarwal, R, Barbieri, A, Henry, S, Hunter, L, Twine, W & Walker, R, 2008. Rural household demographics, livelihoods and the environment. *Global Environmental Change* 18, 38–53.
- Smith, A & Roberts, G, 1993. Bayesian computation via the Gibbs sampler and related Markov chain Monte Carlo methods. *Journal of the Royal Statistical Society* 55(B), 3–24.
- Spiegelhalter, D, Thomas, A & Best, N, 1999. WinBUGS Version 1.2 User Manual, MRC Biostatistics Unit, Cambridge, UK.
- Stover, J & Bollinger, L, 2006. The economic impact of AIDS. *Politics and Economics of Africa* 6, 1–13.
- Tollman, S, Herbst, K, Garenne, M, Gear, J & Kahn, K, 1999. The Agincourt demographic and health study: Site description, baseline findings and implications. *South African Medical Journal* 89, 858–64.
- Twine, R, Collinson, M & Polzer, T, 2007. Evaluating access to a child-oriented poverty alleviation intervention in rural South Africa. *Scandinavian Journal of Public Health Nutrition* 69, 118–27.
- Urassa, M, Boerma, J, Isingo, R, Ngalula, J, Ng'weshemi, J, Mwaluko, G & Zaba, B, 2001. The impact of HIV/AIDS on mortality and household mobility in rural Tanzania. *AIDS* 15, 2017–23.
- Vermeulen, S, Nawir, A & Mayers, J, 2008. Rural poverty reduction through business partnerships? Examples of experience from the forestry sector. *Environmental Development Sustainability* 10, 1–18.
- Wittenberg, M & Collinson, M, 2007. Household transitions in rural South Africa, 1992–2003. *Scandinavian Journal of Public Health* 35, 130–7.
- Wittenberg, M & Collinson, M, 2008. Restructuring of households in rural South Africa: Reflections on average household size in Agincourt sub-district 1992–2003. University of Cape Town, Cape Town.
- Wouterse, F & Pieterse, J, 2008. Migration and income diversification: Evidence from Burkina Faso. *World Development* 36(4), 625–40.
- Wu, B & Pretty, J, 2004. Social connectedness in marginal rural China: The case of farmer innovation circles in Zhidan, North Shaanxi. *Agriculture and Human Values* 21, 81–92.
- Xiangxing, S, Zhong, Z, Shuguang, H & Chong, S, 2008. A review of the major projects constituting the China Academic Digital Library. *Electronic Library* 26(1), 39–54.