WIDOWS' LAND SECURITY IN THE ERA OF HIV/AIDS: PANEL SURVEY EVIDENCE FROM ZAMBIA

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Abstract: In areas of Africa hard hit by HIV/AIDS, there are growing concerns that many women lose access to land after the death of their husbands. However, there remains a dearth of quantitative evidence on the proportion of widows who lose access to their deceased husbands' land, whether they lose all or part of that land, and whether there are factors specific to the widow, her family, or the broader community that influence her ability to maintain rights to land. This study examines these issues using average treatment effects models with propensity score matching applied to nationally-representative panel data of 5,342 rural households surveyed in 2001 and 2004. Results are highly variable, with roughly a third of households incurring the death of a male household head controlling less than 50 percent of the land they had prior to their husband's death, while over a quarter actually controlled as much or even more land than while their husbands were alive. Widows who were in relatively wealthy households prior to their husband's death lose proportionately more land than widows in households that were relatively poor. Older widows and widows related to the local headman enjoy greater land security. Women in matrilineal inheritance areas were no less likely to lose land than women in patrilineal areas.

Key words: Gender inequality, women, widows, HIV/AIDS, land security, Zambia, Africa

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I. Introduction

Beyond the obvious catastrophic effects of the HIV/AIDS pandemic on mortality, demographic changes, and the suffering of individuals and their families, we are still only learning about the complex longer-term effects of the pandemic on poverty and vulnerability. For example, the HIV/AIDS pandemic has substantially increased the number of widow-headed households in Africa. Many narratives and qualitative studies highlight gender inequalities in property rights and the difficulties that widows face in retaining access to land after the death of their husbands. HIV/AIDS has undoubtedly exacerbated such problems. However, to date, there is virtually no quantitative evidence on the proportion of widows who lose their land after the death of their husbands, whether they lose all or part of that land, and whether certain characteristics of the widow, her deceased husband, and/or her household influence the likelihood of her losing land rights. Because the number of widows is growing rapidly in areas hard hit by HIV/AIDS, there is an urgent need to understand the magnitude of the problem and the degree to which it is exacerbating rural poverty.[1]

Such information may have important implications for poverty alleviation programs. If widow-headed households constitute a relatively large group whose ability to retain land is imperiled, then this would suggest the need for much greater attention to gender issues underlying local institutions and property rights as part of comprehensive poverty reduction programs.

This study uses nationally-representative panel data of 5,342 rural households in Zambia, surveyed in 2001 and 2004, to measure changes in landholding size among households experiencing the death of the male head of household between the two surveys. We estimate matched double-difference average treatment effects models using households not experiencing any prime-age (15-59 year aged) mortality during the survey interval as the control group. The longitudinal data used in the study is particularly well suited to understand the factors associated with changes in widow-headed households' conditions, first because of its nationally-representative nature and also because the surveys include a rich set of information on individual kinship ties, the length of settlement of the household in the village, and other retrospective information not commonly collected in economic surveys. This social information provides an ability to examine whether changes in landholding size over time differ by initial household characteristics, attributes of the widow, social capital, and community characteristics such as matrilineal versus patrilineal inheritance institutions.

The remainder of the paper is organized as follows. Section II briefly describes land inheritance patterns in Zambia and perceptions of pressures for change. This is followed by a brief discussion of the conceptual framework and hypotheses to be tested in section III. The data, sample attrition issues, and estimation methods are discussed in section IV. Section V presents estimation results and their interpretation. Finally, section VI discusses the conclusions and implications for donor and government policy.

II. Land Inheritance Patterns in Zambia

Access to land is an important indicator of welfare among rural farm households (Jayne et al. 2003). It is an especially critical source of livelihood for women. In Southern Africa, women make up about 70 percent of the food production and processing workforce (UNECA 2003). But in Zambia, as in almost all of Sub-Saharan Africa, women rarely own or have control over land (Chuulu 1997; Shezongo-Macmillan 2005; UNECA 2003).

Two land tenure systems exist in Zambia: the customary system and the statutory system. Under the customary system, traditional authorities such as the chief and/or village headman allocate vacant land to families and individuals. Under the statutory system, individual land owners have title deeds to their land and can sell, rent, mortgage or transfer that land (Republic of Zambia 2005). According to the Zambian Ministry of Lands (2002), 94 percent of the land area in the country is controlled by the customary system whilst 6 percent is controlled by the statutory system (Machina 2002).

Under customary law, a wife cannot inherit land or other property from her husband and tribal authorities rarely allocate land directly to women (Mutangadura 2004). Although in principle Zambian women can request land under both the statutory and customary systems, in reality women are disadvantaged in terms of access to, as well as ownership and control over, land (Machina 2002). Land and other property and productive assets are normally inherited by the deceased man's male family members (Chuulu 1997; Armstrong 1992; Milimo 1990). "Family" in a patrilineal (matrilineal) society is defined by the blood line of the father (mother) to his (her) male children. Women entering the family through marriage acquire use rights to land through their husbands.

Focus group discussions of men from the region indicate a perception that they do not feel that the land is individually "theirs" (Opiyo 2001; see also Shezongo-Macmillan 2005). It is the family's land and that of the ancestors of the family. If a man arranges to transfer his family's ancestral land out of the family to someone outside the family bloodline (e.g., to his wife), this would be a taboo, and he invites retribution by the ancestors (Opiyo 2001). These traditions and perceptions introduce psychological, religious, and social constraints on transferring land to women.

Under statutory law, women have the right to own land but titles tend to be passed through male relatives in both matrilineal and patrilineal systems (Republic of Zambia 2005). Socio-economic and cultural factors such as illiteracy, the high cost of land, lack of capital, and patriarchal attitudes among men and civil servants prevent women from applying to lease or own land (UNECA 2003; Keller 2000; Republic of Zambia 2005).

Historically, customary law safeguarded women's access to land albeit with limited rights of control over it. Access was always only through a male relative, normally the husband, father, brother, and/or uncle (Shezongo-Macmillan 2005). However, these safeguards may be at risk due to reports of increased property grabbing (von Struensee 2004). For example, Kajoba (2002), in a study undertaken in a village community in Zambia's Chibombo District, found that women complained that they lost their land after their husbands' death and in some cases they were told to vacate the village and go back to their natal homes. Furthermore, according to Article 23 of the Republican Constitution of 1991, amended in 1996, discrimination on the basis of sex is forbidden by law; however, the Constitution explicitly excludes from this provision customary laws related to property inheritance (Keller 2000). Thus, women's access to and security to land is greatly limited despite the Intestate Succession Act (1989), which allows the surviving spouse to inherit 20 percent of the deceased's estate and, together with the children, the house (Milimo 1990). Recent changes to land policy in Zambia attempt to address the gender imbalance in land ownership. Specifically, the Ministry of Land now "requires that at least 30% of the plots which have been created be allocated to women" and also allows women to compete with men for the remaining 70% of allocated plots (Republic of Zambia 2006). Civil society groups consulted about the new land policy insist that the 30% allocation, even if actually implemented, is still too little to fully satisfy the demand for land by women (Zambia Land Alliance 2005).

Despite these recent policy changes, cultural norms and practices among most matrilineal and patrilineal ethnic groups tend to reinforce the lack of women's direct access to, control over, and ownership of land in Zambia, likely because most rural marriages in Zambia follow virilocal/patrilocal residence patterns (Republic of Zambia 2005; Milimo 1990; Mutangadura 2004;

UNECA 2003). In patrilocal marriages, the wife settles in the husband's village. In such marriages, when the woman's husband dies or the marriage ends in divorce, the woman may lose access to the land in her husband's village, which would compel her to return to her natal village (Milimo 1990; Machina 2002; Mutangadura 2004). However, she may have lost access to land in her natal village if she lived away in her husband's village for an extended period (Milimo 1990). In matrilineal systems with matrilocal marriages, meaning the husband settles in the wife's village, women are perceived to have generally more secure land rights (Republic of Zambia 2005). According to Machina (2002) for example, if the woman's husband dies or the couple divorces, the widow is entitled to retain as much of the land as she desires.

There is great concern about widows' land tenure insecurity in Zambia, particularly when the husband's death is attributed to HIV/AIDS. This is reflected in the comments and recommendations of civil society in response to the Draft Land Policy (Zambia Land Alliance 2005) as well as in the popular press in headlines such as "HIV/AIDS impact subjects women to property grabbing" and in comments by the Zambian Minister of Gender in Development (Times of Zambia 2007). Thus, the current analysis is relevant not only to policy makers and donors but also to civil society and the Zambian public in general.

III. Conceptual framework and hypotheses

Drawing from the vast qualitative literature on land inheritance and gender relations, we develop a conceptual framework to formulate hypotheses to be tested in this study. At the core of this framework is the widow, whose access to land after the death of her husband is determined by a range of cultural and legal inheritance norms, socio-economic factors, and social capital factors, the nature of which will vary from setting to setting (Walker 2002; Human Rights Watch 2003). We posit that the amount of land a widow is able to retain after the death of her husband is related to characteristics of the widow herself and her relationships with the husband's family and local authorities (loosely tied to *social capital* factors), socio-economic characteristics of the household, and the inheritance norms of the household and village.

Social capital factors: A growing literature suggests that a household's stock of social capital is a key factor in determining their access to land and other resources (Fafchamps 1992; Platteau 1994; de Marrule 1998; Gabre-Madhin 2001; Robison, Myers, and Siles 1999). Indeed, empirical evidence from Zambia indicates that the number of years a household has settled in an area and blood relations between the household head or spouse and the village headman (proxies for social capital) positively affect landholding size (Jayne et al. 2008). Social capital factors would become relevant variables in this analysis if a widow's relationships with the husband's family and/or with other influential people in the village could affect her ability to retain land after the death of her husband. Important social capital variables in this respect could include the duration of the marriage, the widow's level of education (which could be correlated with motivation, ingenuity, and other traits influencing her ability to retain land), the relationship of the widow to the village authorities, and possibly the relationship of the deceased husband's family to these authorities.

Socio-economic factors affecting women's security of tenure may include the wealth of the family before the death of the husband, and the number of resident adults and children at the homestead. The more assets and wealth that the household possessed prior to the death of the husband, the greater the potential for subsequent loss of assets, including land, after the husband's death. The husband's relatives may more aggressively claim assets when there are many assets capable of being claimed. The effect of household size is ambiguous. The widow could possibly be protected from loss of land if many other adults and children live and depend on that land beside the widow. It is conceivable that widows having more children to feed are more protected against opportunistic behavior of others (von Struensee, 2004). On the other hand, more resident adults brings the risk that one or more of them could seek to alienate some or all of the homestead's land from the widow.

Cultural and inheritance norms: These include laws and traditions that, in effect, deny women the ability to own and inherit land in both matrilineal and patrilineal societies. However, it is possible that matrilineal societies provide greater security of access to land by widows because it is their blood relatives, rather than the family of the deceased husband, who decide how land is allocated after the death of the husband (Mazhangara, 2003). Matrilineal societies are almost all matrilocal as well, i.e., upon marriage, the husband moves to the wife's homestead, which may also provide greater protection to the wife against eviction in the event that the husband dies (Fox, 1967).

The foregoing discussion suggests several testable hypotheses that are used to guide model specification:

<u>*Hypothesis 1:*</u> The death of any adult member would adversely affect the afflicted household's ability to cultivate their land and hence such households could lose access to land compared to non-

afflicted households (Yamano and Jayne 2004; Beegle 2005).[2] However, because of anecdotal evidence of land grabbing from widows, the magnitude of the loss of land is expected to be greater among households losing a male household head compared to other afflicted households.

Hypothesis 2: Widows with more grown children and other adults remaining in the households after the death of the male head are likely to retain more land than widows with fewer adult children and other adult household members. Widows with many children may have a more secure informal property right over the land than a widow with few or no children (Milimo 1990). Other things equal, the larger the own family labor supply, the more land could be productively farmed and the greater the household's food consumption requirements (Kajoba 2002); both of these factors provide a greater rationale for allowing the widow to keep the land and blunt attempts by others to encroach on this land.

Hypothesis 3: The greater the wealth and land assets of the household prior to the death of the male head, the greater the potential loss of land after the death of the male head. Wealthier widow-headed households are more attractive targets for property grabbing (since they own more property) than are poorer households (Izumi 2006).

Hypothesis 4: We test the social capital-related hypothesis that the number of years that the household has existed in the locality improves the ability of widows to retain their land after the death of their husbands. We also hypothesize that the widow's relationship to the headman (as well as the deceased male head's) may be particularly important in influencing her access to land and protection following the death of her husband.

Hypothesis 5: Older widows are better able to retain access to land than younger widows. This is for two reasons. First, younger women may be expected to remarry and gain access to land through their new husband, and so extended family members may feel less conflicted about reclaiming part or all of the family land from the widow. Village authorities are likely to be less sympathetic to the pleas of a young widow if they believe she can acquire land through remarriage. Second, an older widow is likely to have accumulated more social capital with her extended family members by virtue of her age, which would in turn give her greater protection against loss of land.

Hypothesis 6: The educational attainment of the widow is positively related to her access to land following the death of her husband. More educated widows are likely to be more informed of their rights and more persuasive than less educated widows and are thus able to more effectively negotiate to retain access to land.

Hypothesis 7: Finally, land inheritance institutions in the village may influence widows' security over land. *A priori,* we would expect that widows living in matrilineal villages are better protected against loss of land, since the potential heirs to the estate of the deceased husband are normally the male relatives of the widow.

IV. Data and Methods

The study's findings are based on nationally representative longitudinal survey data on 5,342 rural households in 394 standard enumeration areas (SEAs)[3] in Zambia surveyed in May 2001 and May 2004. The survey was carried out by the Central Statistical Office (CSO) in conjunction with the Ministry of Agriculture and Cooperatives (MACO) and Michigan State University. The surveys covered the 1999/00 and 2002/03 crop years, and collected information on households' cropping patterns, landholdings, other assets, crop and livestock production, as well as retrospective and current socio-demographic information on all resident household members. For more details about survey design and sampling procedures see Megill (2004).

A. Sample Size and Attrition

Of the 6,845 households interviewed in 2001, 5,342 were successfully re-interviewed in May 2004 (78.0 percent of the original sample). Enumerators revisiting these households asked for the whereabouts of the members included in the demographic roster of the initial 2001 survey, and recorded cases of death and illness, departure, and new arrival of individual members. If we exclude attrition resulting from several SEAs included in the 2001 survey not being re-visited in 2004 due to inaccessibility or forced government resettlement, the re-interview rate rises to 88.9 percent. And if attrition caused by adult household members being away from home during the enumeration period and those refusing to be interviewed is excluded, the re-interview rate rises to 94.7 percent.

Table 1 presents basic information on the households surveyed, re-interview rates, and the prevalence of disease-related mortality by gender and position in the household over the 2001-2004 period. Of the 5,342 households successfully re-interviewed, 565 households had at least one prime-age death over the three-year period, of which 542 were "disease-related" according to respondents, as opposed to accidents or homicides (n=23). Six households had deaths due to both causes. Of the 542 households experiencing disease-related prime-age mortality between the 2001 and 2004 surveys, 91 households experienced a male head-of-household death in which the wife was a resident member during the initial survey. To ensure that we are tracking the same households between the two surveys, we used the demographic information enumerated in 2001 and 2004 to match the name, age and education of the wife (now widow) in the household.

[Table 1]

Table 2 presents the relationship between household attrition, dissolution, and household size in 2001. The findings show that the percentage of households "attriting" is inversely related to household size (column C). While 8.5 percent of the households sampled in 2001 contained either one or two members, these households accounted for over 12 percent of the cases of attrition and 19 percent of the cases of household dissolution.[4] In contrast, about 65 percent of the 2001 sample contained households with 5 or more members and among these households only 47 percent of attrition due to dissolution is observed. In addition, the results show that dissolution was a more important cause of household attrition among smaller households than among larger households. By contrast, larger households were more likely to incur a prime-age adult death. This is because the probability that a household will incur a prime-age adult death is positively correlated with the number of adult members in the household.

[Table 2]

Potential bias caused by sample attrition is a major concern in longitudinal survey analysis. Systematic differences between attritors and non-attritors, coupled with a high attrition rate, may cause concern about inference with these data. To deal with potential attrition bias, we use the inverse probability weighting (IPW) method (see Robins et al. 1995; Fitzgerald et al. 1998; Wooldridge 2002). The re-interview model is specified as:

$$\text{Prob}(R_{it} = 1) = f(HIV_{t-j}, X_{i,2000}, E_{it}) \qquad (1)$$

where R_{it} is one if household i is re-interviewed at time t, conditional on being interviewed in the previous survey, and zero otherwise; HIV_{t-j} is the district HIV-prevalence rate at the nearest surveillance site in 1995; $X_{i,2000}$ is a set of household characteristics in 2000 from the initial survey, including landholding size, productive assets, demographic characteristics (number of children ages 5 and under, number of prime-age males and females), and ownership of various assets, and E_{it} is a set of 59 enumeration team dummy variables. Enumerator team variables are included in the re-interview model because each enumeration team was headed by a supervisor who was authorized to decide when enumerators would stop trying to contact designated households. Therefore, the likelihood of households being re-interviewed was also dependent on the effort put forth by the enumeration team and its supervisor to make contact or follow up with households who were not at home at the time of interview or had moved to another location within the SEA. All of the variables in (1) are observable even for households that were not re-interviewed in 2004. Equation (1) is estimated with Probit for attrition between the 2001 and 2004 surveys, obtaining predicted probabilities (Pr_{2001}). Then, the inverse probability ($1/Pr_{2001}$) is computed and multiplied by the population weights to obtain a weighting factor applied to the impact models estimated in this paper. The use of IPW to control for possible attrition bias has little effect on the magnitudes of the estimated impact of mortality suggesting that attrition bias is not a major problem.

B. Econometric Model

In order to evaluate the impact of death of the male head of household on land access in Zambia, we adopt treatment effects models commonly used in the program evaluation literature (see Wooldridge 2002; Ravallion 2001, 2003; Cameron and Trivedi 2005). We define the impact as the expected value of the difference between the level of the outcome variable (landholding size) attained by households experiencing male head mortality and that which they would have attained had there been no male head death. The average treatment effect on the treated (ATT) is expressed as follows:

$$ATT = E\left(Y_{ht}^{1} - Y_{ht}^{0} \mid \mathbf{x}, w = 1\right) \qquad (2)$$

where Y_{ht}^{1} is the outcome variable in period t if household h experienced the death of a prime-aged male head of household between the survey years, Y_{ht}^{0} is the outcome variable if household h had not experienced male head mortality, $w_h \in \{0,1\}$ is an indicator variable equal to one if the household experienced male head mortality and zero otherwise, and $\mathbf{x}$ is a vector of covariates.[5]

A common challenge in impact evaluation is that only Y_t^1 or Y_t^0, and not both, is observed for any given household as it is not possible for the same household to be in both the control and treatment group. In our case, the treated/afflicted are households that experienced the mortality of either the male head of household (sub-treatment of interest) or another adult death other than the male head between the survey periods. The control group consists of households not incurring any prime-age mortality. Thus, with $w = 1$ only Y_t^1 is observed and Y_t^0 is missing data, often referred to as the counterfactual. Estimation of the counterfactual constitutes the greatest challenge and a subject for much of the econometric literature on impact evaluation. In a randomized experiment, in which treatment and control households are selected randomly, Y_t^0 can be estimated from control households. Although randomization does not necessarily get rid of selection bias, it balances the bias between the treatment and comparison groups (Baker 2000).

Although several other measures of impact exist under some circumstances,[6] for the most part, equation 2 is the most theoretically appealing and most commonly used (see, for example, Wooldridge 2002; Smith and Sweetman 2001). Equation 2 is further justified by the fact that a treatment (in our case all households experiencing prime-age mortality) is not random and that some individual, household or community characteristics could be systematically influencing both treatment and the outcome variable. Conditioning on a vector of covariates (**x**) is necessary in order to satisfy the assumption of *ignorability of the treatment* (Rosenbaum and Rubin, 1983; Wooldridge 2002; Frolich 2004). Equation 2 is reformulated as follows:

$$ATT = E\left(Y_1^1 - Y_0^1 \mid \mathbf{x}_0, w = 1\right) - E\left(Y_1^0 - Y_0^0 \mid \mathbf{x}_0, w = 1\right) \qquad (3)$$

C. Empirical model

Using the above background on ATT we now specify a model used to examine whether widowed households lose their land after the male household head dies of illness-related causes. We consider the estimation of a panel data model with the amount of land controlled by the household as the dependent variable and two binary variables for prime-age death as explanatory variables: (a) $D_i^W = 1$ for households that incurred the death of a male household head since the 2001 survey and where the wife was resident in 2001, zero otherwise; and (b) $D_i^O = 1$ for households incurring the death of another prime-age adult since the 2001 survey, zero otherwise. (We refer to households in which $D_i^w = 1$ as 'widowed households'.) As mentioned earlier, widowed households are the main focus of this paper but in order to correctly specify the model, a categorical variable identifying households incurring the death of prime-aged adults other than the male head was added as an explanatory variable. The base model is formulated as follows:

$$L_{it} = \gamma_t + t^*D_i^w\alpha + t^*D_i^o\beta + \mu_i + \varepsilon_{it} \qquad i=1,\ldots,N; \quad t=0,\ldots\ldots T \qquad (4)$$

where L_{it} is landholding size in hectares in household *i* at time *t*; the parameter γ_t denotes a time-varying intercept; μ_i captures the household-level fixed effects (assumed constant over time); and ε_{it} is the time-varying error term.

A comparison of the change in landholding size (*L*) over time between the treatment group represented by D_i^w and the control group (households without a prime-age death) provides an estimate of the impact of male head of household death. A statistically significant negative coefficient α would be an indication that households experiencing a male head of household death are losing land, with the magnitude of the coefficient indicating how much. Differencing between time 1 and time 0, equation 4 yields:

$$\Delta L_i = \gamma + D_i^w\alpha + D_i^o\beta + \Delta\varepsilon_i \qquad i=1,\ldots,N \qquad (5)$$

where ΔL_i is the difference in landholding size between the two time periods, D_i^w and D_i^o are the treatment indicators, α and β are the treatment effects, γ is a constant, and $\Delta\varepsilon_i$ is the difference between errors at time 1 and time 0.

Equation (5), a double difference estimator, could be used to evaluate the impact of male head death on access to land. However, rural households are heterogeneous in many ways, some of which may be correlated with widowed households. There is growing evidence of systematic differences between afflicted and non-afflicted households with respect to wealth status, income, education levels, and age group (see Ainsworth and Dayton 2000; Yamano and Jayne 2004; Beegle 2005; Yamano and Jayne 2005). Therefore, to control for these heterogeneous factors, a vector of exogenous household initial covariates in 2000 (X_i) and their interaction with the treatment of interest, D^w, are introduced into equation 5. The estimated treatment effect among households experiencing male head of household death remains α but it is now is unbiased from the effects of heterogeneous initial conditions. The model in equation 4 is extended as follows:

$$L_{it}=\gamma_t + t{*}D_i^w\alpha + t{*}D_i^o\beta + t{*}X_i\varphi + t{*}X_i{*}D_i^w\alpha' + t{*}X_i{*}D_i^o\beta' + \varepsilon_{it} \qquad i=1,\ldots,N \quad t=0,\ldots\ldots T \quad (6)$$

Differencing between time 1 and time 0, equation 6 yields:

$$\Delta L_i=\gamma + D_i^w\alpha + D_i^o\beta + X_i\varphi + X_i{*}D_i^w\alpha' + X_i{*}D_i^o\beta' + \Delta\varepsilon_i \qquad i=1,\ldots,N \qquad (7)$$

Building from equation 7, we partition X_i into two vectors: (1) a vector of household characteristics in 2000 (X^h); and (2) a vector of widow-specific characteristics ($X^{w/h}$). We also add community dummy variables (C) to control for the effects of location-specific omitted variables, a dummy variable for households in a matrilineal village (M=1; =0 otherwise), and the interaction of M and D^w. The following model is estimated:

$$\Delta L_i=\gamma + D_i^w\alpha + D_i^o\beta + X_i^h\varphi + X_i^w\vartheta + M_{ik}\phi + X_i^h{*}D_i^w\varphi' + X_i^{w/h}{*}D_i^w\vartheta' + M_{ik}{*}D_i^w\phi' + X_i^h{*}D_i^o\varphi'' + X_i^{w/h}{*}D_i^0\vartheta'' + M_{ik}{*}D_i^o\phi'' + C_{jk}\eta + \Delta\varepsilon_I \qquad (8)$$

$i= 1,\ldots N \quad k=1,\ldots\ldots K$ where k indexes the village and community variables.

Outcome variables: We have comprehensive information on the area of cultivated land and fallowed land under control of the household in both surveys. However, we only have information on the areas of virgin land (land yet to be cleared for cultivation) and rented land in the 2001 survey (the area of such fields is not available in the 2004 survey). Fortunately, both of these kinds of land make up a very small proportion of mean total household landholding size, with 74.6% of the households having zero virgin land and 99.8% of the sampled households not renting any land in 2000. For consistency, the definition we use for landholding size in this analysis is the sum of land cultivated and fallow land.

Covariates

We need to carefully consider how household labor supply and a set of other variables related to social ties interact with mortality shocks to assess the importance of labor availability versus other factors in influencing changes in cultivated and fallow land. These social capital variables include the widow's and deceased husband's relation to the village headman, the number of years in which the household's clan settled in the area, and whether the village adheres to matrilineal or patrilineal land inheritance rules. We interact these variables with the mortality variables to help us understand whether widows are losing access to land, and if so, what other factors influence the severity of this effect.

Household and widow characteristics: X_i is a vector of initial household conditions in 2000 which are partitioned into a vector of household characteristics in 2000 (X^h) and a vector of widow-specific characteristics in 2000 ($X^{w/h}$). X^h includes household demographic variables (the number of children age 5 and under, children age 6 to 14, males and females age 15 and above), wealth status measured by the value of household assets, two dummy variables for whether the head and the spouse were related to the headman in 2001 (kinship ties), and the number of years the household has been residing in the area. $X^{w/h}$ includes the age and years of schooling of the widow/current household head as reported in the first survey. Years of schooling are included in dummy variable form for primary (one to seven years), and secondary and higher schooling (eight years and above), with the reference group being no formal schooling. These variables were interacted with D^w to capture differential impacts according to the initial characteristics of the household and widow.

Matrilineal inheritance (M): M is a village-level categorical variable for areas of matrilineal inheritance. To examine whether the impacts on land access by widows are different in villages of matrilineal versus patrilineal inheritance, we include an interactions term between D^w and *M*.

Province x time dummies (C): Although the matched double difference estimator presented in this paper controls for unobserved time-invariant characteristics, there may be area-specific time-variant effects that might be correlated with both the treatment and the outcome. To control for such area-specific time-variant effects, *province x time* interaction dummies were added to the estimation models. With the double difference framework and the inclusion of *province x time* dummies, equation (8) is able to control for unobserved effects except time-variant household and individual effects.

D. Models estimated

We estimate two sets of models: a) *non-matched* provincial double-difference fixed effects models of changes in logged land access and b) *matched* provincial double-difference fixed effects models of changes in logged land access. For each set of models (a and b), we estimate three different models to assess the robustness of results. The first model has the death variables as the only covariates. In Model 2, we add widow/current head characteristics, initial household characteristics, kinship ties, years settled in the locality and whether the household is located in a matrilineal village (hereafter referred to as social capital variables). And in Model 3, we add interaction terms between the death variables and the widow/current head characteristics, the initial household characteristics, and the social capital variables.

E. Propensity Score Matching

The double-difference fixed effects estimator of equation 8 is confounded by the possibility that prime-age death variables are endogenous, hence OLS results may be biased. One way to deal with this problem of time-varying unobserved differences is to combine the double-difference with propensity score matching (PSM). The matched double difference estimator, first formalized by Heckman et al. (1997, 1998), involves matching treatment households with comparison households based on the propensity score (estimated from the initial conditions) and then estimating the double difference from the sub-sample exhibiting common support (i.e. treated observation are matched with 'like' counterparts in control group). While there are many matching regimes, we adopt kernel matching which tends to perform better especially when standard errors have to be bootstrapped.[8]

The double difference and propensity score matching (PSM) presents a unique set of techniques for reconstructing an experimental environment out of a non-random, quasi-experimental design. The treatment relationship with matching was first modeled through a probit framework with the aim to identify the factors that explained the likelihood of experiencing prime-age male head death mortality and other prime-age mortality as well as to estimate the conditional probability of treatment, or propensity scores (PSs), given the observed characteristics. The specification of the PS was subjected to and influenced by a series of balancing tests. The final specification of the PS satisfied all the balancing tests as well as the common support requirement. The probit models were specified as:

$$\text{Prob}\left(w^h = 1 \mid \mathbf{x}\right) = \Phi\left(\beta + \boldsymbol{\delta}\mathbf{x} + \varepsilon\right) \tag{9a}$$

$$\text{Prob}\left(w^0 = 1 \mid \mathbf{x}\right) = \Phi\left(\beta'' + \boldsymbol{\delta}''\mathbf{x} + \varepsilon''\right) \tag{9b}$$

where w^h is a dichotomous variable equal to one if the household experienced the death of a male head of household and zero otherwise, and w^0 equal to one if the household experienced the death of any other prime-age household member and zero otherwise ; Φ is a normal cumulative distribution function (CDF); ε and ε'' are the error terms; β , β'' $\boldsymbol{\delta}$ and $\boldsymbol{\delta}''$ are parameters and vectors of parameters, respectively, to be estimated; and **x** is a vector of characteristics of the deceased, household and community hypothesized to increase the likelihood of the household experiencing a prime-age disease-related mortality. PSM allowed us to match each household experiencing male head of household death and non-male head death with "similar" unafflicted households and use the outcome of the unafflicted households as a proxy for the outcome of the afflicted household if it had not incurred the death of a male household head. Equations 9a and 9b were estimated using maximum likelihood (ML) procedures in Stata. We then estimate the double difference from the sub-sample exhibiting common support from the two PSM.

PSM leads to unbiased estimates of the impact of a programme by matching the participants and non-participants on their observed characteristics. However, PSM is only as good as the quality of the matching and is valid only under certain identifying assumptions. The balancing effects of the PSM models were tested using a number of procedures, including t-tests for the differences in covariate means between the two groups (participants and non-participants) before and after the matching (Rosenbaum and Rubin 1985), effectiveness in reducing standardized bias to within acceptable levels (no more than 5 percent), and ability to drive the overall probit relationship to insignificance as measured by a joint likelihood ratio (LR) test and pseudo R^2 (Caliendo and Kopeinig 2008).[9]

Due to space restrictions, we only show and briefly discuss the results from the balancing tests for widowed households. The results in Table A2 show that the balancing property was fully satisfied when the propensity score (PS) was estimated. While 10 of the 26 covariates used in propensity score matching estimation were highly significantly different between the treated and control households before matching (Table A2, Column C), none were significant after matching and restricting the sample to the region of common support (Column F). Table A2, Column G also suggests that the matching procedure used was successful in lowering the standardized bias to within acceptable levels of no more than 5 percent for many covariates (see Caliendo and Kopeinig 2008). A LR test on the joint significance of all the regressors in the probit model was significant before the matching (x^2=296.01; p-value<0.000) but highly insignificant after matching (x^2=17.25; p-value<0.901). Similarly, pseudo R^2 reduced from 0.329 in the unmatched sample to 0.069 after matching. Confining the impact analysis to the region of common support from both PSM led to loss of 0 and 386 observations from the treatment and control groups, respectively. We the base our estimation of the double difference models with matching on the sub-sample exhibiting common support from the two PSM.

V. Results

We begin this section with a descriptive analysis of the characteristics of households experiencing the death of a prime-age (15-59 year) male household head between 2001 and 2004 in which the spouse was a resident in 2001. We hereafter refer to these households as 'widowed households'. The remainder of the section presents the results from the econometric analysis measuring the impact of becoming a widowed household on changes in landholding size compared to non-afflicted households and households having suffered the death of another household member.

A. Descriptive Results

Figure 1 shows the mean percentage change in landholding size between the 2001 and 2004 surveys for three groups: (i) non-afflicted households, (ii) households experiencing the death of an adult other than the male household head, and (iii) households experiencing the death of the male household head (widowed households). Mean landholdings declined for each group: by 12.7 percent among non-afflicted households, 18.1 percent among households experiencing the death of a prime-age adult other than the male household head, and by 39.8 percent among households experiencing male head of household death. These bivariate findings do not control for other shocks affecting these households, yet they provide at least surface evidence that widowed households in general became worse off compared to non-afflicted households and households suffering the death of other members. The large decline in landholding size among widowed households could be due to at least two factors: (1) after the death of their husband, widows could be experiencing severe labor shortages; or (2) the widows might have lost access to land as a result of property redistribution.

[Figure 1]

[Figure 2]

Figure 2 shows the distribution of changes in landholding size between 2001 and 2004 for the three groups. Among non-afflicted households, 45.7 percent increased their landholding size between 2001 and 2004, 50.3 percent incurred a decline, and 4.0 percent had no change. The proportion of "other mortality" households incurring more than a 50 percent decline in landholding size was almost the same as that of non-afflicted households but considerably less than households that suffered a prime-age male head death. By contrast, only 26.4 percent of the households that became widowed between 2001 and 2004 increased their landholding size, while more than 67.0 percent incurred a decline and 6.6 percent had no change. Of the widowed households experiencing a decline in land access, almost half of them incurred a greater than 50 percent decline. Of the three groups, widowed households were the least likely to increase their land access, the most likely to reduce their land access, and the most likely to suffer a greater than 50 percent decline in land access. However, it is worth noting that more than 33.0 percent of widowed households were able to retain or increase the amount of their land access, indicating that the loss of land by widows and their dependents is far from universal. This leads us to ask whether there are some attributes of the widow, the household in which she resides, and/or the community that influence widows' ability to retain access to land. To shed more light on this question we examine the initial household characteristics among widowed households by changes in cropped land.

Table 3 presents initial 2001 conditions of households becoming widowed between 2001 and 2004 for seven groups, according to the percentage change in the household's landholding size between the two surveys. Several interesting observations stand out. *First*, it appears that neither education nor age of the widows had a clear influence on her likelihood of losing a large fraction of land after the death of her husband. The average age of widows losing more than 50 percent of their land (43.5 years) is only slightly greater than the average age for the full sample of widows (42.4 years) and the average age of widows whose landholdings increased by more than 25 percent (42.4). Furthermore, among widowed households losing greater than 50 percent of their land, 21.9 percent had no formal education whilst 43.8 percent had educational attainment of grade 7 or greater.

[Table 3]

Second, widows incurring a greater than 50 percent loss in land had the greatest number of adult equivalents in 2000 (3.2 compared to the mean of 2.5 among all widowed households), more children aged 6 to14 years, and slightly more adult male members and the same number of adult female members as the mean of all widowed households. Using the *ex ante* number of prime-aged adults as an indicator of available household labor, these results suggest that the average widowed household experiencing a large decline in landholding size does not have less available adult labor compared to widowed households with positive changes in land access.

Third, widowed households experiencing the greatest decline in landholding size appear to have been relatively wealthy in the initial survey. Table 3 shows that the initial mean value of assets, value of livestock (cattle and small animals), and overall household income are substantially higher among widowed households experiencing a greater than 50 percent decline in land access compared to other widowed households. These results suggest that widows in households that were initially wealthier are more likely to lose land and other productive assets after the death of their husbands. However, all of these results are bivariate; we now move to econometric techniques to identify the factors influencing widows' loss of land after controlling for other factors.

B Econometric results

We estimated models with log-level specifications to provide estimates of percentage changes in landholding size. As a robustness check, we present side by side results from double difference models with and without matching. The results in Table 4 show that the sign and statistical significance of the covariates are the same in the two sets of results. The point estimates are slightly different in magnitude. Other than pointing out apparent differences between the models with and without matching, where appropriate, we place more emphasis on results from the double difference models after propensity score matching (columns D through F).

Changes in access to land

Results in Table 4 column A (non-matched) and D (matched) indicate a significant decline of 36.0 and 35.6 percent, respectively, in total landholding size among households suffering a prime-age male head death. By contrast, the death of another prime-age adult had a negative but statistically insignificant impact on landholding size; the measured decline never exceeded 7 percent in any of the models estimated. The percentage decline in land among widowed households was even slightly more severe (36.6 and 36.3 percent declines) after controlling for widow-specific, household and social capital variables (columns B and E).

Columns C and F show the model results accounting for interaction terms between male head mortality and widow/head-specific, household and social capital variables. To better understand the magnitude of impact of these interaction terms on widowed households, we simulated the predicted changes in landholding size based on results in both columns C and F for seven illustrative profiles of widowed households, as shown in Table 5. Table A1 presents the descriptive statistics of the covariates from which these percentage changes are computed.

[Table 4]

[Table 5]

Age of widow

We test the hypothesis that the impact of male head mortality on widows' access to land depends on the age of the widow. Simulations based on the results in Table 4, columns C and F, show that the negative impact of mortality of the male head of household on landholding size is somewhat smaller in magnitude among older widows. Profiles 1 and 2 in Table 5 are identical in all characteristics except for the age of the widow. Landholding size declined by 45.2 percent for widows aged 36, compared to 36.5 percent among households in which the widow was 50 years old when the husband died. This finding suggests that older women have comparatively more protection against losing land compared to younger widows. This could reflect assumptions implicit in traditional land inheritance laws that younger women are more likely to remarry and gain access to the new husband's land, thereby obviating her need to keep most of the deceased husband's land. In contrast, older women are considered less likely to remarry; they are therefore more likely to retain most (but not all) of the land formerly controlled by the deceased husband. Also, all other factors held constant, older women might have more social capital in the community that protects them from losing rights to land. Notwithstanding these possible rationale, it appears that widowed households are vulnerable to losing a substantial portion of the land they formerly controlled, regardless of the widow's age.

Education level

The estimated coefficients on the interaction terms between male head death and the education of the widow (Table 4, columns C and F) suggest that the educational attainment of the widow has no clear impact on landholding size. All of these interaction terms are statistically insignificant even at the 20 percent level.

Wealth status

The death of a male household head has particularly severe effects on households that were initially relatively well-off. The coefficient on the interaction term between male head mortality and initial wealth is negative and significant at the 10 percent level. Profiles 3 and 4 in Table 5 are identical in all characteristics except that in profile 3 the household is initially at the 90th percentile of the wealth distribution in 2000 (relatively better-off) whereas in profile 4 the household is at the 25th percentile of the wealth distribution. Landholding size declines by an estimated -71.1 percent for the initially better-off households in contrast to only -36.8 percent for households that were initially poor. If the decline in landholding size were due to severe labor or capital shortages among widowed households, then we would have expected a more moderate decline in landholding size among initially wealthy households, yet we find the reverse. These results are consistent with the premise that widows who remain with substantial assets compared to other households in the community may be more vulnerable to land grabbing and loss of other assets after the passing of her husband. If widows and dependents coming from relatively well-off households are more vulnerable to losing land after the death of their husbands, then this would suggest the need to safeguard the interests of widows regardless of their initial economic status.

Household composition

If the *ex ante* number of prime-aged adults in the household is used as an indicator of available household labor, one would expect a positive coefficient on the interaction term between male head of household mortality and the number of prime-age males and females in the family, thus a one unit increase in the number of prime-age males and/or females mitigates the impact of male head mortality on the availability of family labor. However, the coefficients on these variables are statistically insignificant. This result suggests that the decline in landholding size observed in widowed households is apparently not affected by the availability of family labor.

In contrast, the coefficient on the interaction between male household head mortality and the number of children age 6 to 14 is negative and statistically significant at the 5 percent level. Thus, the negative impact of mortality of the male head of household on land access is also not mitigated by the widow having more children to support. For example, profiles 4 and 5 are identical in all characteristics except that in profile 5 the household has on average 3 more children aged 6 to 14 than the household in profile 4. Landholding size is estimated to decline by -55.1 percent among households with more children aged 6 to 14 compared to -36.8 percent for households with fewer children. While we might have expected widowed households with more children to be considered more vulnerable and hence less likely to lose land after the death of the husband, this is not supported by the findings in Table 4. Having more children does not appear to protect the widow from losing land access after the death of her husband.

Kinship ties: relation to the headman

The negative impact of mortality of the male head of household on landholding size is substantially mitigated among widows who are related to the headman, as indicated by the positive and statistically significant coefficient on the interaction between the widow's relationship to the headman and the death of the male head of the household. Profiles 6 and 7 are identical in all characteristics except that in profile 7 the widow is related to the headman and in profile 6 she is not. Landholding size declines by 14.3 percent when the widow is related to the headman, and by 59.5 percent if not. This huge difference between these two profiles suggests that social capital factors, in particular the widow's kinship ties to local authorities, play a crucial role in protecting her rights to property and assets after her husband's death. This finding implies that with the willingness and participation of community leadership, it may be possible to provide greater protection to widows against loss of land access. Community leaders may be important entry points for organizations attempting to provide greater protection for widows.

Number of years settled in locality

Jayne et al. (2008) find that the number of years that a household has settled in a locality is positively associated with landholding size.. However, the negative coefficient on the interaction between the death of male head of the household and the number of years settled in the locality (Table 4, column F) indicates that the duration of the households' presence in the village does not protect the widow from losing land after the death of her husband. However, this effect is significant only at the 20 percent level.

Do widows in matrilineal inheritance areas fare better?

A priori, one might expect that widows living in matrilineal villages would be better protected against loss of land, since the potential heirs to the estate of the deceased husband are normally the male blood relatives of the widow. However, the results in Table 4, column F suggest that widows do not benefit from living in a matrilineal village; the coefficient on the interaction term between male head mortality and households in matrilineal villages is actually negative but not statistically significant. The results indicate that widows living in matrilineal inheritance areas are at least equally at risk of losing some of the household's land compared to widows living in patrilineal areas. This finding is consistent with evidence from focus group interviews in predominately matrilineal northern Mozambique. Participants revealed that property rights violations were common occurrences, and that matrilineal land inheritance customs offered little in the way of protection against land loss (Hendricks and Meagher 2007). Also, as discussed in Section III, whether a marriage is matrilocal or patrilocal marriage residence patterns may be a more important determinant of widows' land access than whether inheritance patterns are patrilineal or matrilineal, although it is typically the case that areas of patrilineal (matrilineal) inheritance follow patrilocal (matrilocal) marriage patterns (Fox 1967). Unfortunately, information on residence pattern was not collected in the surveys, so we are unable to empirically test this hypothesis.

VI. Conclusion and Policy Recommendations

This paper is motivated by concerns that the AIDS epidemic is resulting in a large proportion of rural women becoming impoverished due to losing access to land after the death of their husbands. Using nationally-representative panel data of 5,342 rural households in Zambia, surveyed in 2001 and 2004, we estimated matched double-difference average treatment effects models to assess how landholding sizes change among households incurring the death of a prime-age (15-59 year old) male head of household, compared to households losing another prime-age adult as well as households not incurring any prime-age mortality. The study is designed to identify factors specific to the widow, the household, and the community that influence the magnitude of the change in landholding size.

We highlight seven findings. *First*, more than 66 percent of the households that suffered the death of the male household head after the 2001 survey did indeed have less land (defined by the sum of cultivated and fallow land) in 2004 than in 2001. Over 30 percent of the widowed households controlled less than half of land they had before the death of the male head. Landholdings declined by 12.7 percent among non-afflicted households, by 18.1 percent among households experiencing the death of a prime-age adult other than the male head, and by 39.8 percent among households experiencing male head-of-household death (widowed households). Of the three groups, widowed households were the least likely to increase the size of their landholdings and the most likely to suffer a greater than 50 percent decline in landholdings. However, it is worth noting that 33.0 percent of widowed households were able to retain or increase their landholding size, indicating that the loss of land by widows and their dependents is far from universal.

*Second***,** the econometric results show that older widows are to some extent protected against the loss of land compared to younger widows. Landholding size declined by 36.5 percent among households headed by a widow aged 50 compared to a 45.2 percent decline among households headed by a widow aged 36, holding all other variables at their mean levels. This could reflect assumptions implicit in traditional land inheritance laws that younger women are more likely to remarry and gain access to a new husband's land, thereby obviating the need for her to retain the deceased husband's land. However, this does not appear to be the case in this nationally representative sample from Zambia, at least in the short run. Because the surveys recorded the name of the individuals in the family in both surveys, we were able to determine whether widows left their homes after the death of their husbands. We found that 100 percent of the wives of the household head in the initial 2001 survey were still resident at the household in 2004 after having become widowed in the interim. This does not count the 7.7 percent of the 2001 sample that were unable to be re-interviewed in 2004 due to apparent household dissolution. Additional longitudinal surveys will be necessary to track these individuals and households to determine how many continue to reside on their farms in subsequent years. Notwithstanding the potential for widows to acquire use rights to land through remarriage, it appears that widowed households suffer a non-marginal decline in landholdings regardless of the age of the widow, at least within a one to three year period after the death of their husbands.

Third, the results do not suggest any differential impact on land loss according to the education level of the widow. All of the education level variables are statistically insignificant even at a 20 percent level of significance.

Fourth, if we use the initial number of prime-age adults as an indicator of available household labor, our results show that in contrast to the conventional wisdom, having more prime-age males, females and/or children in the household does not protect the widow from losing land access after the death of her husband. These findings indicate that labor shortages due to mortality do not influence the reduction in landholding size among widowed households.

Fifth, the greatest decline in landholding size is among widowed households that were relatively wealthy prior to the death of the husband. The initial mean 2000/01 value of assets, farm equipment, and livestock are substantially higher among widowed households experiencing a greater than 50 percent decline in landholding size compared to other widowed households. Widows whose households were relatively well-off compared to other households in the community prior to the husband's death appear to have the most property to lose. However, the programmatic implications of this result are unclear; one might argue that special assistance should be targeted to widowed households, or any other kind of household, that are currently the poorest.

Sixth, widows who have kinship ties to the village authorities are substantially less likely to lose land. Other factors held constant, landholdings declined by 14.3 percent when the widow was related to the headman and by 59.5 percent if not. This finding underscores the importance of social relations within the community in influencing land tenure and allocation decisions.

Finally, contrary to the a *priori* expectation that widows living in matrilineal villages have some protection against loss of land, our results show that there appears to be no difference in changes in land access between widows living in matrilineal versus patrilineal villages; both are equally at risk of losing their rights to land.

The view that widows and their dependents face greater livelihood risks in the era of HIV/AIDS is indeed supported by the findings of these nationally-representative surveys from Zambia. Efforts to safeguard widows' rights to land through land tenure innovations involving community authorities may be an important component of social protection, poverty alleviation, and HIV/AIDS mitigation strategies. Several of the findings reported above show the influence of local traditional authorities in affecting the extent to which widows are able to retain land. Increased government commitment to ensure security of widows' access to land is another approach, but initial evaluations of government efforts provide mixed evidence (see Izumi 2006). Government decrees appear to have little impact if local community authorities are not part of the agreement. But certainly, national governments, donors, and NGOs have an important role to play in developing programs to work with local authorities to protect widows and children against property grabbing by relatives of the deceased as well as to institute property rights that are more compatible with social protection and anti-poverty objectives in the era of AIDS.

Notes

[1] The few qualitative studies give somewhat conflicting evidence. Izumi (2006) finds that, throughout eastern and southern Africa, widows commonly experience land and property disputes with their in-laws. Von Struensee (2004) reviews available literature on the topic in east Africa, but there is little information reported on the proportion of widows who actually lose access to land. By contrast, a study of the relationship between land tenure insecurity and

HIV/AIDS in three villages in Kenya in 2002 found little evidence that HIV/AIDS is a major cause of land tenure loss by widows in AIDS-afflicted households (Aliber and Walker 2006). Although HIV/AIDS may make widow-headed households more vulnerable to land tenure loss, other factors such as poverty, population growth, and disempowerment of women were more important drivers of land tenure insecurity, at least in this particular study. The Aliber and Walker study, however, was based on only three villages and the small number of AIDS-affected widows interviewed (n=15) limits the extent to which the findings can be generalized to Kenya or the region.

[2] This paper follows the taxonomy convention of Barnett and Whiteside (2002): "Afflicted" households are those that have incurred a prime-age death among resident household members; households that have not directly suffered a death but are nevertheless affected by the impacts of death in the broader community or extended family are referred to as "affected." The term "non-affected" in our view is probably meaningless in most of eastern and southern Africa because it is doubtful that there are any households in this region that have not been indirectly affected by HIV/AIDS, especially in the more hard-hit communities of the region.

[3] "Standard enumeration areas" (SEAs) are the lowest geographic sampling unit in the Central Statistical Office's sampling framework for its annual Post Harvest Surveys. Each SEA contains roughly 150 to 200 rural households.

[4] One might even question the relevance or meaning of household "dissolution" among households with one or two members.

[5] See Imbens (2004) and Wooldridge (2002) for a comprehensive discussion of other treatment effects.

[6]Other measures of impact include the average treatment effect, $ATE = E\left(Y_h^1 - Y_h^0\right)$, and the Local Average Treatment Effect (LATE) (see Wooldridge 2002).

[7]For a detailed discussion of the instruments see Chapoto and Jayne, 2008.

[8]Unlike nearest-neighbor matching, for example, bootstrapping standard errors in kernel matching is free of discontinuities and, thus, produces more valid standard errors (Gilligan and Hoddinott 2007).

[9]A well-balanced propensity score is necessary for artificially constructing an experimental environment from a quasi-experimental situation. Estimation of the propensity score and generation of balancing tests were achieved through a combination of **psmatch2**, **pscore** and **pstest** procedures in Stata.

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TABLE 1:
Prime-age mortality[a] by province, rural Zambia between May 2001 and May 2004

Province	Households interviewed in 2001	Households re-interviewed in 2004[b]	Household incurring at least one prime-age death due to illness[c]				
			total[d]	male head	female head /spouse	other females	other males
	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Central	713	572 (80.2)	65	14	13	22	20
Copperbelt	388	307 (79.1)	28	3	6	10	9
Eastern	1328	1123 (84.6)	128	21	21	52	48
Luapula	771	613 (79.5)	51	13	15	14	11
Lusaka	213	160 (75.1)	27	4	8	12	4
Northern	1342	1006 (75.0)	84	17	13	33	25
Northwestern	467	319 (68.3)	22	4	1	6	11
Southern	839	656 (78.2)	78	9	19	34	25
Western	784	586 (74.7)	59	6	26	19	14
Total	6845	5342 (78.0)	542	91	122	202	167

Source: CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Survey, 2001 and 2004.

Notes: [a]Prime-age is defined as ages 15-59 for both men and women. [b]Of the 22.0% not re-interviewed, 0.2% were refusals, 10.3% moved out of SEA, 5.7% were recorded as dissolved, and 5.8% were categorized as "non-contact" (not home but still resident). [c]Descriptive results in 5,342 valid re-interviewed households. [d]542 households have at least one disease-related prime-age death, 52 of them suffered multiple prime-age death, with 44 households experiencing 2 deaths, 6 households experiencing 3 deaths and 2 households experiencing 4 deaths. Of those households experiencing multiple prime-age deaths, 15 households experienced more than one male death and 16 households had more than one female death.

TABLE 2.
RELATIONSHIP BETWEEN HOUSEHOLD SIZE, ATTRITION, DISSOLUTION, AND PRIME-AGE MORTALITY IN 2001-2004

Household Size	Households in 2001 sample	Households attriting in 2001-2004	Households attriting due to dissolution	Households dissolving as % of 2001 sample	Households dissolving as % of households attriting	Among re-interviewed households	
						Households incurring disease-related prime-age mortality	Households incurring disease-related prime-age mortality as % of re-interviewed households
(A)	(B)	(C)	(D)	(E)[a]	(F)[b]	(G)[c]	(H)[d]
number	number	number	number	(%)	(%)	number	(%)
1	201	71	30	14.9	42.3	3	2.3
2	383	118	45	11.7	38.1	24	9.1
3	781	194	55	7.0	28.4	44	7.5
4	1011	266	77	7.6	28.9	58	7.8
5	1030	223	47	4.6	21.1	81	10.0
6	920	214	47	5.1	22.0	68	9.6
7	728	125	33	4.5	26.4	54	9.0
8	596	106	22	3.7	20.8	64	13.1
9	377	68	11	2.9	16.2	34	11.0
≥10	818	118	23	2.8	19.5	112	16.0
Total	6845	1503	390	5.7	25.9	542	10.1

Source: Chapoto and Jayne (2008) using data from the CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Surveys, 2001 and 2004.

Notes: [a]Column E =(Column D /Column B)*100. [b]Column F=(Column D/Column C)*100. [c]36 households incurred more than one prime-age death. [d]Column H=[Column G/(Column B-Column C)]*100.

TABLE 3
CHARACTERISTICS OF WIDOWED HOUSEHOLDS BY PERCENTAGE CHANGE IN LANDHOLDING SIZE BETWEEN 2000/01 AND 2003/04

Attributes	% change in landholding size between 2000/01 and 2003/04						
	Full Sample	Negative			No change	Positive	
		>50	25-50	0-25		0-25	>25[a]
Number of households	91	32	18	11	6	7	17
Age of widow (years)	42.4	43.5	38.6	42.6	48.2	42.0	42.4
Level of education of widow (=1)							
No education	19.8	21.9	22.2	18.2	16.7	0.0	23.5
Lower primary education	19.8	15.6	11.1	18.2	66.7	14.3	23.5
Upper primary education	22.0	18.8	22.2	18.2	0.0	42.9	29.4
Grade 7 or greater	38.5	43.8	44.4	45.5	16.7	42.9	23.5
Baseline household characteristics in 2000							
Effective dependency ratio (number)	1.3	1.4	1.2	0.9	1.5	1.1	1.2
Adult equivalent HH members	2.5	3.2	2.2	2.1	2.1	2.3	2.2
Children 5 years and under (number)	0.8	1.0	1.0	0.7	0.2	0.6	0.5
Children age 6 to 14 years (number)	2.2	2.7	1.9	2.3	2.3	1.8	1.7
Prime-age males (number)	1.4	1.8	1.1	1.3	0.8	0.9	1.2
Prime-age females (number)	1.3	1.3	1.3	1.5	1.0	1.6	1.1
Value of assets (000 Kwacha)	968.1	1936.0	189.8	1432.1	201.0	333.9	202.1
Household Income (000 Kwacha)	2413.5	2813.4	2068.3	2355.4	1289.3	5442.9	1213.1
Off-farm income (000 Kwacha)[b]	1123.2	1047.0	1017.2	1140.7	725.4	3427.3	559.1
Value of livestock (000 Kwacha)	676.0	1586.3	63.5	678.2	45.1	8.7	107.3
Value of cattle (000 Kwacha)	566.1	1389.6	0.0	575.9	0.0	0.0	42.0
Value of small animals (000 Kwacha)[c]	109.9	196.7	63.5	102.4	45.1	8.7	65.3

Source: CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Survey, 2001 and 2004

Notes: [a]In only 1 case was the change in landholding size between +25-50 %; the rest are greater than +50%.
[b] Off-farm income include salary and wage income, informal and formal business income. [c] Small animals include goats, sheep, pigs, chicken, ducks and rabbits.

TABLE 4
REGRESSION RESULTS FOR IMPACT OF DEATH ON LANDHOLDING SIZE BETWEEN 2000 AND 2003 WITH AND WITHOUT PROPENSITY SCORE MATCHING[a]

Covariates	Change in log of land access (hectares) between 2000 and 2003					
	---DD Fixed Effects without matching--			----DD Fixed effects with matching---		
	A	B	C	D	E	F
Male head mortality (widowed) (=1)	-0.360**	-0.366**	2.228*	-0.356**	-0.363**	2.247*
	(0.096)	(0.091)	(0.98)	(0.096)	(0.091)	(0.99)
All other mortality (=1)	-0.0644	-0.0249	0.643	-0.0637	-0.0236	0.668
	(0.050)	(0.050)	(0.61)	(0.051)	(0.052)	(0.63)
Age of head/widow (years)		0.00289	0.00629		0.00376	0.00746
		(0.0088)	(0.0096)		(0.0091)	(0.0100)
Age of head/widow squared		-0.667E-04	-0.107E-03		-0.761E-04	-0.120E-03
		(0.000090)	(0.000098)		(0.000094)	(0.00010)
Education level of head/widow						
No education (reference group)						
Grade 1 to 6 (=1)		0.101*	0.112*		0.112**	0.123**
		(0.042)	(0.045)		(0.043)	(0.046)
Grade 7 and upper (=1)		0.130**	0.132**		0.144**	0.148**
		(0.044)	(0.047)		(0.045)	(0.048)
Household composition in 2000						
Children under age 5 (number)		-0.00406	-0.00144		-0.00851	-0.00597
		(0.016)	(0.017)		(0.017)	(0.018)
Children age 6 to 14 (number)		-0.00244	-0.00353		0.000437	-0.000424
		(0.0084)	(0.0089)		(0.0092)	(0.0099)
Prime-age male (number)		-0.00943	-0.00878		-0.00868	-0.00863
		(0.016)	(0.017)		(0.016)	(0.018)
Prime-age female (number)		0.0118	0.0132		0.00449	0.00562
		(0.018)	(0.019)		(0.019)	(0.022)
HH wealth status in 2000 (million kwacha)		-0.0172**	-0.0138*		-0.0177**	-0.0134*
		(0.0049)	(0.0054)		(0.0056)	(0.0063)
Male head related to headman in 2000		-0.0604*	-0.0685*		-0.0646*	-0.0734*
		(0.030)	(0.032)		(0.031)	(0.033)
Spouse/Widow related to headman		0.0201	0.0150		0.0247	0.0191
		(0.046)	(0.049)		(0.048)	(0.051)
Years settled in locality (number)		-0.00569**	-0.00488**		-0.00574**	-0.00490**
		(0.0015)	(0.0016)		(0.0015)	(0.0017)
HH in matrilineal inheritance village (=1)		-0.0246	-0.0215		-0.0282	-0.0250
		(0.034)	(0.035)		(0.035)	(0.036)
Interaction Terms						
Widowed x Age of head/widow			-0.0949*			-0.0955*
			(0.043)			(0.044)
Widowed x Age of head/widow squared			0.00118*			0.00118*
			(0.00049)			(0.00049)
Widowed x 1-6 years of education			-0.160			-0.166
			(0.23)			(0.23)
Widowed x 7 years and above of education			-0.195			-0.210
			(0.24)			(0.24)
Widowed x children age 5 and under			-0.181			-0.175
			(0.131)			(0.127)
Widowed x children age 6 to 14			-0.0640*			-0.0664*
			(0.029)			(0.030)
Widowed x number of prime-age males			-0.126			-0.127
			(0.086)			(0.087)
Widowed x number of prime-age females			-0.0686			-0.0616
			(0.12)			(0.12)

Widowed x wealth/asset level			-0.0866**			-0.0876**
			(0.029)			(0.030)
Widowed x Head related to headman			0.0532			0.0567
			(0.15)			(0.15)
Widowed x Spouse or widow related to headman			0.456*			0.451*
			(0.23)			(0.23)
Widowed x number of years settled in village			-0.00383			-0.00380
			(0.0028)			(0.0027)
Widowed x Matrilineal village			-0.268			-0.264
			(0.17)			(0.17)
Constant	0.300**	0.324	0.225	0.287**	0.289	0.182
	(0.10)	(0.23)	(0.25)	(0.11)	(0.24)	(0.26)
Observations	5035	5035	5035	4649	4649	4649
R-squared	0.03	0.05	0.05	0.03	0.05	0.05
Joint Tests						
F-statistic for model	12.39*	9.65*	6.27*	11.02*	7.42*	4.87*
Widow x Widow/household attributes			3.67*			2.06+
Widow x All interactions			4.92*			2. 70*

Source: CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Survey, 2001 and 2004

Notes: ** 1% level of significance, * 5% level of significance and + 10% level of significance. Numbers in parentheses are standard errors. [a]Not reported in the table are the interactions terms between other mortality and pre-death household characteristics.

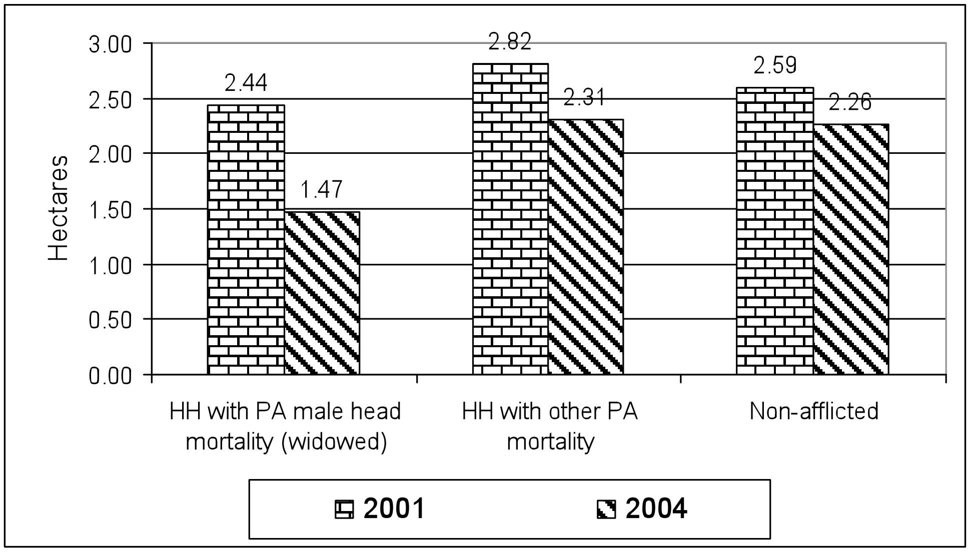
TABLE 5

SIMULATIONS[a] OF THE PERCENTAGE CHANGE IN LANDHOLDING SIZE BASED ON SPECIFIC WIDOW, INITIAL HOUSEHOLD ATTRIBUTES

Profile	Household type	Age of widow (Years)	Wealth Status (000 Kwacha)	children aged 6 to 14 (Number)	Widow related to headman (1=Yes)	% Δ in landholding size	
						Models without Matching	Models after matching
1	Male head death-widow headed	36	mean (1404.8)	mean (2.3)	mean (0.098)	-45.70	-45.24
2	Male head death-widow headed	50	Mean	mean	mean	-36.63	-36.52
3	Male head death-widow headed	50	90th Percentile	Mean	mean	-70.83	-71.12
4	Male head death-widow headed	50	25th percentile	mean	mean	-36.93	-36.82
5	Male head death-widow headed	50	25th percentile	90th percentile	mean	-54.49	-55.05
6	Male head death-widow headed	50	25th percentile	90th percentile	no	-58.95	-59.45
7	Male head death-widow headed	50	25th percentile	90th percentile	yes	-13.32	-14.34

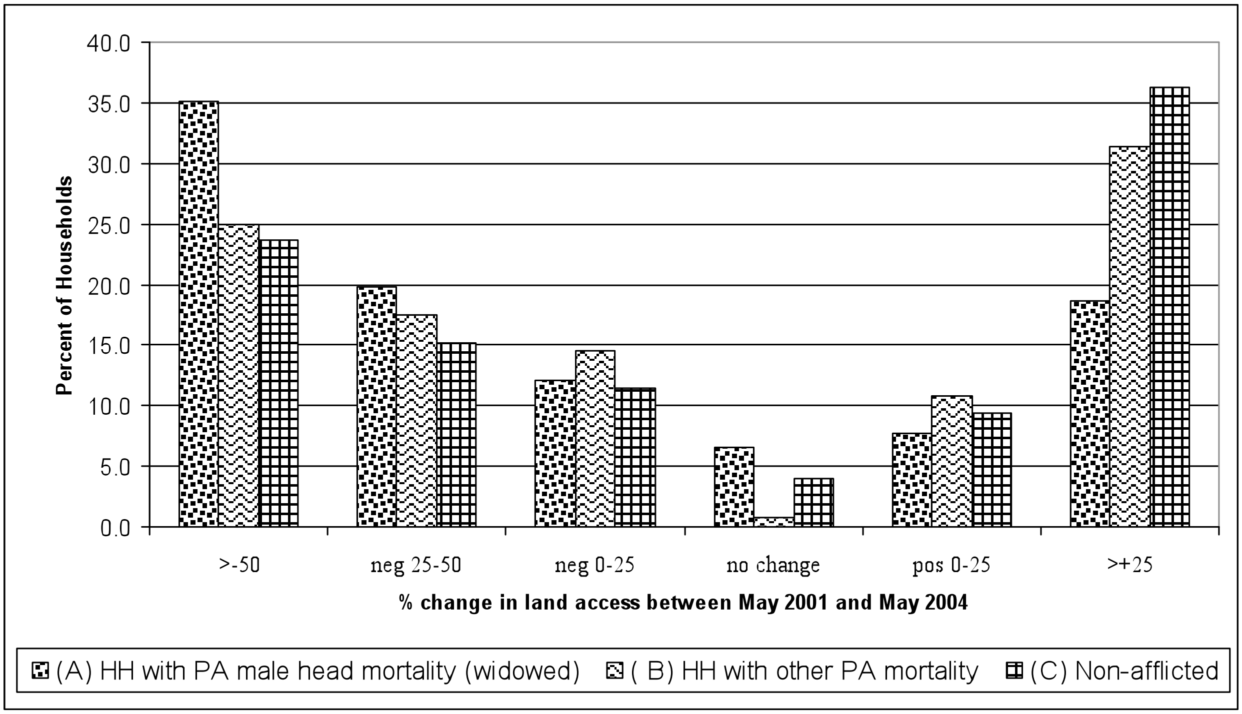
Source: CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Survey, 2001 and 2004

Notes: [a]Simulation outcomes based on regression models in Table 4, column C and F. All other variables in the model are set at their mean levels.



Source: CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Survey, 2001 and 2004

Figure 1: Comparison of landholding size in 2001 and 2003 (Hectares)



Source: CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Survey, 2001 and 2004

Figure 2. Frequency distribution of changes in landholding size among non-afflicted households, households incurring male-head mortality, and households incurring the death of an adult other than the male head.

TABLE A1
DESCRIPTIVE STATISTICS

Variable	Mean	Percentile				
		10	25	50	75	90
Prime-age (15-59 year) male head death (widowed) (=1)	0.018	-	-	-	-	-
Prime-age non male head death (=1)	0.080	-	-	-	-	-
Age of head/widow	47.01	31.00	36.00	46.00	57.00	66.00
Years of education of head/widow						
No education	0.141	-	-	-	-	-
1-6 years	0.387	-	-	-	-	-
7 and greater	0.472	-	-	-	-	-
Children 5 years and under in 2000 (number)	0.970	0.0	0.0	1.0	2.0	2.0
Children 6 to 14 years in 2000 (number)	2.255	0.0	1.0	2.0	3.0	5.0
Prime-age males excluding deceased in 2000 (number)	1.192	0.0	1.0	1.0	2.0	3.0
Prime-age females excluding deceased in 2000 (number)	1.286	0.0	1.0	1.0	2.0	2.0
Household value of assets in 2001 ('000 Zkw)	1404.79	0	35.69	207.23	558.69	3951.98
Husband related to headman (=1)	0.308	-	-	-	-	-
Spouse/Widow related to headman (=1)	0.098	-	-	-	-	-
Number of years settled in locality (years)	14.07	3.00	5.00	11.00	21.00	30.00
HH in matrilineal inheritance village (=1)	0.330	-	-	-	-	-

Source: CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Survey, 2001 and 2004

TABLE A2
PROPENSITY SCORE BALANCING TESTS, WIDOWED HOUSEHOLDS (TREATED) AND CONTROL

Covariates	Unmatched -------Mean ------ Treated	Control	t-test	%bias	Matched -------Mean ------ Treated	Control	t-test	%bias
	(A)	(B)	(C)		(D)	(E)	(F)	(G)
Age group of deceased (=1)								
Age 20-24	0.044	0.012	2.68**	19.3	0.044	0.038	0.40	3.6
Age 25-29	0.089	0.016	5.32**	33.1	0.089	0.055	1.24	5.2
Age 30-34	0.078	0.016	4.53**	29.5	0.078	0.059	0.34	8.8
Age 35-39	0.144	0.012	10.43**	50.4	0.144	0.114	1.17	11.5
Age 40-44	0.133	0.010	10.83**	49.2	0.133	0.088	1.60	8.0
Age 45-49	0.122	0.006	12.33**	48.5	0.122	0.074	1.12	2.1
Age 50-54	0.133	0.005	14.41**	52.0	0.133	0.091	0.61	7.1
Age 55-59	0.122	0.005	12.89**	48.9	0.122	0.099	0.43	9.6
Education level of Head								
No education (reference)								
1-6 years (=1)	0.411	0.386	0.48	5.1	0.411	0.390	0.39	4.3
7 years and above (=1)	0.389	0.473	1.59	-17.0	0.389	0.404	-0.34	-3.1
Value of assets in 2001 (million Kwacha)	0.422	0.500	1.86+	-15.6	0.422	0.545	-1.12	-4.7
Land holding size in 2001(ha)	2.400	2.629	-0.02	-8.9	2.400	2.422	-0.04	-0.9
Household composition								
Children age 14 and under (number)	2.961	3.230	-1.13	-12.8	2.961	3.098	-0.27	-6.5
Prime-age males (number)	1.333	1.189	1.30	13.5	1.333	1.308	0.42	2.4
Prime-age females (Number)	1.322	1.285	0.37	4.1	1.322	1.339	-0.02	-1.9
Market access								
Distance to nearest town (Km)	31.5	34.1	-1.08	-11.5	31.5	32.5	-0.29	-4.5
Distance to nearest tarmac road (Km)	24.0	24.7	-0.21	-2.2	24.0	26.4	-0.49	-6.9
District on the line of rail (=1)	0.344	0.330	0.29	3.0	0.344	0.323	-0.48	4.6
Provincial dummies								
Central	0.156	0.105	1.95*	15.1	0.156	0.136	0.66	5.7
Copperbelt	0.033	0.059	1.04	-12.3	0.033	0.058	-0.40	-12.0
Eastern	0.233	0.209	0.55	5.8	0.233	0.258	-0.27	-5.9
Luapula	0.144	0.116	0.84	8.5	0.144	0.099	0.47	13.3
Northern	0.189	0.189	-0.01	-0.1	0.189	0.167	0.11	5.5
Northwestern	0.044	0.062	-0.68	-7.8	0.044	0.044	-0.18	0.4
Southern	0.089	0.125	-1.02	-11.6	0.089	0.100	-0.14	-3.7
Western	0.067	0.106	-120	-14.0	0.067	0.082	-0.74	-5.5

Source: CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Survey, 2001 and 2004

Notes: ** 1% level of significance, * 5% level of significance and + 10% level of significance. Numbers in parentheses are standard errors.