Gender, Power and Agricultural Investment in Ghana[1]

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INTRODUCTION

Livelihoods and welfare in the rural areas of developing countries are largely determined by agricultural productivity. Therefore, the economic forces that shape patterns of investment in agriculture have long been the focus of attention by development economists. It is apparent that investment incentives depend upon expectations of rights over the returns to that investment. This argument has spawned a large literature on property rights in land and there relationship to investment in land and in turn to agricultural productivity. There are several obvious mechanisms through which property rights over land might influence investment in agriculture: fears of expropriation or loss of control over land on which investments have been made might deter investment; access to credit might be hindered if property rights are not sufficiently well-defined for land to serve as collateral for loans; and an inability to capture potential gains from trade in improved land might reduce investment incentives. Each of these mechanisms has received a good deal of attention in what has become a large literature (citations).

In much of Africa, explicit land transactions – sales, cash rentals, sharecropping – have become more common over recent decades. However, the consensus of the literature is that "the commercialisation of land transactions has not led to the consolidation of land rights into forms of exclusive individual or corporate control comparable to Western notions of private property" (Berry, NCP, 104). Instead, in much of West Africa, land "is subject to multiple, overlapping claims and ongoing debate over these claims' legitimacy and their implications for land use and the distribution of revenue" (Berry, CNTB, xxi). Individuals' investments in a particular plot might in turn influence their claims over that piece of land: "individually rewarded land rights are further strengthened if land converters make long-term or permanent improvements in the land, such as tree planting. Land rights, however, tend to become weaker if land is put into fallow over extended periods." (Quisumbing, Aidoo, Payongayong and Otsuka, 55; see also Besley *JPE* 1995). Causality can run in both directions between investment and rights over land.

The complexity and flexibility of property rights is apparent in our study area in Akwapim, Ghana. (Refs) Most of the land cultivated by farmers in these villages is under the ultimate control of local political leadership. Land is held by holders of stools, in trust for members of the lineage (*abusua*). It is allocated to families for use on the basis of perceived need and the political influence of the family, and also to individuals on the same basis.

Outline of remainder of introduction:

1. outline of claims to land in southern Ghana: individual, household, family, stool. most important point, these are multiple and overlapping. Property rights over land in southern Ghana complex, multifaceted, negotiable. cites to Berry, etc... Land rights are political: they depend on your ability to mobilize support for them. They depend on the provenance of the land, on interpretations of history, they depend on your position within a political hierarchy. And they might depend on your demonstrated need for the land. Things to cite: B.K. Fred-Mensah, "Changes, ambiguities and conflicts in Buem, eastern Ghana" Ph.D. diss JHU 1996. Biebuyck, ed. *African agrarian systems* Oxford Univ press; J. Bruce and S. Migot-Adholla, eds., *Searching for Land Tenure Security in Africa*, 1994; Binswanger and Rosenzweig; Binswanger, Deininger and Feder in Handbook III; Bassett, "Cartography, ideology and power: The World Bank in northern Côte d'Ivoire," *Passages* 5 (1993); Pauline Peters, *Dividing the Commons: Politics and Culture in Botswana.* D. Bromley, "Property relations ..."

2. Because they are so ambiguous, they are exercised informally, perhaps through political power. "Instead, people's ability to exercise claims to land remains closely linked to membership in social networks and participation in both formal and informal political processes..." Berry, NCP 104 "Claims on land are routinely exchanged for money, but land itself is subject to multiple, overlapping claims and ongoing debate over these claims' legitimacy and their implications for land use and the distribution of revenue. Rather than induce or impose consensus on rules and boundaries, the formalization of land administration and processes of adjudication have added new layers of interpretation and debate, complicating rather than hardening the lines of

authority and exclusion." Berry, CNTB xxi. "In principle, any individual is entitled to use some portion of his or her family's land, but people's abilities to exercise such claims vary a good deal in practice and are often subject to dispute. Disputed claims may turn on conflicting accounts not only of individuals' histories of land use, field boundaries, or contributions to land improvements but also their status within the family, or even their claims of family membership itself." (Berry, CNTB, 145). "As people negotiate claims to farmland, they also negotiate claims to kinship and citizenship: their debates reflect the links between property and social relationships ..." (Berry, CNTB 145).

3. Plots are virtually never lost when cultivated – it is while they are fallow that rights can be lost. Describe farming system. Maize-cassava intercropping, soil fertility maintained through periodic fallow. "Since colonial times, the courts have held that while allodial rights to land belong to the stool, families' rights of usufruct are secure from arbitrary intervention." (Berry, CNTB 145, citing N.A. Ollenu and G.R. Woodman, eds., *Ollenu's principles of customary law*. 2nd ed

4. Thus there is the possibility that the most important investment in land in the area, which is appropriate fallowing, might be discouraged by fear of losing control. "We postulate that evolutionary changes in customary land tenure institutions have taken place to achieve greater efficiency in the use and allocation of land ... shifting cultivation implies that land will be periodically put to fallow in order to restore soil fertility. However, because of tenure insecurity under traditional land tenure institutions, there is no strong guarantee that the cultivator can keep fallow land for his or her own use in the future. The most feasible strategy to guarantee use rights is to use the land continuously. Thus, we hypothesize that tenure insecurity induces the shortening of the fallow period." (QAPO, 71-72). QAPO table 3.12 shows that allocated land is less likely to be fallowed, and borrowed from nonrelative land is almost never fallowed. But not much in the way of controls for fertility.

5. Other types of investment, especially tree planting, will look very different. The type

of investment matters crucially – planting a tree or building a structure helps cement your claim. Fallowing leaves you more vulnerable. It is the nexus of a particular form of investment and these complex and overlapping rights that is problematic.

6. All of this will be observed within households. The lines of influence that secure tenure largely bypass women.

RESOURCE MANAGEMENT AND LAND TENURE

In southern Ghana as in many African societies, agricultural production is carried out on multiple plots managed separately by individuals in households. Soil fertility is managed primarily through fallowing: cultivation is periodically stopped in order for nutrients to be restored and weeds and other pests to be controlled. An individual's decisions regarding the optimal time path of fertility and of agricultural output from a given plot in such a system depends, *inter alia*, on the opportunity cost of capital to that individual and his or her confidence in her ability to re-establish cultivation on the plot after fallowing.

Consider an individual i (in household h) managing several plots indexed by p. We assume that $i's$ aim is to manage fertility to maximize the present value of the stream of profits she can claim from her plots.[1] Soil fertility is a dynamic system which affects and is affected by crop growth. We simplify drastically by supposing that all the relevant aspects of soil fertility on i's plot p at time t can be represented by a single index ϕ_{ipt}. Output on plot p at t depends upon its fertility and on labor input l_{ipt}: $y_{ipt} = f(\phi_{ipt}, l_{ipt})$ with f increasing and strictly concave in both fertility and labor inputs. Let w_{ht} be the (possibly household-specific) cost of labor (it is easy to generalize this to a vector of inputs - nothing of substance changes, though fertility dynamics can be more interesting).

[1] In general, of course, this assumption is consistent with utility maximization only if factor and insurance markets are complete (Krishna 1964; Singh, Squire and Strauss 1986). However, by the second welfare theorem, fertility management in an efficient allocation of resources within a group of people – a household, for example – is identical to that under complete markets (Goldstein and Udry 2002). We discuss the implications of this for our argument below.

Consider a particularly simple law of motion for fertility on plot i:

$$\phi_{ip,t+1} = \phi_{ipt} + g(l_{ipt}) \tag{1}$$

where $g(0) = \bar{g} > 0$, $g(x) < 0$ for all $x > 0$, with $g'(x), g''(x) \leq 0 \ \forall x > 0$. When (and only when) the plot is fallowed, labor inputs are zero and the fertility of the plot regenerates at a rate of $\bar{g}$ per period.[2] When the plot is cultivated, fertility declines, and that decline is possibly increasing with more intensive cultivation.

Another essential aspect of a system of resource management based on periodic fallowing is the existence of a transition cost associated with returning a plot to cultivation after fallowing. In southern Ghana, this is the cost of clearing (and burning) the fallowed plot before it can be cultivated. Let b_{it} be the cost associated with clearing on plot i in period t, so $b_{it} = \bar{b}$ if $l_{i,t-1} = 0$ and $l_{it} > 0$, and $b_{it} = 0$ otherwise.

Finally, the discussion in the previous section makes it apparent that rights over a plot can be lost while it is fallow. Let ω_{ip} be the probability that individual i will be able to maintain her rights over plot p during a period of fallow. It is possible that this probability varies both across individuals and across plots of a given individual, depending upon i's ability to mobilize political and social support for her claims over particular pieces of land.

Therefore, i's decisions regarding the management of her plot solve

$$\max_{\{l_{ipt}\}} \sum_{t=0}^{\infty} \sum_{p} (1 + r_i)^{-t} \pi_{ipt} \tag{2}$$

where

$$\pi_{ipt} = \Omega_{ipt} \left[f(\phi_{ipt}, l_{ipt}) - w_{ht} l_{ipt} - b_{ipt} \right] \tag{3}$$

and Ω_{ipt} is an indicator equal to 1 if i controls plot p at t. $\Omega_{ip0} = 1$; $\Omega_{ipt} = 0$ if $\Omega_{ip,t-1} = 0$ (because we assume that plots, once lost, are not recovered); $\Omega_{ipt} = 1$ if $\Omega_{ip,t-1} = 1$ and $l_{ipt} > 0$ (because control over a cultivated plot is not disputed); and if $\Omega_{ip,t-1} = 1$ and

[2] This is not an entirely sensible assumption in farming systems with managed fallows, as in Ghana. In such systems, farmers sometimes find it optimal to use labor on fallow plots to speed the regeneration of fertility (Amanor 1994). For our purposes here, though, little is lost by this simplification.

$l_{ipt} = 0$, $\Omega_{ipt} = 1$ with probability ω_{ip} and $\Omega_{ipt} = 0$ with probability $1 - \omega_{ip}$ (control over the plot is maintained with probability ω_{ip} while fallow).

Suppose $\{l^*_{ipt}\}$ is the solution to (2). It is apparent that decisions regarding plot p for individual i are independent of the decisions on any other plot q of i; the problems are additively separable. It is straightforward (and tedious) to show that for strictly convex f and $g(x) < 0$ for $x > 0$, there is a unique optimal sequence $\{l^*_{ipt}\}$ such that there exists a $\hat{\phi}$ such that $l^*_{ipt} > 0$ for all t such that $\phi_{ipt} > \hat{\phi}$. Because $l_{ipt} > 0$ in such periods, $\phi_{ip,t+1} < \phi_{ipt}$. At $\hat{t}$ such that $\phi_{ip,\hat{t}-1} > \hat{\phi} \geq \phi_{ip\hat{t}}$, $l_{ip\hat{t}} = 0$ and the land is fallowed. There also exists a $\bar{\phi}$ such that at $\bar{t} > \hat{t}$, $\phi_{ip,\bar{t}-1} < \bar{\phi} \leq \phi_{ip,\bar{t}}$, and for all τ such that $\hat{t} \leq \tau < \bar{t}$, $l_{ip,\tau} = 0$ but $l_{ip\bar{t}} > 0$ and the land is put back into cultivation and remains in cultivation until ϕ again drops below $\hat{\phi}$ and the cycle repeats.[3]

The values $\hat{\phi}$, $\bar{\phi}$, the optimal sequence $\{l^*_{it}\}$ and its implied $\{\phi^*_{it}\}$ depend upon r_i and ω_{ip}. The duration of fallowing $(\bar{t} - \hat{t})$ is increasing in ω_{ip}, and declining in r_i. However, $\hat{\phi}$ and $\bar{\phi}$ are *independent* of initial fertility ϕ_{ip0}. Thus the particular sequence $\{l^*_{ipt}\}$ depends upon the initial level of fertility of plot p only to the extent that ϕ_{ip0} determines the point of entry into the optimal fertility cycle. The duration of fallowing will be the same on any two plots p cultivated by i and q cultivated by j and labor use (and profits and output) are identical on the two plots when they are at the same point in the fertility cycle if $r_i = r_j$ and $\omega_{ip} = \omega_{jq}$.

Given imperfect financial and labor markets in rural Ghana, it is unlikely that the opportunity costs of capital or labor are identical across plots cultivated by individuals in different households. However, they will be the same across plots cultivated by the same individual, and if households allocate resources efficiently across household members, then they will be identical across plots within households. These observations form the basis of our initial empirical work.

[3] Lewis and Schmalensee (1977, proposition 11) were the first to describe optimal fallowing cycles for renewable resources. McConnell (1983), Barrett (1991) and Krautkraemer (1994) use closely related models to examine the responsiveness of optimal fertility management policies to exogeneous changes in the economic environment.

THE DATA AND EMPIRICAL SETTING

The data in this paper come from a two year rural survey in the Akwapim South District of the Eastern Region of Ghana. We selected four village clusters (comprising 5 villages and two hamlets) with a variety of cropping patterns and market integration. Within each village cluster we selected 60 married couples (or triples - about 5-10 percent of the population is polygynous) for our sample; in three village clusters this was random, and in the fourth, we interviewed the entire population of married couples. Each member of the pair or triple was interviewed 15 times during the course of the two years. Every interview was carried out in private, usually by an enumerator of the same gender.

The survey was centered around a core group of agricultural activity questionnaires (plot activities, harvests, sales, credit) that were administered during each visit. In addition about 35 other modules were administered on a rotating basis. We also administered (once per field) an in-depth plot rights and history questionnaire and mapped each plot using a geographical information system. We supplemented this with data on soil fertility: the organic matter and pH of each plot was tested each year.

The core of the analysis in this paper is based on the plot activities questionnaires. These collected data on inputs, harvests and sales at intervals of 5-6 weeks for all plots farmed by individual respondents. We complement this with data on education (administered once) credit use (14 times), family background (administered once), household demographics (administered 3 times), and time allocation (administered twice). {description of data on individual wealth. definitions of each of the family background variables, description of contract types and sources of land variables} {description of summary statistics, maize&cassava as an intercropped system, focus on that system alone}

PRODUCTIVITY IN A FALLOW FARMING SYSTEM

We begin by testing the hypothesis that land rights are sufficiently strong that $\omega_{ip} \approx 1$, so that no one need fear that their plot will be lost when fallowed. If this is the case, and households allocate resources efficiently, then the marginal value products of inputs used on farm operations are equated across plots, at least within households. We do *not* assume that input costs or the opportunity cost of capital is similar across households. A simple characteristic of an efficient allocation within households is that

$$\phi^*_{ipt} = \phi^*_{jqt} \Rightarrow l^*_{ipt} = l^*_{jqt}$$

for plots p, q cultivated by i, j in a given household. Within the household, plots of similar fertility should be cultivated similarly. Moreover, we have seen that the optimal fallowing path does not vary across plots within the household, so in the efficient allocation ϕ^*_{ipt} varies across plots only because plots are observed at different points in the cycle. We take the timing of the survey to be arbitrary and assume that the within household variation in position of plots within the fallowing cycle is uncorrelated with other plot characteristics.

So we can define profits on plot p at time t as a function only of fixed characteristics of that plot:

$$\pi_t(\phi_{ip0}, X_{ip}) \equiv f(\phi^*_t(\phi_{ip0}, X_{ip}), l^*_t(\phi_{ip0}, X_{ip}), X_{ip}) - w_{ht} l^*_t(\phi_{i0}, X_{ip}) - b^*_{ipt}(\phi_{ip0}, X_{ip}),$$

where X_{ip} is defined as a vector of fixed characteristics of plot p. A first-order approximation of the difference across plots within a household is

$$\pi_t(\phi_{ip0}, X_{ip}) - \pi_t(\bar{\phi}_{h0}, \bar{X}_h) \approx \frac{\partial \pi_t}{\partial X}(X_{ip} - \bar{X}_h) + \frac{\partial \pi_t}{\partial \phi}(\phi_{ip0} - \bar{\phi}_{h0}). \tag{4}$$

We rewrite (4) as

$$\pi_{it} = \mathbf{X}_{ip}\beta + \gamma G_{ip} + \lambda_{h_{ip},t} + \epsilon_{ipt}, \tag{5}$$

where X_{ip} is the vector of fixed characteristics of plot i, β is $\frac{\partial \pi_t}{\partial X}$, and G_{ip} is the gender of the cultivator of that plot. h_{ip} is the household in which the cultivator of plot ip resides, and $\lambda_{h_{ip}t}$ is a fixed effect for the household-year . $\epsilon_{ipt} = \frac{\partial \pi_t}{\partial \phi}(\phi_{ip0} - \bar{\phi}_{h0}) + \nu_{ipt}$, where ν_{it} is an error term (that might be heteroskedastic and correlated within household-year groups) that summarizes the effects of unobserved variation in plot quality and plot-specific production shocks on profits. The exclusion restriction of the model is that $\gamma = 0$, in an efficient household, the identity of the cultivator is irrelevant for profits.

Within the vector **X** we include a variety of plot characteristics – size, toposequence, direct measures of soil quality (the soil pH and organic matter content) as well as the respondent-reported soil type classified into clay, sand or loam. These soil types might affect profits and inputs through their different nutrient retention capacities, among other factors.

The Within-Household Gender Differential

Table 2 presents estimates of equation (5). Recall that the interpretation of the results is in terms of deviations from household-year means for cassava-maize plots: with imperfect factor markets we do not expect returns to be equalized across households or years. However, a systematic difference in the returns to cassava/maize cultivation on similar plots of men and women *within* a household in a given year violates the joint hypothesis of Pareto efficiency within households and secure land tenure. This is what we find. Conditional on plot characteristics and household fixed effects, profit per hectare (x1000 Ghana cedis, column 1) is much lower on women's plots then on the plots of their husbands.[4] Moreover, the coefficient on gender is quite large – at approximately one million cedis, it is about twice the size of average profits on maize and cassava plots. In column 2 we see a similar result for yield per hectare. Again the effect is large: the coefficient is about the same as the average yield per hectare. Conditional on the observed characteristics of their plots, wives produce much less maize and cassava than their husbands and achieve correspondingly lower profits.

There is no strong evidence that factor inputs are systematically different on the plots of women and those of their husbands. While the point estimates of the gender effect are large (almost twice the mean) for both labor and seed costs, the standard errors are even larger. It is not possible to draw strong conclusions regarding the relative intensity of input use on husbands and wives' plots from our data.

Other observed plot characteristics have little effect on profits. Plot size is particularly

[4]During the survey, the value of the cedi was approximately 2200 cedis to $1 US.

relevant for yields: output per hectare drops strongly with plot size, but so does labor use. We do not have strong evidence that observed soil type, measured soil chemistry and plot topography are strongly related to profits, yields, or input use.

Men are much more likely to have attended school than women: on average, husbands have 4 more years of schooling than their wives ($t = 8.6$), and average schooling in the sample is just 7 years. In addition, men are an average of 7 years older than their wives ($t = 10.6$). However, in column 1 of Table 3 we see that these differences in the human capital of husbands and their wives do not contribute to the gender differential in farm profit (or, in results not shown, to the difference in yields). We find that the gender differential in farm profit is actually larger when we condition on age and education, because education is strongly negatively correlated with plot profits. This almost surely reflects the strong selection induced by rural-urban migration in Ghana: well educated individuals who are cultivating in rural Ghana are not typical of the population.[5]

It is not possible to reject the hypothesis that the coefficients of soil pH and OM are jointly zero in any of these regressions. Moreover, soil chemical analysis is not available for all of the plots cultivated by individuals in our sample. Approximately 200 observations with missing values for these variables are gained by dropping pH and OM from the analysis. As can be seen in column 2 of Table 3, the gender differential is somewhat smaller in this larger sample, but still large and statistically significant.

Perhaps the most obvious and worrisome potential econometric problem with the estimates presented thus far is the possibility that there are systematic unobserved differences in the quality of land farmed by husbands and wives. The regressions include measures of the topography, soil type and basic soil chemistry of each plot. This is a relatively rich characterization of land quality. However, unobserved variation in land quality certainly remains. If women farm systematically lower quality land then their husbands, then it is not surprising that there is a gender differential in profits and yields within the household

[5] There could be an additional selection process into maize and cassava cultivation (as opposed to production of pineapple for export). However, the negative correlation between education and profitability remains strong when we pool together plots with any crop.

on observationally similar plots.

Land characteristics change gradually across space, hence our maps of the cultivated plots may help mitigate the consequences of unobserved land quality in this data. In Column 3 of Table 3, we maintain the assumption that ϵ_{hit}, the unobservable term in equation (5) is uncorrelated with the regressors but permit it to be correlated across plots as a general function of their physical distance using the spatial GMM estimation strategy in Conley (1999).[6] The standard error of the gender coefficient is lower once we account for this possible correlation.

We generalize 5 further to permit a local neighborhood effect in unobserved land quality that could be correlated with gender and the other regressors. With some abuse of notation, let N_{ip} denote both the set of plots within a critical distance of plot p and the number of such plots. We construct a within estimator by differencing away these spatial fixed effects:

$$\begin{aligned} \pi_{ipt} - \frac{1}{N_{ip}} \sum_{q \in N_{ip}} \pi_{qjt} &= (\mathbf{X}_{ip} - \frac{1}{N_{ip}} \sum_{q \in N_{ip}} X_{jq})\beta + \gamma(G_{ip} - \frac{1}{N_{ip}} \sum_{q \in N_{ip}} G_{jq}) \\ &\quad + \lambda_{h_{ip}t} - \frac{1}{N_{ip}} \sum_{q \in N_{ip}} \lambda_{h_{jq}t} + \epsilon_{ipt} - \frac{1}{N_{ip}} \sum_{q \in N_{ip}} \varepsilon_{jqt}. \end{aligned} \tag{6}$$

In column 4 of Table 3, the geographical neighborhood N_{ip} is defined using a critical distance of 250 meters. If that component of unobserved land quality that is correlated with observed plot characteristics is fixed within this small neighborhood, then the spatial fixed effect estimator defined in (6) removes this potential source of bias.

The estimate of the gender differential with both household-year and spatial fixed effects is larger than the estimate not conditional on spatial fixed effects, and the standard error (again robust to unobserved spatial correlation in the remaining error) remains small. Unobserved, spatially-correlated dimensions of land quality do not appear to underlie the

[6] Spatial standard errors are calculated using the estimator in Conley (1999) with a weighting function that is the product of one kernel in each dimension (North -South, East-West). In each dimension, the kernel starts at one and decreases linearly until it is zero at a distance of 1.5 km and remains at zero for larger distances. This estimator is analogous to a Newey-West (1987) time series covariance estimator and allows general correlation patterns up to the cutoff distances.

gender differential in agricultural profits within households. Women achieve much lower profits than their husbands on plots that appear to be of similar inherent quality.

Land Resource Management and Productivity

There is no evidence that unobserved variations in the inherent fertility of land help explain the within-household gender differential in plot profits. However, anthropogenic variations in fertility do appear to be at the root of the gap in profits between wives and their husbands. In column 1 of Table 4 we introduce a measure of the duration of the most recently completed fallow on the plot to the profit regression. When we condition on the last fallow duration, the gender differential in profits drops by about two-thirds and becomes statistically insignificant. The duration of the previous fallow is strongly positively associated with current profits. Note that this difference in fallowing durations is entirely a within-household phenomenon. Evidence for this is provided in Figure 1, which indicates that there is no striking difference in the overall fallowing patterns of men and women. In column 2 we look for evidence of nonlinearities in the relationship between fallow duration and profitability, and find little.

Of course, the duration of the previous fallow is chosen and likely to be correlated with unobserved plot characteristics, so these estimates are likely to be inconsistent. In column 3, we present household-year fixed-effect instrumental variables estimates of the same relationship, using a variety of measures of the family background of the cultivator as instruments for the duration of the most recent fallow. There is now no discernible difference between the profits on plots cultivated by women and those cultivated by their husbands; the point estimate is now *positive*, albeit small and statistically indistinguishable from zero. An additional year of fallowing is associated with an increase in profits of over $400,000$ cedis, and this estimate is statistically significant at conventional levels. This difference in fallowing behavior fully accounts for the gender differential in profits. What appeared to be evidence of an inefficient static allocation of factors of production across the plots cultivated by husbands and wives instead reflects differences in the endogenously-determined dynamic of soil fertility.

The first stage estimates of fallow duration are presented in column 4 of Table 4. The instrument set includes some important aspects of the family background of the cultivator of the plot (the number of wives of the cultivator's father and the parity of the cultivator's mother in that set, the number of children of the father,the educational background of the parents, some aspects of the migratory history of the cultivator, and an indicator equal to one if the cultivator holds a traditional family or village office). Of these indicators, only traditional office-holding has a significant relationship to fallowing behavior: plots cultivated by those who hold a traditional office have been fallowed almost 4 years longer than other plots. This is a very strong effect: the average duration of the last fallow period in our sample is just over 4 years.

This result is robust to spatially-correlated unobserved effects. In column 5 we present the instrumental variables profit function estimates with both spatial and household-year fixed effects. The estimated relationship between fallow duration and plot profits falls by about one-quarter, but is estimated more precisely. Once again there is no discernible relationship between the gender of the cultivator and profits conditional on the duration of the last fallow. The first stage estimates of the determinants of fallow duration are reported in column 6. Again, the estimates imply that those who hold traditional offices fallow for longer periods, though the coefficient falls to approximately two years. Conditional on spatial fixed effects, children of fathers who had more wives are also estimated to fallow for longer periods; this variable may be our best measure of parental wealth.

Fallowing and Wealth

What drives these different fallowing behaviors of husbands and their wives? In particular, why should individuals who hold a traditional office (who are virtually all men), or those with richer parents fallow their plots for longer periods than their spouses? Two types of explanation for why cultivators within a single household might make different decisions regarding the fallowing of physically similar plots are consistent with the evidence presented thus far.

1. It might be the case that the household is an inappropriate unit of analysis for the purposes of modeling land resource management. The intertemporal budgets of the cultivators in the household might be sufficiently individualized and the different cultivators might face credit constraints of varying severity. In this case, the different cultivators could confront different opportunity costs of capital and therefore would chose different optimal fertility paths for their plots. This is consistent with the evidence thus far because those who hold traditional office or who have wealthier fathers are both more wealthy than average and more likely to have good access to informal finance.

2. The security of tenure might vary across plots, so that the expected return to investments in the fertility of these plots is different. Tenure rights in southern Ghana are often ambiguous and negotiated, and there are a variety of mechanisms through which wealth and political influence might be manifested in superior security of tenure.

We begin by examining the hypothesis that women fallow their plots less than their husbands because they face a higher opportunity cost of capital. It is plausible that if this hypothesis is correct that (within a household) relatively wealthy individuals are less credit constrained and therefore choose longer fallow periods. Of course, individual wealth is likely to be correlated with unobserved characteristics of the plots cultivated by the individual. Therefore we estimate the determinants of the duration of the last fallow period treating current wealth as endogenous, using the occupational background of the cultivator's parents as instruments for wealth. The relevant conditioning information includes all the measures of the social and political background of the cultivator that appeared in Table 4, including the amount of inherited land, traditional office-holding status, and migratory history. The identification assumption is that conditional on these other dimensions of the cultivators background, parental occupation influences fallowing decisions only through its effect on wealth.

The first stage estimates of the determinants of current wealth are reported in column 2 of Table 5. The instruments are jointly highly significant determinants of current wealth: in particular, current wealth is much higher if the cultivator's mother was a trader rather than a farmer (the excluded category is "other occupation") or if the cultivator's father was a farmer or civil servant (relative to the excluded category of laborer). Several of the conditioning variables are also strongly related to current wealth: current wealth is positively related to the schooling of one's mother, and negatively correlated with father's schooling, strongly positively correlated to the number of wives of the father and to the parity of one's own mother in that set, and negatively related to the number of children of one's father. Individuals whose families have recently migrated to the village tend to be wealthier, and those who were fostered as children poorer.

Current wealth is well-determined by the occupation of one's parents, but in turn has nothing to do with fallowing decisions. In column 1 we present the fixed-effect instrumental variables estimates of the determinants of fallow duration with current wealth treated as endogenous. The coefficient on current wealth is quite precisely estimated to be near zero: the point estimate implies that individuals with $1,000,000$ cedis in additional wealth (mean wealth is $700,000$ cedis) fallow their plots an additional 5 months, and the coefficient is not significantly different from zero. Intrahousehold variation in fallowing durations is not related to differences in wealth across members of the household. We conclude that variations within the household in the cost of capital do not lie at the root of variations in fallowing across the plots cultivated by household members.

'Need' and Security of Land Tenure

We turn, therefore, to an investigation of tenure security and its relationship to fallowing decisions. As described in the introduction, this area of Ghana is characterized by extremely complex property rights and tenure patterns. Control over many plots is subject to negotiation Land is bought and sold or rented, but more often it comes through family or household channels with a less explicit contract. The primary source of plots for both genders is allocated family land, i.e. land that is provided by the family for use by the cultivator, usually for an open-ended period and for no rent or a small token payment. Aside from this source, men and women do have some differences in acquisition. Women rely more on allocated household land – plots that are given to them by their husband. Men, on the other hand, are more active on the land market, drawing about 30 percent of their plots from the land market through share cropping or cash rent. Although it is a less important source of land, women do engage in the land market, sharecropping and cash rent account for about 20 percent of their plots.

A straightforward interpretation of our results is provided by the model (2). The likelihood of maintaining control over a plot ω_{ip} is not near 1, and varies across individuals and perhaps across plots of a given individual. This corresponds closely to the notion that "the process of acquiring and defending rights in land is inherently a political process based on power relations among members of the social group.... A person's status ... can and often does determine his or her capacity to engage in tenure building" (Bassett, 20).

A sequence of seven focus group interviews conducted in the four villages in August-September 2002 provided further evidence on perceptions of the salient determinants of fallowing choices. Description of composition & construction of focus groups: voluntary participation, drawn from both survey respondents and non-respondents. Some groups single-gender, others mixed.

When confronted with preliminary results relating to the gender differential in plot profits and fallowing behavior, and its relationship to holders of traditional office many participants expressed little surprise. A consensus quickly emerged that the primary cause of our finding is uncertainty over land tenure, particularly for women, and particularly for those not well-connected to chiefs and family heads.

Interestingly, the mechanism that was emphasized was not a fear of investing in future land fertility on plots over which future rights were uncertain, but rather a fear that the very act of investment (that is, leaving the land fallow) would weaken future rights over the plot.[7] Much of the land cultivated in these villages is obtained through negotiation. More

[7] One female participant stated,"Se me gya asase no to ho sɛ enyin a obi bɛ ba abɛsa efi sɛ eyɛ mekunu

than half of the plots cultivated are on land that is allocated to them by either their lineage (*abusua*) or by the village leadership. The rhetoric surrounding this allocation process focuses primarily on need. Any member of the *abusua* who needs land is entitled to some for cultivation. The determination of "need", not surprisingly, is often contentious. In our focus group discussions, the claim was made several times that the act of leaving a plot fallow would demonstrate a lack of sufficient need, and therefore cast doubt on one's right to the plot.

This explanation is somewhat different from that embedded in our model (2), in which fallowing decisions are made on the basis of expectations of future tenurial security that depend upon one's social and political power and the contractual arrangements through which one has obtained land.

The problematic concept raised by the focus group participants was 'need', and the idea that the degree of one's need could be signalled by one's choices regarding fallowing. If this concept is to have any traction in an explanation of intrahousehold differences in fallowing behavior, then it must be the case that 'need' is determined on an individual basis. Therefore, we begin our model with an extreme version of this and consider each individual as autonomous from his/her household. Each individual has a plot of land, and an off-farm income opportunity. The return to this off-farm activity is private information to the individual.[8]

The model has two periods (years). Individuals are risk neutral and do not discount the future. Each individual has an endowment of T units of time in each period and control over a plot of land (of area 1). Let c be the amount of time spent cultivating the plot, and choose units of area such that c is also the amount of land that is cultivated in that c units of time. Thus $(1-c)$ of the plot is left fallow. Any land cultivated each year has a yield of 1 in each year; land left fallow this year yields $y > 2$ next year, so fallowing is productively efficient.

asase."

[8] The argument that follows builds on suggestions from Ashok Rai; we thank him, but claim all errors as our own.

Any time spent not cultivating is spent on an off-farm job with return w. There are two types of individual, one with a high return off-farm activity with return w_h, where $y > w_h > 1$; and the second with a low return $w_l < 1$.

The high-type individual's (undiscounted) income over the two periods is

$$w_h(T - c) + c + (1 - c)y + (T - (1 - c))w_h.$$

The first two terms are the first period return: w_h for the time spent not cultivating, and 1 for the time spent cultivating. The second two terms are the second period return: y for the time spent cultivating the $(1 - c)$ land that was left fallow in the first period, and w_h for the time spent not cultivating (any land that had been cultivated in period 1 is not worth cultivating in the second period, since $w_h > 1$). Left to his own devices, the high type chooses to fallow his plot in the first period ($c = 0$ since $y > 2$). Hence the high type obtains

$$w_h(2T - 1) + y$$

The low-type's income is

$$w_l(T - c) + c + (1 - c)y + c + (T - 1)w_l,$$

where once again the first two terms are period 1 income. In the second period the low-type obtains a return of y for the time spent cultivating the $(1 - c)$ land left fallow in the first period, 1 for the time spent cultivating again the land cultivated in the first period (because $w_l < 1$), and w_l for the remaining time. As with the high type, the low type would choose $c = 0$ (since $y > 2$) and obtains

$$w_l(2T - 1) + y.$$

Both types fallow their land in the first period, and because w (and, obviously, consumption) is private information, look identical to outsiders.

We consider a lineage head who allocates land to maximize his own income subject to a constraint that the incomes of the members of the lineage must be sufficiently high. In particular, suppose $w_l(2T - 1) + y$ is too low, so the lineage head is obliged to allocate land to them, but not to the high types.

If the lineage head has full information about the individuals' types, he simply allocates a unit of land to each of the low types, withholding land from the high types. In this case the low-type's income becomes

$$w_l(T - c) + c + (2 - c)y + c + (T - 2)w_l,$$

and once again the low type chooses $c = 0$. She now achieves an income of

$$w_l(2T - 2) + 2y.$$

Unfortunately, the lineage head does not have full information and so must devise a contract such that the high types will refuse the additional land; a cultivation requirement serves this purpose. The lineage head offers an additional unit of land on the condition that at least c units of land are cultivated in period 1. The incentive compatibility constraint of the high type is that

$$w_h(2T - 1) + y \geq w_h(T - c) + c + (2 - c)y + (T - (2 - c))w_h \tag{7}$$

or

$$c \geq \frac{y - w_h}{y - 1} \equiv c_h. \tag{8}$$

At some critical level of required cultivation ($c_h < 1$ because $w_h > 1$), the high type refuses the additional land because it is too costly in terms of the high wage non-farm activity that he would have to sacrifice.

The low type will benefit from the additional land, despite the cultivation requirement as long as

$$w_l(2T - 1) + y < w_l(T - c) + c + (2 - c)y + c + (T - 2)w_l \tag{9}$$

or

$$c < \frac{y - w_l}{y + w_l - 2} \equiv c_l. \tag{10}$$

As long as the cultivation requirement is not too high, the low type will accept the additional land ($c_h < 1 < c_l$, because $w_l < 1$) even with the low level of fallowing.

Given these information constraints, the constrained-efficient mechanism of land allocation is for the lineage head to offer the land with cultivation requirement c_h. A farmer's willingness to accept this requirement reveals that her return to off-farm work is low, and that she therefore needs the additional land to avoid poverty.

Suppose that the lineage head has access to the otherwise private information about some individuals' returns to off-farm work, perhaps because these individuals are socially or politically well-connected to the lineage leadership. For these individuals, the land allocation can be made without the cultivation requirement, and both high- and low- types in this set efficiently fallow their land.

The key empirical implication is that all plots under the control of an individual are treated similarly. Well-connected individuals about whom the lineage head has full information efficiently fallow their entire portfolio of plots. Low types among the set of more isolated individuals reveal their 'need' by inefficiently cultivating land that - considered only from the viewpoint of technical productivity - should be fallowed. It is inconsequential what the source of that land is, it could either be the cultivator's own land or the land provided by the lineage head.

The alternative model (2) is based on the idea that land rights over plots vary with both the political position of the individual and the mechanism he or she used to obtain the land. Here we expect that optimal fallowing behavior might vary with the source of the land, even across an individual's plots.

Power or Need?

In Table 6, we see that fallow durations are influenced by the source of a plot. Each specification includes household and spatial fixed effects as defined in (6), along with a full set of plot characteristics (indicator variables for quintiles of plot size, toposequence and soil type) and the family background characteristics used earlier (migration history, demographic characteristics of the parents' household, parents' education, fostering experience). We report results on the relationship between fallowing behavior and the source of the plot, for those with and without traditional offices. The base category is land acquired from the family. In column 1, we see that for non-office holders, land acquired from one's spouse, or from non-relatives (either resident in the village or not) is fallowed for significantly shorter periods than land acquired from one's family.

Land acquired from one's spouse is fallowed only briefly is informative. In Table 1 it is shown that very few men obtain land via their spouse; however, this is an important mechanism through which women obtain land. In our focus group interviews, it became apparent that a common arrangement is that plots are obtained for the wife from the husbands's lineage. In our data, this would generally be recorded as household land allocated to the wife, but much of the uncertainty regarding future access to such plots likely arises due to the plots' status as lineage land, acquired indirectly through one's husband.

Office holders exhibit dramatically different fallowing histories. They fallow land from their spouse, and from non-relatives for dramatically longer periods than those who do not have office, and for longer periods than they do land from family.

Both office holders and non-office holders make different decisions regarding fallowing depending upon the source of land. The following two columns provide some evidence on the mechanism driving this varied behavior by disaggregating office holders according to the type of office they hold. We divide holders of traditional office into two categories: those whose office is primarily family-based, and those who have a political office in the hierarchy of the village and stool. The former category consists largely of individuals who claim to be 'family elders', while the later consists of people who hold a particular office in the stool hierarchy. Comparing the estimates in columns 2 and 3 of Table 6, we see that family office holders fallow land from family and from their spouse for longer periods than do holders of political office.

Table 7 examines variations across an individuals plot in fallowing decisions. Column 1 provides a sharp reject of the hypothesis that a given individual invests similarly in similar land that she controls. Conditional on individual and spatial fixed effects (and on the full set of plot characteristics), people fallow land from their spouse or from resident non-relations for significantly shorter periods than they do land from their family. Because these results compare fallowing decisions across plots of a given individual, it is difficult to attribute the results to individual characteristics such as unobserved wealth or skill.

In columns $2, 3$ and 4 of Table 7, we see that variations in fallowing choices according to the source of land are different for office holders and non-office holders. Office holders fallow land from their family significantly *less* than land from other sources. Individuals who hold office fallow land obtained from non-relations for much longer periods than they do land from other sources, in stark contrast to the behavior of non-office holders.

These results align with the observations of Berry, Bassett, Peters and Fred-Mensah. A major contribution of this recent work is "the conceptualization of land tenure as a political process." [Bassett, p. 4]. Rights over a particular plot of land are political: they depend on the farmer's ability to mobilize support for her right over that particular plot. Hence the security of tenure is highly dependent upon the individual's position in relevant political and social hierarchies. But even conditional on the individual's position, her security depends upon the circumstances through which she came to obtain access to the particular plot.

We differ, however, with much of the recent literature in our interpretation of the consequences of these observations. Bassett (p. 4) notes that "colonial administrators, African elites, and foreign aid donors have historically viewed indigenous landholding systems as obstacles to increasing agricultural output. ... There is a need to transcend [the World Bank's] technocratic and theological approaches that posit a direct link between freehold tenure and productivity." Berry (CNTB, 155-56) similarly argues that "contrary to recent literature, which argues that sustainable development will not take place unless rights to valuable resources are 'clearly defined, complete, enforced and transferable' (citing WB), assets and relationships in Kumawu appear to be flexible and resilient because they are *not* clearly defined, or completely and unambiguously transferable". However, we find that the complex multiple and overlapping rights to land in Akwapim are associated with barriers to investment in land fertility. Individuals who are not central in the networks of social and political power that permeate these villages cannot be confident of maintaining their rights over land while it is fallow. Hence, they fallow their land less than would be optimal given freehold tenure, and farm productivity for these individuals is correspondingly reduced. There is a strong gender dimension to this pattern, because women are rarely in positions of sufficient political power to be confident of their rights to land. Hence women fallow their plots less than their husbands, and achieve much lower yields.

Table 1: Summary Statistics

Plot Level Data

Variable	Men Mean	Men Std. Dev.	Women Mean	Women Std. Dev.
profit x1000 cedis/hect	794.63	7175.28	-95.71	1502.33
yield x1000 cedis/hect	1788.00	7705.59	880.06	1777.64
hectares	0.39	0.43	0.21	0.17
labor cost x1000 cedis/hect	802.20	2281.07	912.53	1196.60
seed cost x1000 cedis/hect	285.52	782.23	133.45	259.23
ph	6.37	0.72	6.28	0.78
organic matter	3.20	1.12	3.02	0.95
last fallow duration (years)	4.26	3.37	3.66	1.74
length of tenure (years)	10.11	12.05	6.17	9.90
plot from spouse=1	0.03	0.16	0.29	0.46
plot from spouse's family=1	0.07	0.26	0.12	0.32
plot from family=1	0.60	0.49	0.41	0.49
plot from resident non-relation=1	0.20	0.40	0.16	0.36
plot from non-res. non-relation=1	0.10	0.30	0.03	0.16
plot contract: alloc family land=1	0.53	0.50	0.41	0.49
plot contract: alloc hh land=1	0.04	0.19	0.32	0.47
plot contract: cash rent=1	0.20	0.40	0.14	0.35
plot contract: sharecropping=1	0.15	0.36	0.08	0.27
plot contract: other=1	0.08	0.27	0.06	0.23

Individual Level Data

Variable	Men Mean	Men Std. Dev.	Women Mean	Women Std. Dev.
age	42.63	12.65	42.04	13.18
average assets x1000 cedis	905.85	1066.63	596.58	1023.81
years of schooling	8.50	4.84	4.80	6.01
1 if mother was a trader	0.20	0.40	0.21	0.41
1 if mother was a farmer	0.77	0.42	0.75	0.44
1 if father was a farmer	0.80	0.40	0.83	0.38
1 if father was an artisan	0.10	0.30	0.07	0.25
1 if father was a civil servant	0.08	0.27	0.08	0.27
1 if father was a laborer	0.00	0.00	0.02	0.14
1 if first in village of family	0.14	0.35	0.30	0.46
yrs family or resp has been in village	64.11	39.48	48.62	39.21
1 if resp holds traditional office	0.26	0.44	0.05	0.22
number of wives of father	2.28	1.39	2.05	1.11
number of children of father	10.48	6.57	11.81	6.28
parity of mother in father's wives	1.38	0.74	1.33	0.70
1 if fostered as a child	0.60	0.49	0.79	0.41
size of inherited land	0.33	0.63	0.09	0.35
1 if mother had any school	0.05	0.21	0.15	0.36
1 if father had any school	0.22	0.42	0.32	0.47

Table 2: Base results

	1	2	3	4
	profit x1000 cedis/hectare	yield x1000 cedis/hectare	labor cost x1000 cedis/hectare	seed cost x1000 cedis/hectare
gender: 1=woman	-1,043.43	-1,497.18	-262.71	-91.22
	[472.73]	[561.54]	[276.17]	[125.70]
hectare decile=2	446.64	-775.44	-1,313.13	-244.97
	[576.66]	[684.99]	[336.89]	[184.37]
hectare decile=3	1,039.18	-793.74	-1,734.12	-238.22
	[595.48]	[707.34]	[347.88]	[182.15]
hectare decile=4	1,135.09	-331.22	-1,556.35	-169.9
	[597.12]	[709.30]	[348.84]	[165.58]
hectare decile=5	656.62	-1,188.55	-1,721.02	-345.87
	[588.40]	[698.94]	[343.75]	[168.38]
hectare decile=6	810.67	-1,083.07	-1,821.08	-209.65
	[586.80]	[697.03]	[342.81]	[159.66]
hectare decile=7	875.33	-1,369.88	-2,079.89	-277.51
	[590.16]	[701.03]	[344.78]	[170.48]
hectare decile=8	438.97	-1,816.14	-2,074.95	-232.3
	[599.90]	[712.60]	[350.47]	[182.80]
hectare decile=9	249.13	-2,733.71	-2,783.99	-298.64
	[638.96]	[759.00]	[373.29]	[178.01]
hectare decile=10	-315.67	-2,847.31	-2,278.36	-587.54
	[700.07]	[831.59]	[408.99]	[190.82]
soil type=loam	-174.76	-249.94	-105.46	-7.57
	[400.06]	[475.21]	[233.72]	[103.42]
soil type=clay	-511.77	-101.82	329.79	108.4
	[467.71]	[555.58]	[273.24]	[117.99]
ph	-259.79	-118.68	200.78	-102.67
	[249.19]	[296.00]	[145.58]	[59.12]
organic matter	-15.94	19.09	73.05	-46.63
	[151.08]	[179.46]	[88.26]	[37.65]
topo: midslope	299.14	96.63	-295.81	499.03
	[1,595.93]	[1,895.74]	[932.35]	[600.76]
topo: bottom (level)	663.23	358.48	-228.79	279.67
	[1,584.04]	[1,881.62]	[925.41]	[593.65]
topo: steep slope	2.73	460.28	282.27	389.05
	[1,625.75]	[1,931.16]	[949.77]	[609.07]
Constant	1,209.25	3,234.46	1,253.24	949.85
	[2,186.75]	[2,597.55]	[1,277.51]	[702.08]
Observations	614	614	614	336
R-squared	0.81	0.52	0.9	0.89

all regressions include household-year fixed effects
standard errors in brackets
hectare decile=1, soil type=sand, topo=uppermost (level) excluded

Table 3: Robustness of base result

	1	2	3	4
	OLS	OLS	spatial GMM	spatial GMM*
	dep variable = profit x1000 cedis/hectare			
years of school	-61.9			
	[81.88]			
gender: 1=woman	-1,233.99	-858.66	-1043.43	-1666.78
	[570.43]	[369.05]	[299.87]	[373.79]
ph	-153.47		-259.79	-346.83
	[276.30]		[88.51]	[75.62]
om	-45.44		-15.94	154.97
	[159.16]		[52.27]	[42.95]
Observations	558	888	614	575
Fixed Effects	household-year	household-year	household-year	household-year and spatial**

standard errors in brackets
plot controls and constant included in every regression
* spatial standard errors calculated as defined in footnote 5
** spatial fixed effects for unobserved characteristics in the plot neighborhood

Table 4: Profits and fallow duration

	1	2	3	4	5	6
		OLS	IV	first stage	IV	first stage
	profit x1000 cedis/hect	profit x1000 cedis/hect	profit x1000 cedis/hect	fallow duration (years)	profit x1000 cedis/hect	fallow duration (years)
fallow duration (years)	163.12	238.37	421.41		314.07	
	[47.88]	98.19	[225.67]		[182.00]	
fallow duration (years) squared		-4.30				
		4.90				
gender: 1=woman	-356.19	-370.24	19.28	-0.58	143.06	-0.43
	[397.00]	397.43	[537.24]	[0.67]	[426.13]	[0.54]
1 if first of family in town				-0.44		0.29
				[0.66]		[0.64]
years family/resp lived in village				-0.01		0.01
				[0.01]		[0.01]
1 if resp holds trad. office				3.91		1.95
				[1.11]		[0.80]
number of wives of father				0.39		0.52
				[0.35]		[0.23]
number of father's children				-0.08		-0.02
				[0.07]		[0.05]
parity of mom in father's wives				-0.44		-0.42
				[0.41]		[0.36]
1 if fostered as child				0.86		0.35
				[0.74]		[0.61]
size of inherited land				-0.29		-0.52
				[0.63]		[0.57]
1 if mother had any education				-0.87		0.96
				[1.17]		[1.05]
1 if father had any education				-0.13		-0.98
				[0.80]		[0.63]
Observations	760	760	755	755	700	700
Fixed Effects	household-year	household-year	household-year	household-year	household year and spatial	household year and spatial
F-test of instruments				F(10,415)=2.10		F(10,381)=2.49

standard errors consistent with arbitrary spatial correlation in brackets
plot controls and constant included in every regression

Table 5: Fallow and credit constraints

	1	2
	IV	first stage
	last fallow duration (yrs)	avg assets x1000 cedis
average assets x1000 cedis	0	
	[0.00]	
gender: woman=1	-1.01	-2.37
	[1.10]	[126.38]
1 if first of family in town	-1.18	537.51
	[0.99]	[106.60]
years family/resp lived in village	-0.03	7.96
	[0.01]	[1.59]
1 if resp holds trad. office	2.77	-68.91
	[1.79]	[185.27]
number of wives of father	0.12	416.23
	[0.63]	[59.27]
number of father's children	-0.05	-44.74
	[0.10]	[9.61]
parity of mom in father's wives	-0.51	156.64
	[0.63]	[61.46]
1 if fostered as a child	1.05	-983.67
	[1.28]	[132.66]
size of inherited land	-0.02	140.36
	[1.18]	[133.90]
1 if mother had any school	-0.48	1,546.91
	[1.72]	[232.34]
1 if father had any school	-0.54	-969.84
	[1.40]	[160.69]
1 if mother was a trader		1,041.00
		[304.51]
1 if mother was a farmer		-1,982.73
		[346.50]
1 if father was a farmer		4,070.56
		[500.44]
1 if father was an artisan		971.38
		[423.82]
1 if father was a civil servant		4,283.37
		[516.50]
Observations	486	486
Fixed Effects	household-year	household-year
F-test of instruments		F(5,212)=36.18

standard errors in brackets
all regressions include plot controls and a constant
excluded categories: father other occupation, mother other occupation

Table 6: Fallowing and Source of Land

	1		2		3	
	Last Fallow Duration (years)		Last Fallow Duration (years)		Last Fallow Duration (years)	
	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error
Female	-0.52	0.27	-0.67	0.28	-0.87	0.30
Direct Effect:						
Land from Spouse	-1.95	0.37	-2.04	0.35	-1.83	0.39
Land from Spouse's Family	-0.15	0.29	0.16	0.26	-0.21	0.28
Land from Resident Non-Relation	-0.96	0.25	-0.64	0.25	-0.81	0.21
Land from Non-Resident Non-Relation	-0.62	0.34	-0.59	0.37	-0.28	0.32
Office Holder times:						
Land from Spouse	4.43	0.94				
Land from Spouse's Family	3.73	0.56				
Land from Resident Non-Relation	5.64	1.12				
Land from Non-Resident Non-Relation	3.70	0.68				
Land from Family	2.26	0.49				
Family Office Holder times:						
Land from Spouse			4.42	1.13		
Land from Resident Non-Relation			5.27	1.36		
Land from Non-Resident Non-Relation			4.02	1.12		
Land from Family			2.92	1.20		
Village Office Holder times:						
Land from Spouse					2.98	0.67
Land from Resident Non-Relation					5.29	1.77
Land from Family					1.41	0.65
observations	422		422		422	

Omitted Category: Direct Effect of Family Land
All specifications include: full set of plot characteristics, full set of family background variables.
Household and spatial fixed effects

Observations	728	728	728	728	728	728
Fixed Effects	ɔusehold-ye	usehold-ye	ɔusehold-ye	usehold-ye	ɔusehold-ye	usehold-year

standard errors in brackets
all regressions include plot controls and a constant
excluded categories: allocated family land (contract) land from family (source)

Table 7: Determinants of Fallowing, With Individual Fixed Effects

	1		2		3		4	
	Last Fallow Duration (years)		Last Fallow Duration (years)		Last Fallow Duration (years)		Last Fallow Duration (years)	
	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error
Female								
Direct Effect:								
Land from Spouse	-0.73	0.39	-1.03	0.35	-1.04	0.34	-0.71	0.39
Land from Spouse's Family	0.69	0.44	0.41	0.55	0.56	0.47	0.54	0.51
Land from Resident Non-Relation	-0.46	0.20	-0.94	0.23	-0.61	0.22	-0.78	0.19
Land from Non-Resident Non-Relation	-0.19	0.32	-0.80	0.43	-0.68	0.42	-0.30	0.31
Office Holder times:								
Land from Spouse			3.85	0.51				
Land from Spouse's Family			0.38	0.74				
Land from Resident Non-Relation			4.03	1.00				
Land from Non-Resident Non-Relation			2.32	0.77				
Family Office Holder times:								
Land from Spouse					3.82	0.51		
Land from Resident Non-Relation					2.25	0.49		
Land from Non-Resident Non-Relation					2.28	0.77		
Village Office Holder times:								
Land from Spouse							0.19	0.78
Land from Resident Non-Relation							4.67	1.32
	422		422		422		422	

Omitted Category: Direct Effect of Family Land
All specifications include: full set of plot characteristics, full set of family background variables.
Household-year and spatial fixed effects

Observations	728	728	728	728	728	728	728	728
Fixed Effects	ousehold-ye	usehold-ye	ousehold-ye	usehold-ye	ousehold-ye	usehold-ye	ousehold-ye	usehold-year

standard errors in brackets
all regressions include plot controls and a constant
excluded categories: allocated family land (contract) land from family (source)

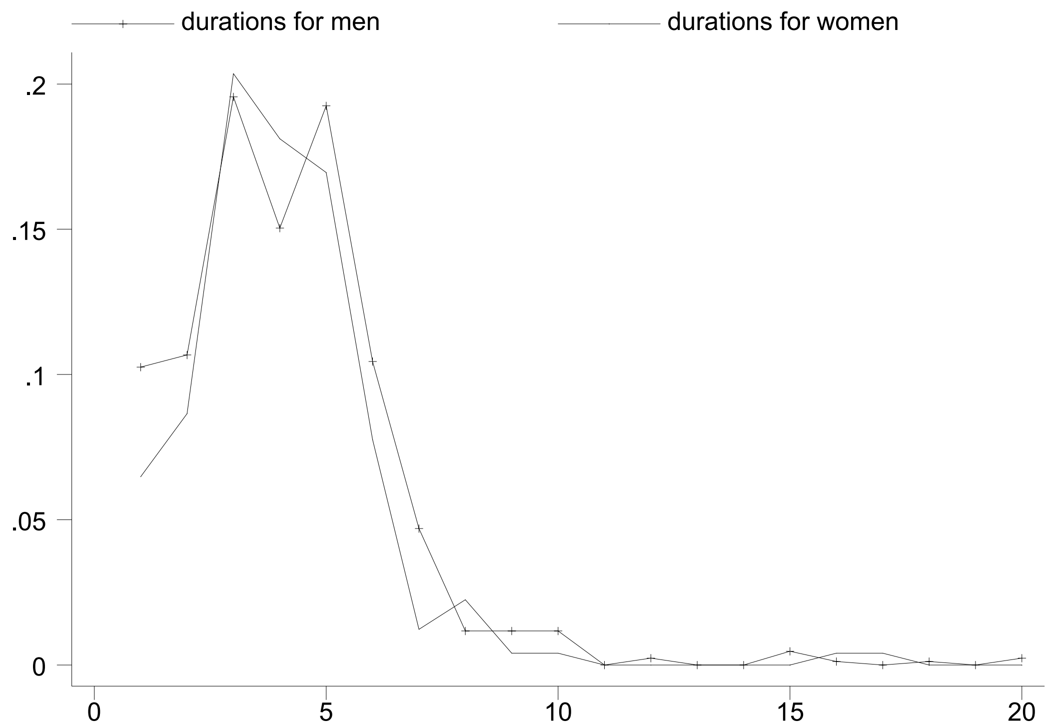

Figure 1: Histogram of Fallow Durations