The Effects of Land Inheritance Laws on Agricultural Investment in Polygynous Households: Evidence from Uganda

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Abstract

This paper examines the connection between widows' land inheritance rights and agricultural investment. While substantial research exists on the relationship between property rights and investment, the number of studies on the effects of tenure systems, more specifically as they relate to inheritance, on agricultural investment has been limited. Using four waves of the Uganda Living Standards Measurement Survey-Integrated Survey on Agriculture (LSMS-ISA), I measure the effects of inheritance laws on both short-term and long-term agricultural investment. My results suggest that the threat of land expropriation upon widowhood leads to a decrease in fertilizer use, labor supply, as well as in the likelihood of fallowing and planting perennial crops. I also observe that parcels jointly managed by husbands and wives in polygynous households use more fertilizer and plant more perennial crops than their monogamous counterparts. This paper contributes to a growing body of literature that explores the causes of widows' vulnerability in Sub-Saharan Africa.

Keywords: Inheritance laws, Investment, Polygyny

1 Introduction

Within the context of Sub-Saharan Africa's rapid population growth and the need to ensure increased productivity and food security, there is a growing debate, extensively surveyed in Place (2009), about whether indigenous land tenure systems are a constraint to agricultural development. Defined as the relationship, whether legally or customarily determined, among individuals or groups with respect to land (FAO, 2002), land tenure systems are the primary manifestation of property rights in both African cities and rural areas. By creating the framework within which individuals are granted the right to use, control, and transfer land, land tenure institutions play a vital role in shaping farmers' land use decisions and could explain some of the obstacles to economic development. While some forms of tenure systems may encourage investment in productivity enhancing factors, others constitute a barrier for such investment. More formally, economists such as Besley (1995), and Goldstein and Udry (2008) argue that incentives depend on the expectations of an individual's rights over the return to her investment, and as such weak property rights and insecure tenure systems tend to result in agricultural underperformance.

Within this literature, authors identify three links between property rights and investment. First, studies such as Feder and Feeney (1991) emphasize the freedom from expropriation guaranteed by land rights. When individuals face the risk of losing the product of their labor to others, investment becomes sparser. For instance, Goldstein and Udry (2008) find that the likelihood and duration of fallowing[1] is reduced among female farmers in the

[1] Fallowing, or the practice of letting land regenerate after a period of cultivation is argued to be one of the most important types of investment in Sub-Saharan Africa. Goldstein and Udry (2008) argue that due to high fertilizer costs, the relative abundance

Akwapin region of Ghana. This is because women within that community suffer from less political power and less secure land rights. In addition to protecting an investor from expropriation, investment and property rights are also connected through the credit market as is suggested by Feder et al. (1988), Feder and Feeney (1991) and Besley (1995). Indeed, if well-defined rights permit the use of land as collateral, then constraints on funding investment can be reduced. Lastly, property rights allow for possible gains from trade. Besley (1995) posits that investment is encouraged when individuals own the transfer rights to rent or sell their land.

In Sub-Saharan Africa however, this literature often reveals contradictory results. While studies such as Place and Otsuka (2001), Gavian and Fafchamps (1996) and Besley (1995) respectively use data from Malawi, Niger and Ghana and find that in areas with stronger land rights, tree planting, fencing and manuring are more common, others (Pender et al. 2004; Holden and Yohaness 2002; Place and Hazell 1993) do not find evidence of a statistically significant change in investment behavior. Instead, authors such as Toulmin and Quan (2000) and Toulmin et al. (2002) advocate for the reinforcement of customary rights to land on the grounds that privatization favors the wealthy who are better able to navigate bureaucratic procedures, and thus prevents the registration of land title in a woman's name. Moreover, as Chimhowu and Woodhouse (2006) posit, the development of land markets and freehold systems open the possibility of distress-sales in times of hardship and accelerate landlessness among the poor.

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of land and the prevalence of shifting cultivation, fallowing remains the primary mechanism by which farmers increase yield.

Due to these mixed findings, the general consensus in the literature is that in Sub-Saharan Africa, generalizations are hard to make due to the heterogeneity of indigenous land tenure systems. Because of the vast number of ethnic groups and their different institutions, the different rates of market development and the degrees to which formal governments have been able to influence local tenure arrangements, African systems often encompass variegated methods of land access, and different levels of privatization of rights.

More recently, the evaluation of the relationship between property rights and investment has shifted to a particular feature of land tenure: inheritance laws. According to studies such as Cooper (2010) and Platteau and Baland (2000) inheritance is the principal means for the transfer of physical capital in most Sub-Saharan African countries. As such, inheritance laws can have positive and negative effects on a person's lifetime income and poverty status. While for some, inheritance events represent driving factors for capital accumulation and financial security, for others, these laws, often customary, lead to exclusion from productive assets and an increase in vulnerability and intergenerational poverty (Bird et al., 2004; Fafchamps and Quisumbing, 2005; Cooper, 2008). This latter situation is particularly true for women and widows in patrilineal societies.

Several qualitative studies reveal that marriage laws are essential to women's property and inheritance rights. In many Sub-Saharan African countries, women do not have independent property rights (Cooper, 2010). Instead, traditional customary laws, which govern many aspects of African daily lives, often stipulate that women must access land through their fathers, husbands, or adult sons (Cooper, 2010). Consequently, gender differences in access and control over land persist, as documented by several studies

(Quan, Tan, and Toulmin 2005; Meinzein-Dick et al., 1997; Place 1995, Walker 2002). In many African countries, women are rarely allowed to inherit land even in matrilineal systems (Lastarria-Cornhiel, 1997). Consequently, marriage has become the most important source of farmland for women. Yet, claims on land acquired through marriage are often weak and contingent upon marital residence, the continued existence of the marriage, the goodwill of the spouse and the amount of land to which he is entitled (Quan, Tan and Toulmin, 2005). Situations of marital conflict or divorce render a wife's right to land even less secure. If the wife returns to her family compound for example, she loses out on the land she farmed and developed during the marriage because customary law does not recognize marital property or non-monetary contributions to the acquisition of property during marriage (Assimwe and Crankshaw, 2010).

In addition to gender-based discrimination in access to productive assets, the shock of widowhood renders women's situation even more precarious. Although widows may benefit from their children's inheritance, the fact that in some contexts, they cannot directly inherit property from their husband increases their social vulnerability and poverty. Complicating matters further, the prevalence of polygamy in many countries may alter the patterns of asset inheritance. While previous research on the effects of polygyny have mainly focused on its effects on intra-household cooperation and agricultural productivity (Jacoby 1995; Akresh, Chen and Moore 2012; Dauphin 2013), little empirical research exists on the relationship between polygyny and women's access to land and tenure security. While it can be argued that polygyny may lead to greater cooperation among cowives, ethnographic studies such as Besteman (1995), Fafchamps and Quisumbing (2005); Namubiru-Mwaura et al. (2012) report that it is not uncommon for disputes to arise between multiple wives over their husband's land. Moreover, this

body of literature suggests that women's access to land and ability to mobilize labor are often determined by a complex set of factors including: her age, husband status, status in polygynous marriage and number, sex and ages of children (Roberts, 1988; Besteman, 1995).

Besteman (1995) for instance investigates the effects of polygyny on women's land tenure in riverine agricultural villages in Somalia. She observes that within those communities in the Jubba Valley, polygynous widows were in a particularly difficult situation regarding subsistence. Contrary to Islamic practice, when a man died, his widow and daughters had no rights to his land, which was inherited by his sons. Moreover, if the widow's sons were not old enough to claim their inheritance, the land usually passed to the deceased's brothers or his older sons from another marriage. As a result, Besteman (1995) notes that women sought to form mother-son partnerships in order to secure their access to a portion of land. Similar patterns have been observed in other studies such as Kevane and Grey (1999), Young (2006), Ross (2008), and more recently Po and Hickey (2018).

What is more, studies such as Deschenes (2017) show that in patrilineal social organizations, women often seek to establish their security and to gain a competitive edge over present and future co-wives by bearing a number of children, especially sons, who will retain rights of residence and inheritance in the compound and will eventually take over its leadership roles.

A growing body of literature reinforces these patterns of women's vulnerability upon widowhood (van de Walle, 2013, Peterman, 2010; Cooper 2008; Oleke et al., 2005; Bird et al., 2004; Strickland, 2004). Using a 2006 cross-section of Mali's Demographic and

Health Survey (DHS) data, van de Walle (2013) examines the welfare of households headed by widows and the individual welfare of women aged 15 to 49 who have experienced the shock of widowhood. The paper concludes that widows, both heading household or not, experience lower levels of welfare as measured by their per capita consumption. The paper also reveals that these detrimental effects persist through remarriage and are passed on to children, especially to daughters. In the same vein, Peterman (2010) uses cross-country, nationally representative DHS data from 15 Sub-Saharan African countries to assess levels of asset inheritance among widowed women. The study finds that among the 15 countries, less than half of widows reported inheriting any assets, with results as low as 22% in Sierra Leone. Moreover, inheritance was generally correlated with higher education and wealth, indicating that women with higher socioeconomic status may be more able to negotiate inheritance outcomes. More recently, Dillon and Voena (2018) investigate the connection between widow's land inheritance rights and agricultural investment in Zambia. Using both OLS and IV regressions, they find that concern over prospective loss of land by the wives reduces the use of fertilizer in enumeration areas where widows do not inherit by 37%, even while the husband is alive.

In summary, in the context of Sub-Saharan Africa, previous literature shows mixed results on the relationship between insecure land tenure and the level of agricultural investment. While women, as a group, have been shown to be negatively affected by unfavorable customary inheritance laws, widows in particular remain the most vulnerable. Building from these earlier studies, I use the Uganda National Household Survey, a panel dataset comprised of 3132 households with data collected over four rounds to estimate the relationship between widows' tenure insecurity and agricultural

investment. In this paper, I contribute to this body of literature in three ways. First, I investigate the connection between land inheritance norms in Uganda and households' investment decisions. More specifically, I study whether women's risk perception of tenure security before widowhood changes households' input, crop choice and fallowing decisions. Unlike previous research that uses cross-sectional data, my study employs a household panel, which allows me to control for time-invariant household and district characteristics. Secondly, I measure the differentiated effects of tenure insecurity between different household structures. Indeed, in addition to the dearth of empirical studies that estimate the magnitude of the relationship between tenure security and investment, the evidence to date on this topic has not focused on the interaction between polygyny and tenure insecurity. In this paper, I expand this literature by estimating the differences in investment behavior between monogamous and polygynous households in the sample. Lastly, although there is a significant body of literature in economics that studies the impacts of institutions on economic outcomes, I expand this literature by focusing on a particular set of rules of the game defined by inheritance laws.

The rest of this paper is organized as follows: Section 2 provides a brief background on Uganda and the evolution of land tenure systems in the country. Section 3 outlines the economic model used in this paper. Section 4 describes the empirical strategy. In Section 5, I present the data. Section 6 presents the results. Lastly Section 7 concludes and describes some of the limitations of my study.

2 Background

Like many other African countries, Uganda practices three legal systems of inheritance: customary law, religious law and statutory law. Before British colonialism, inheritance of

land in Uganda was governed by patriarchal customs in many communities. Although there existed a multitude of tenure types reflecting different ethnic systems, Asiimwe and Crankshaw (2010) argue that generally the custom dictated that the transfer of land to an individual be through a male relative. Traditionally, men within customary tenure systems achieved indisputable ownership and inheritable rights over land through the effective use and occupation of that land. This, however, did not apply to women who only possessed user rights to land (Birabwa-Nsubuga, 2006; Bikaako and Ssenkumba, 2003).

According to Asiimwe and Crankshaw (2010), widows did not inherit land from their spouses either. Instead, they acted as guardians of the land for the male minors until they grew up and inherited the land themselves (Bikaako and Ssenkumba, 2003). Consequently, widows with adult sons were more likely to have user rights over land than widows without sons.

At the dawn of colonialism, these patterns of inheritance did not change. While colonial administrators introduced new property ownership laws, the new system did not extend to women in most parts of the country. Instead, many argue that colonial legislation was more detrimental than useful to women (Whitehead and Tsikata, 2003). In fact, these policies altered women's previously secure use-rights by enabling male household heads to alienate land from women without consulting the larger communal groups.

Today, Uganda is still largely a patrilineal society in which four land tenure systems are recognized by the Constitution: freehold, leasehold, mailo and customary with the latter

covering more than half of the country.[2] Despite the government's efforts to promote equal access to and inheritance rights to land regardless of gender and marital status through the 1995 Ugandan Constitution and the 1998 Land Act, there still exist inconsistencies between the legislation and actual practices (Doss, 2010). As a result, women in communities governed by customary law still face the risk of land expropriation upon widowhood.

3 Theoretical Model

My theoretical model builds from the work of Damon (2008) and Dillon and Voena (2018). Consider a farm household which simultaneously makes consumption, production and investment decisions. The household is comprised of three members, a husband (H) and two wives (W^1, W^2), each of whom deriving utility from consumption C_t^i according to the utility function $ln(C_t^i)$, where t is the time period and $i \in (H, W^i)$. In every period t, the household divides its resources between consumption and agricultural investment. For the moment q_t is a generic investment, which can be either short or long-term.

The farm production function is $F(A, Q_t)$ where A is the fixed amount of land that the household owns and Q_t denotes the quality of land at time t. Similar to Damon (2008), I assume that there is no depreciation in land quality. Thus, investment raises future output according to the equation of motion for land quality: $Q_{t+1} = q_t + Q_t$.

[2] Page 36 of the appendix provides a description of the different tenure systems.

Given (r, β, Q_0), where r is the interest rate, β is a discount factor that satisfies 1 > β> 0 and Q_0 is the initial quality of land, the household chooses $(C_i, B, q_t)_{t=1,2}$ to maximize a two-period utility function. B is the amount borrowed to facilitate investment, which is borrowed in period 1 and paid back in full in period 2.

The household maximizes a two-period utility function written as:

$$Max\ \mu^H \ln(C_1^H) + \mu^W \sum ln\left(C_1^{W^i}\right) + \beta[\mu^H \ln(C_2^H) + \mu^W \sum ln\left(C_2^{W^i}\right) \quad (1)$$

When a household is not credit constrained, members of the household maximize (1) subject to the following budget constraints for periods 1 and 2:

$$F_1(A, Q_1) + B = \sum_{i\in(H,W^i)} \ln(C_1^i) + rq_1 \quad (2)$$

$$F_1(A, Q_2) = \sum_{i\in(H,W^i)} \ln\left(C_2^i\right) + (1+r)B \quad (3)$$

$$Q_2 = Q_1 + q_1 \quad (4)$$

where μ^H and μ^W represent the husband and wife's bargaining power.

In other words, for each period, the household's total spending both in consumption goods and in agricultural investment cannot surpass the sum of the household's agricultural revenue and the amount borrowed. r is the rental rate or the price of one unit of investment.

I assume that production and consumption decisions are separable, meaning that the household decides on the optimal amount of inputs for production, and then uses the profit from selling the agricultural output to make consumption decisions.

To capture the effects of inheritance rules on agricultural investment, I introduce a variable, ϕ^i which takes a value of 1 if wives can inherit and 0 otherwise. In keeping with the prevailing norms in Uganda detailed in the literature and referenced in Dillon and Voena (2018), I assume that a man always inherits if his wife dies. Moreover, widows who lose their land enjoy a positive consumption floor c > 0.

Suppose the household faces uncertainty regarding the survival of its members, each of whom has probability π_t^i of being alive in period t. π^H represents a situation in which only the husband is alive, π^W represents a situation in which the wives are alive, and π^B is when all spouses are alive.

The new utility maximization problem can be written as:

$$Max\ \Lambda = \mu^H \ln(C_1^H) + \mu^W \sum ln\left(C_1^{W^i}\right) + \pi^B[\mu^H \ln(C_2^H) + \mu^W \sum ln\left(C_2^{W^i}\right)] + \pi^H[\mu^H \ln(C_2^H)] + \pi^W[\phi^i \mu^W \sum ln\left(C_2^{W^i}\right) + (1-\phi^i)c] \quad (5)$$

subject to

$$F_1(A, Q_1) + B = \sum_{i\in(H,W^i)} \ln(C_1^i) + rq_1 \quad (6)$$

$$F_1(A, Q_2) = \sum_{i\in(H,W^i)} \ln\left(C_2^i\right) + (1+r)B \qquad (7)$$

$$Q_2 = Q_1 + q_1 \qquad (8)$$

2.1 Lagrangian optimization

The Lagrangian equation and its first order conditions are as follows:

$$Max_{C_1^H, C_1^{W^i}, C_2^H, C_2^{W^i}, B, q_1, q_2} \Lambda = \mu^H \ln(C_1^H) + \mu^W \sum ln\left(C_1^{W^i}\right) + \beta[\mu^H \ln(C_2^H) + \mu^W \sum ln\left(C_2^{W^i}\right)$$

$$- \lambda_1 [\ln C_1^H + rq_1 - (f(A, Q_0 + q_1) + B$$

$$- \lambda_2 [\sum \ln C_1^{W^i} + rq_1 - (f(A, Q_0 + q_1) + B$$

$$- \lambda_3 \pi^B [\ln C_2^H + rq_2 + (1+r)B - (f(A, Q_0 + Q_1 + q_2)]$$

$$- \lambda_4 \pi^B [\sum \ln C_2^{W^i} + rq_2 + (1+r)B - (f(A, Q_0 + Q_1 + q_2)]$$

$$- \lambda_5 \pi^H [\ln C_2^H + rq_2 + (1+r)B - (f(A, Q_0 + Q_1 + q_2)]$$

$$- \lambda_6 \pi^W \phi^i [\sum \ln C_2^{W^i} + rq_2 + (1+r)B - (f(A, Q_0 + Q_1 + q_2)] + \left(1 - \phi^i\right)c \qquad (9)$$

The first order conditions for this problem are:

$$\frac{\delta\Lambda}{\delta C_1^H} = \mu^H \frac{1}{C_1^H} - \lambda \frac{1}{C_1^H} \tag{10}$$

$$\frac{\delta\Lambda}{\delta C_1^W} = \mu^W \sum \frac{1}{C_1^{W^i}} - \lambda \sum \frac{1}{C_1^{W^i}} \tag{11}$$

$$\frac{\delta\Lambda}{\delta C_2^H} = \beta\mu^H \frac{1}{C_2^H} - \lambda\pi^B \frac{1}{C_2^H} - \lambda\pi^H \frac{1}{C_2^H} \tag{12}$$

$$\frac{\delta\Lambda}{\delta C_2^{W^i}} = \beta\mu^W \sum \frac{1}{C_2^{W^i}} - \lambda\pi^B \sum \frac{1}{C_2^{W^i}} - \lambda\pi^W \phi^i \sum \frac{1}{C_2^{W^i}} \tag{13}$$

$$\frac{\delta\Lambda}{\delta q_1} = -\lambda r + \frac{\delta \mathrm{f}(A, Q_0 + q_1)}{\delta q_1} - \lambda r + \frac{\delta \mathrm{f}(A, Q_0 + q_1)}{\delta q_1} \tag{14}$$

$$\frac{\delta\Lambda}{\delta q_2} = -\lambda\pi^B r + \lambda\pi^B \frac{\delta \mathrm{f}(A, Q_0 + Q_1 + q_2)}{\delta q_2} - \lambda\pi^B r + \lambda\pi^B \frac{\delta \mathrm{f}(A, Q_0 + Q_1 + q_2)}{\delta q_2}$$

$$-\lambda\pi^H r + \lambda\pi^H \frac{\delta \mathrm{f}(A, Q_0 + Q_1 + q_2)}{\delta q_2}$$

$$-\lambda\pi^W \phi^i r + \lambda\pi^W \frac{\delta \mathrm{f}(A, Q_0 + Q_1 + q_2)}{\delta q_2} \tag{15}$$

2.2 Setting FOCs = 0

From equations 14 and 15, I find that

$$\frac{\delta \mathrm{f}}{\delta q_1} = r \tag{16}$$

$$\frac{\delta \mathrm{f}}{\delta q_2} = \frac{2\pi^B r + \pi^H r + \pi^W \phi^i r}{2\pi^B r + \pi^H r + \pi^W r} \tag{17}$$

From (16) and (17), two conclusions can be drawn. First, in period t = 1, the household achieves optimal investment when the marginal return of that investment is equal to the exogenous rental rate. Secondly, assuming complete and functioning markets, we can deduce that inheritance laws favoring wives are associated with positive increases in investment level. As ϕ^i becomes one (meaning that the wife is allowed to inherit), the right-hand side of equation (17) gets larger, signaling a higher return to agricultural investment Q.

4 Empirical Strategy

For the purpose of this study, I estimate a set of two empirical equations that measure the difference in agricultural investment between households in which widows are allowed to inherit land and those where they lack property rights. Similar to Dillon and Voena (2018), my empirical strategy relies on the assumption that holding observable household and community characteristics constant, inheritance norms should be independent of other factors affecting agricultural investment. While the history of land tenure systems in Uganda does not suggest any such relationship, a reasonable concern is that inheritance

laws may be correlated with other district-level trends that also affect agricultural investment. However, table 2 in the descriptive statistics shows no significant differences between households in which widow inheritance is allowed and those in which it is not. Moreover, using panel data and district and year fixed effects allows me to limit the risk of omitted variable bias due to time-invariant district level factors.

Another concern for my model specification is the possibility of endogeneity, and more specifically of reverse causality between tenure security and investment. Citing Ethiopia's 2006 land reforms which require that land not be left idle for more than two years before being confiscated, Holden and Ghebru (2016) show that such type of restrictions might contribute to this reverse causality.

My first model specification is a district and year fixed-effects regression that measures agricultural investment at the parcel level and is presented below:

$$q_{dsht} = \beta_0 + \beta_1 NoInherit_{dsh} + \gamma X_{dsh} + \nu_d + \mu_t + \varepsilon_{dsht} \qquad (18)$$

where q_{dsht} is land investment of household *h* in village *s* in district *d* at time *t*, $NoInherit_{dsh}$ is a household-level dummy variable that takes a value of 1 if widows do not inherit, X_{dsh} is a vector of household and community controls, ν_d is a vector of district fixed effects to control for prices and other time-invariant district characteristics, μ_t is a year fixed effects vector and ε_{dsht} is an error term clustered at the community level. β_1 is our main coefficient of interest. The hypothesis that insecure tenure rights for widows reduces land investment leads to the null hypothesis H_0: $\beta_1 > 0$. In other words,

when ϕ^i is equal to 0, we should expect our main coefficients to be negative indicating that households decide to limit agricultural investments due to the fear of losing control over the returns. Conversely, when ϕ^i is equal to 1, the coefficients should be positive, as a proof of investment incentives created by more secure land rights.

Next, I run a more specified regression to measure the interactive relationship between tenure rights, polygyny and agricultural investment.

$$q_{dsht} = \beta_0 + \beta_1 NoInherit_{dsh} + \beta_2 P_{dsh} + \beta_3 P_{dsh} * NoInherit_{dsh} + \gamma X_{dsh} + \nu_d + \mu_t + \varepsilon_{dsht} \quad (19)$$

In model (19), P_{dsh} is a dummy variable indicating if a household is polygynous. The interactive term P_{dsh} * $NoInherit_{dsh}$ measures the relationship between household structure and investment following the shock of widowhood. If polygamy exacerbates land tenure insecurity for co-wives, then we would expect the coefficient on this interaction term to be negative and statistically significant.

Building on these two models, I also estimate the effects of joint management on agricultural investment. Given there are no instances of women independently managing parcels in households where the husband is present, this third specification compares parcels that are jointly managed by husbands and wives to those independently manage by husbands only.

5 Data

This paper uses data from the Uganda National Household Survey (UNHS) which is one of the World Bank's Living Standards Measurement Surveys- Integrated Surveys on Agriculture (LSMS-ISA). The dataset contains a wide variety of demographic, agricultural and economic information at the plot, household and community levels. I use four waves of data between 2009 and 2013 which are representative at the national, regional, district, and urban/rural levels.

The household data cover a total of 3,123 households distributed over 322 enumeration areas (EAs). After dropping households with no agricultural activity during both cropping seasons, single-headed households as well as a small number of households that are missing key variables, the final dataset comprises 1850 households distributed over 181 enumeration areas.

For this paper, my main variables of interest are inheritance laws, which are provided at the parcel level, as well as a dummy variable indicating whether a household is polygynous. When asked about the tenure system, households are able to pick one of four options: Freehold, Leasehold, Mailo and Customary. In my main specification, I code these responses by forming a widow inheritance variable which takes a value of 1 if the land tenure system is customary and 0 otherwise.[3]

[3] According to the FAO (2002), widows in Uganda are denied all rights to inherit land under customary regimes. A government study of men's wills showed that only 10 percent of men left their land to their wives in a trust for their children, while 90 percent of the wills directed the land to be given to the children directly and stipulated that the wife would be taken care of by the children. A widow is only ensured of her continued occupation of the residential property she used to occupy with her husband but does not have the right to control this property in any way. Also, as soon as a widow remarries, her occupancy rights to this property expire.

The pooled dataset includes 9713 observations at the parcel level for 1850 households. In 2009, 21.65% of those households were polygynous, in 2010 this increased to 27.57% before decreasing respectively to 22.77% and 20.15% in 2011 and 2013.

Table 1 provides descriptive statistics for the entire sample for all outcome and control variables. The main outcome variables used in this study are the farmer's choices regarding agricultural investment. The variables that I consider are: the choice to use fertilizer (both organic and inorganic), the quantities of fertilizer used in kilograms per acre, the total number of labor hours, the type of crop cultivated (perennial vs annual) and the portion of land left to fallow. While the first three are short-term types of investment, the latter two are longer term investments since the returns are zero in the present period.

Next, in Table 2, I examine the differences in investment decisions between households in which widows are allowed to inherit vs households in which they are not. As shown by the table, there seems to be statistically significant differences in almost all of the outcome variables, except for inorganic fertilizer use, between the two inheritance structures. However, no statistically significant difference in the means of explanatory variables across the two groups.

Lastly, table 3 shows the relationship between investment and household structure. Monogamous households seem to have a greater likelihood of using organic fertilizer and of planting perennial crops as compared to their polygamous counterparts.

6 Results

In this section, I present fixed-effects regression results for the two model specifications described in the empirical strategy section. I then present several extensions to the main models, looking at the heterogeneous effects of differences in village of origin, joint management, and method of land acquisition.

6.1 Main Results

Table 4 presents the coefficient estimates for the relationship between inheritance laws and the different outcome variables. These regressions take into account both monogamous and polygynous households and include district and year fixed effects as well as household and parcel level controls.

Column 1 shows the effects of insecure land tenure on organic fertilizer use. The coefficient of interest is highly statistically significant and negative, indicating that land tenure insecurity leads to about a 6% decrease in the mean rate of fertilizer application for coupled-headed households. Similarly, column 2 suggests that inorganic fertilizer use also decreases when widows are not permitted to inherit. This coefficient is significant at the 5% level.

Columns 3, 4 5 and 6 respectively show the effects of inheritance rights on crop choice (the decision to plant perennial or annual crops), the building of erosion control for water harvesting facilities such as terraces, the portion of land left to fallow and the household's labor allocation. While widow non-inheritance is associated with a 4.20% decrease in the likelihood of planting perennial crops, a 3% decrease in the quantity of investment on erosion control facilities and in an average decrease in labor per acre by 16 days, all significant at the 1% level, it is shown to increase the likelihood of fallowing by 2.6%.

Except for fallowing, these results are consistent with those of Dillon and Voena (2018) who find that tenure insecurity led to statistically significant decreases in agricultural investment. However, the magnitudes found differ which can be explained by the differences in model specification and data. While Dillon and Voena (2018) use cross-sectional data to estimate OLS regressions, this paper benefits from a larger span of data and uses fixed-effects regressions to estimate the relationship between tenure insecurity and investment.

6.2 Effects of Household Structure

Now I turn to the effects of household structure on agricultural investment by estimating the differences in the levels of investment between monogamous and polygamous households.

Table 5 shows the regression estimates for the different outcome variables. While our main coefficient of interest is the interaction term between polygyny and no inheritance, all three coefficients reported are important in understanding the dynamics between household structure, tenure insecurity and investment.

First, β_1 the coefficients on "widows do not inherit" is negative and statistically significant for all outcome variables except for fallowing, which is consistent with the results in table 4 and indicate that monogamous households follow the pattern of investment predicted by our theoretical model defined in section 3. However, this seems to differ for polygynous households. In fact, we see that except for column 5, the coefficient on the interaction term is positive indicating that, in communities where widows face the threat of land expropriation, polygamy may act as an insurance and provide a way to mitigate some of the risk associated with insecure land tenure for

women. Results from column 3 for instance indicate that when a policy of widow non-inheritance exists, being in a polygamous household leads to a statistically significant 4.79% increase in the planting of perennial crops.

6.3 Empirical Extensions

So far, the empirical results suggest that the fear of land expropriation leads to a decrease in agricultural investment in couple-headed households, which is consistent with the findings of Dillon and Voena (2018). Moreover, unlike monogamous households which follow a pattern similar to that predicted by our conceptual model, polygynous households seem to experience positive changes in investment when land tenure is insecure.

I now consider three potential extensions to the main specifications. The first one looks at the effects of joint management between husband and wives, the second tests for heterogeneity based on differences in district of origin and the last one studies the implications of different land acquisition methods.

6.3.1 Effects of Joint Management

Table 6 shows the effects of joint management and polygyny on agricultural investment. Focusing on the terms “jointly managed”, “jointly managed*no_inheritance” and “jointly managed*no_inheritance*polygamy” in the regression allows us to understand the effects of management structure on agricultural investment. First, the coefficient on “jointly managed” is positive and statistically significant for variables such as organic fertilizer use (kg/acre), crop choice, and labor allocation. This demonstrates that in monogamous households where widows do inherit, the joint management of a parcel between spouses leads to improvements in the amount of agricultural investment. On the other hand, when

the inheritance structure changes and women are longer able to inherit, joint management becomes negatively correlated with investment as shown by the negative sign on the interaction term “jointly managed*no_inheritance”. This coefficient is negative and statistically significant at the 1% level for crop choice, indicating that fewer perennial crops are being planted. These results indicate that women’s bargaining power is high enough to negatively influence agricultural investment in communities and households where women do not inherit.

The effects of joint management differ however between monogamous and polygynous households. Similar to our predictions from table 5, polygyny seems to mitigate the risk associated with insecure tenure, as shown by the positive sign on the triple interaction term “jointly managed*no_inheritance*polygamy” for variables such as organic fertilizer use and crop choice. This might be due to the fact that the presence of cowives within a household might increase each woman’s bargaining power and her ability to negotiate inheritance outcomes.

6.3.2 Effects of differences in district of origin

In addition to within-community laws and customs that regulate land access and inheritance, differences in widow inheritance outcomes might also occur due to differences in ethnicity or district of origin between spouses. While women from the same ethnic group and district of birth as their spouse might benefit from their insider status, other women can face a different set of regulations regarding property rights. Assuming that households are aware of these variations and incorporate them into their decision-making process, we should expect a decrease in investment when spouses are from different districts.

Table 7 shows an extension of our main model specification where the main coefficient of interest is the interaction term between no inheritance and the difference in district of origin. While this coefficient is negative for the majority of outcome variables, it is statistically significant at the 5% level for inorganic fertilizer use and the building of erosion control facilities such as terraces. These results indicate that for couple-headed households, differences in district of origin exacerbate land tenure insecurity and thus result in lower levels of investment.

6.3.3 Effects of heterogeneity in land acquisition methods

The last extension to the model explores the relationship between insecure land tenure systems and land acquisition. While customary land tenure remains the most prevalent form of tenure arrangement in Uganda, individuals within communities might try to circumvent its limitations by purchasing land and acquiring a title deed to it. In this sense, despite the land being located on customary grounds, individuals are able to designate their legal heirs, independent of traditional guidelines.

Table 8 shows the relationship between tenure insecurity. the purchase of land and agricultural investment. The interaction term shows that in communities where widows lack inheritance rights, purchasing land has a positive and significant effect on investment. This effect ranges from a 3.66% increase in organic fertilizer use to a 5.8% increase in the planting of perennial crops. On the other hand, these results show that the rate of fallowing decreases when land is purchased. This latter result demonstrates that purchasing land is a proxy for the active utilization of that land. In other words, households who decide to mitigate the risk associated with tenure insecurity by purchasing their parcels are more likely involved in agricultural production.

7. Conclusion

In this paper, I investigate the effects of widows' land inheritance rights on agricultural investment. Using four waves of the Uganda LSMS-ISA, I estimate district and year fixed-effects regressions for two main empirical specifications. My results suggest that insecure land tenure resulting from unfavorable inheritance laws leads to a decrease in fertilizer use, labor supply, fallowing and the planting of perennial crops, all at a statistically significant level. Moreover, I find evidence that the negative effects of insecure land tenure on investment are lower in polygamous households than in monogamous ones. In fact, polygynous households significantly increase their decision to plant perennial crops, which means that polygyny mitigates the risk associated with insecure land tenure.

Additionally, monogamous households in which parcels are jointly managed by husbands and wives together experience a statistically significant decrease in agricultural investment when land tenure is insecure as compared to other monogamous households in which widows do inherit. This goes to say that women’s bargaining power in this context is strictly positive and households take into account the risk of land expropriation upon widowhood in their decision-making process. Similar to our previous conclusions however, here also polygyny is shown to be associated with a decrease in the risk associated with policies of widow non-inheritance.

Lastly, my results also show that differences in district of origin between spouses have a negative effect on investment while purchasing land leads to statistically significant increases in investment levels.

Despite these implications of my study regarding the relationship between land tenure insecurity, household structure and agricultural investment in Uganda, a primary concern in interpreting the estimates from the models is potential bias in the parameters of interest. This bias might arise due to the presence of unobservable factors affecting the independent and outcome variables. In the context of Uganda, polygyny and agricultural investment are likely correlated with unobserved household characteristics such as wealth for example, which is not explicitly controlled for in my regressions. While I control for farm size, and cattle possession as proxies for wealth, it is possible that the error term encompasses the effects of unobserved characteristics. Additionally, while using panel data and district-year fixed effects in all model specifications help reduce some of those concerns, bias can still occur if induced by a time-variant factor.

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Table 1: Descriptive Statistics

VARIABLES	N	Mean	std. dev.
Panel A. Outcome Variables			
Labor (Days/acre)	9,177	73.06	145.340
Organic fertilizer(dummy)	9,260	0.102	0.302
Organic fertilizer(kg/acre)	9,177	24.410	183.049
Inorganic fertilizer (dummy)	9,261	0.032	0.175
Inorganic fertilizer (kg/acre)	9,177	0.752	8.592
Fallowing decision (dummy)	9,713	0.236	0.425
Crop choice (perennial = 1)	9,713	0.737	0.261
Panel B. Explanatory Variables			
Inheritance law (customary = 1)	9,713	0.577	0.494
Total Area planted (acres)	9,713	2.437	8.169
Parcel size (acres)	9,713	4.468	12.152
Total no. wives	9,713	1.019	0.267
Number of children	9,713	4.306	2.615
Household size	9,713	7.850	3.306
Jointly managed	9,713	0.739	0.236
Household head schooling	9,713	0.881	0.324
Household head age	9,713	46.085	13.968
Erosion	9,713	0.186	0.389
Soil quality	9,713	0.769	0.674

Table 2: Investment decisions by inheritance norm

VARIABLES	Widows can inherit	Widows can't inherit	Difference
Panel A. Outcome Variables			
Labor (Days/acre)	88.782	61.279	27.503***
Organic fertilizer(dummy)	0.197	0.030	0.166***
Organic fertilizer(kg/acre)	49.194	5.839	43.355***
Inorganic fertilizer (dummy)	0.034	0.030	0.004
Inorganic fertilizer (kg/acre)	0.476	0.958	-0.481**
Fallowing decision (dummy)	0.038	0.099	-.061***
Crop choice (perennial = 1)	.387	0.126	0.261***
Panel B. Explanatory Variables			
Total Area planted (acres)	2.358	2.494	-0.136
Parcel size (acres)	5.190	3.939	1.251
Total no. wives	1.013	1.024	-0.011
Number of children	4.364	4.263	0.101
Household size	7.884	7.824	0.060
Jointly managed	1.658	1.792	-0.134**
Household head schooling	0.879	0.881	-0.001
Household head age	45.939	46.191	-0.251
Erosion	0.192	0.181	0.011
Soil quality	0.776	0.764	.0012
	4,108	5,605	

Table 3: Investment decisions by household structure

VARIABLES	Monogamous Households	Polygamous Households	Difference
Panel A. Outcome Variables			
Labor (Days/acre)	72.959	73.393	-.433
Organic fertilizer(dummy)	.106	.086	.019**
Organic fertilizer(kg/acre)	25.521	20.785	4.736
Inorganic fertilizer (dummy)	.031	.033	-.002
Inorganic fertilizer (kg/acre)	.795	.608	.187
Fallowing decision (dummy)	.075	.066	.009
Crop choice (perennial = 1)	.246	.204	.041***
Panel B. Explanatory Variables			
Inheritance law (customary = 1)	.561	.629	-.068***
Total Area planted (acres)	2.358	2.697	-.339
Parcel size (acres)	2.358	5.047	-.754**
Total no. wives	1.006	1.063	-.057***
Number of children	4.158	4.794	-.636***
Household size	7.656	8.487	-.831***
Jointly managed	1.658	1.792	-0.134**
Household head schooling	.893	.838	.055***
Household head age	45.376	48.423	-3.047***
Erosion	0.183	0.195	-0.012
Soil quality	0.777	0.744	0.032*
	7,454	2,259	

Table 4: Effects of inheritance on land investment

VARIABLES	(1) Organic fertilizer (dummy)	(2) Inorganic fertilizer (dummy)	(3) Crop choice	(4) Erosion control facility	(5) Fallowing	(6) Labor days per acre
Widows do not inherit	-0.0567***	-0.0149**	-0.0419***	-0.0281**	0.0262**	-15.80***
	(0.0116)	(0.00716)	(0.0149)	(0.0132)	(0.147)	(5.377)
Constant	0.177***	0.0545***	0.184***	0.560***	0.0737***	0.0737***
	(0.0263)	(0.0162)	(0.0338)	(0.0299)	(0.0235)	(0.0235)
Observations	8,829	8,829	9,240	9,240	9240	8,750
R-squared	0.221	0.137	0.323	0.588	0.121	0.290
Controls	YES	YES	YES	YES	YES	YES
District-Year FE	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

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

Note: Control variables were removed in order to fit regression output on this page. These controls include: parcel size, farm size, household size, number of children, number of wives, age and education level of the household head, soil quality indicators, and a wealth control in the form of a dummy for possession of cattle.

Table 5: Effects of inheritance rights on polygynous vs monogamous households

VARIABLES	(1) Organic fertilizer dummy	(2) Inorganic fertilizer dummy	(3) Crop choice	(4) Fallowing	(5) Erosion control facility
Widows do not inherit	-0.0568***	-0.0177**	-0.0535***	0.0218**	-0.0273**
	(0.0122)	(0.00754)	(0.0157)	(0.0109)	(0.0139)
Polygamy	0.000474	-0.00244	-0.0398***	-0.0116	0.0280**
	(0.0119)	(0.00735)	(0.0154)	(0.0107)	(0.0136)
Polygamy*No_inheritance	0.000317	0.0108	0.0479**	0.0180	-0.00530
	(0.0152)	(0.00940)	(0.0196)	(0.0137)	(0.0173)
Constant	0.177***	0.0554***	0.186***	0.0747***	0.562***
	(0.0263)	(0.0162)	(0.0338)	(0.0235)	(0.0299)
Observations	8,829	8,829	9,240	9,240	9,240
R-squared	0.221	0.137	0.324	0.121	0.588
Controls	YES	YES	YES	YES	YES
District-Year FE	YES	YES	YES	YES	YES

Standard errors in parentheses

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

Note: Control variables were removed in order to fit regression output on this page. These controls include: parcel size, farm size, household size, number of children, number of wives, age and education level of the household head, soil quality indicators, and a wealth control in the form of a dummy for possession of cattle.

Table 6: Effects of joint management

VARIABLES	(1) Organic fertilizer	(2) Inorganic fertilizer	(3) Crop choice	(4) Labor per acre	(5) Fallowing decision
Widows do not Inherit	-0.0574***	-0.00879	-0.00284	-11.98*	0.0227*
	(0.0164)	(0.0100)	(0.0208)	(6.577)	(0.0137)
Polygamy	-6.37e-06	0.00285	-0.0224*	11.74***	-0.000605
	(0.0102)	(0.00627)	(0.0130)	(4.105)	(0.00855)
Jointly managed	0.00599	0.00454	0.0465***	12.92***	0.00226
	(0.0110)	(0.00671)	(0.0139)	(4.377)	(0.00916)
Jointly*no_inheritance	-0.0117	-0.00421	-0.0750***	-0.554	0.00307
	(0.0149)	(0.00912)	(0.0189)	(5.967)	(0.0124)
Jointly*no_inheritance*polygamy	0.00311	-0.00124	0.0305	-11.43*	-0.00331
	(0.0159)	(0.00973)	(0.0203)	(6.368)	(0.0133)
Constant	0.178***	0.0560***	0.147***	83.78***	0.0605**
	(0.0286)	(0.0175)	(0.0364)	(11.45)	(0.0239)
Observations	7,981	7,981	8,213	7,901	8,213
R-squared	0.231	0.146	0.336	0.501	0.126
Controls	YES	YES	YES	YES	YES
District-Year FE	YES	YES	YES	YES	YES

Standard errors in parentheses

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

Note: Control variables were removed in order to fit regression output on this page. These controls include: parcel size, farm size, household size, number of children, number of wives, age and education level of the household head, soil quality indicators, and a wealth control in the form of a dummy for possession of cattle.

Table 7: Effects of differences in district of origin between spouses

VARIABLES	(1) Organic fertilizer	(2) Inorganic fertilizer	(3) Crop choice	(5) Fallowing	(5) Erosion control facility
Widows do not inherit	-2.832	-0.00919	-0.0320**	0.0226**	-0.0151
	(8.099)	(0.00751)	(0.0156)	(0.0110)	(0.0139)
Difference in district of origin	14.57**	0.00997	0.00278	-0.000941	0.0323***
	(6.644)	(0.00618)	(0.0129)	(0.00905)	(0.0114)
No_inheritance*difference in origin	-12.27	-0.0162**	-0.00386	0.00145	-0.0385**
	(8.881)	(0.00824)	(0.0171)	(0.0120)	(0.0151)
Constant	39.63**	0.0516***	0.173***	0.0778***	0.537***
	(17.16)	(0.0159)	(0.0331)	(0.0233)	(0.0294)
Observations	8,960	9,040	9,469	9,469	9,469
R-squared	0.082	0.137	0.325	0.121	0.594
Controls	YES	YES	YES	YES	YES
District-Year FE	YES	YES	YES	YES	YES

Standard errors in parentheses

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

Note: Control variables were removed in order to fit regression output on this page. These controls include: parcel size, farm size, household size, number of children, number of wives, age and education level of the household head, soil quality indicators, and a wealth control in the form of a dummy for possession of cattle.

Table 8: Effects of purchasing land on investment

VARIABLES	(1) Organic fertilizer	(2) Inorganic fertilizer	(3) Crop choice	(4) Fallowing	(5) Erosion control facility
Widows do not inherit	-0.0719***	-0.0215***	-0.0662***	0.0370***	-0.0312**
	(0.0130)	(0.00804)	(0.0167)	(0.0117)	(0.0148)
Purchase dummy	-0.0412***	-0.00487	-0.0440***	0.0206**	-0.00704
	(0.00945)	(0.00583)	(0.0121)	(0.00847)	(0.0108)
No_inheritance*Purchase	0.0366**	0.0158*	0.0582***	-0.0260**	0.00751
	(0.0142)	(0.00879)	(0.0182)	(0.0127)	(0.0161)
Constant	0.188***	0.0595***	0.202***	0.0655***	0.563***
	(0.0266)	(0.0164)	(0.0342)	(0.0239)	(0.0303)
Observations	8,829	8,829	9,240	9,240	9,240
R-squared	0.221	0.137	0.324	0.121	0.588
Controls	YES	YES	YES	YES	YES
District-Year FE	YES	YES	YES	YES	YES

Standard errors in parentheses

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

Note: Control variables were removed in order to fit regression output on this page. These controls include: parcel size, farm size, household size, number of children, number of wives, age and education level of the household head, soil quality indicators, and a wealth control in the form of a dummy for possession of cattle.

Appendix: Land tenure systems in Uganda

Article 237 of the Constitution of Uganda recognizes four tenure systems: customary, freehold, leasehold and mailo.

Customary land ownership is based on traditional rules which are specific to clans or communities. According to Oryema (2014), in this type of social organization the rights to use or control land are derived from being a member of the clan and by retaining affiliation to that clan. However, no specific ownership rights are conferred to individual users.

Unlike customary laws, freehold tenure is the land tenure system that grants absolute rights of ownership to individuals. To many this form of land tenure system, which is governed by Uganda's Registration Title Act, is preferable to communal ownership for it allows the individual with the title deed access to and use of land for an indefinite period of time. Unlike customary tenure which exists across more than half of the national territory, the portion of land under freehold tenure is estimated to only 18.6% of Uganda arable lands (Oryema, 2014).

The third type of land tenure arrangement is mailo which often described as a hybrid between the first two systems. While land occupants under this system often are tenants rather than landlords, they benefit from statutory rights to the land.

Lastly, the leasehold system can as defined holding land for a known time frame based on conditions in an agreement between the registered owner and the tenants. This type of tenure is often required of non-citizen of Uganda who are not allowed to own land under the under systems (FAO, 2002).