TENURE SECURITY AND LAND-RELATED INVESTMENT:

EVIDENCE FROM ETHIOPIA

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Abstract: We use a large data set from Ethiopia that differentiates tenure security and transferability to explore determinants of different types of land-related investment and its possible impact on productivity. While we find some support for endogeneity of investment in trees, this is not the case for terraces. Transfer rights are unambiguously investment-enhancing. The large productivity effect of terracing implies that, even where households undertake investments to increase their tenure security, this may not be socially efficient. In Ethiopia, government action to increase tenure security and transferability of land rights can significantly enhance rural investment and productivity.

1. Introduction

Property rights to land that are secure and easily transferable have long been identified as a key element to bring about higher levels of investment and access to credit, facilitate reallocation of production factors to maximize allocative efficiency in resource use, and allow the development of an off-farm economy. In fact, the way in which property rights to land are allocated can have far-reaching impacts on other social outcomes (Nugent and Robinson 2002; Banerjee and Iyer 2002; Conning and Robinson 2002) and there is agreement that providing the basis for secure and transferable land rights is an important function of the state. However, the literature on this issue in Africa has yielded inconclusive results. In fact, a large number of studies which often equated tenure security with possession of formal title found little impact on either credit access or investment (Migot-Adholla *et al.* 1994). More recently, there is evidence suggesting that the causality may run the other way, i.e. that investment may be undertaken to enhance tenure security rather than as a response to higher levels of tenure security (Besley 1995; Sjaastad and Bromley 1997). Descriptive evidence seems to be consistent with this hypothesis (Gray and Kevane 2001; Platteau 1996). In fact, in Burkina Faso, land-related investment appears to be undertaken primarily to increase tenure security rather than as a consequence of more secure rights (Brasselle *et al.* 2002).

This raises a number of issues with potentially far-reaching consequences for policy, especially in predominantly agrarian economies in Africa where rural productivity, investment, and the functioning of factor markets will need to improve significantly to overcome pervasive poverty. Does the endogeneous nature of land-related investment imply that there is no need for governments to take steps that would increase households' tenure security? Or are the "tenure-building" strategies adopted by farmers just a stop-gap measure that is used because government interventions to provide basic tenure security and transferable property rights are ineffective - thus illustrating the need for government intervention to increase tenure security? In other words, should African governments be less concerned about land tenure because households are managing on their own or is the fact that producers have to resort to such action a

sign that government is not actually fulfilling its functions? Answering this question will require to identify the magnitude of the investment effect of more secure tenure and the channels bringing it about.

In this paper, we conduct such analysis for the specific case of Ethiopia. Conceptually, we build on the model that has been underlying most earlier studies by assuming that rights to transfer land are exogenous whereas tenure security may be enhanced by land-related (visible) investment. A first prediction arising from this is that greater transferability will, in virtually all situations, be associated with higher levels of investment. Second, the endogenous nature of tenure security implies that investment can be undertaken not only to increase productivity but also to enhance tenure security. Thus, the net impact of tenure security on investment is ambiguous; it would be positive if the productivity effect were to outweigh the tenure security effect and negative otherwise. As the relative magnitude of these two effects can not be determined a priori, and would arguably vary over time, space, and even types of investment within the same locality, empirical evidence is needed.

We provide such evidence by drawing on a nationally representative data set from Ethiopia that is both larger and richer than what has been used in the literature. To assess the impact of differences in the relative importance of the tenure security and productivity effect, we use information on whether specific investments were undertaken since 1999. Two types of such investment are distinguished, one of which, planting of trees, is highly visible and can therefore be used to manifest property rights, and another one, establishment or maintenance of terraces, which is more productivity-enhancing and less immediately visible. Tenure security is measured by village-level or individual experience of a land reallocation before 1999 and by households' expectations about future reallocations at the village-level. Transferability is proxied by respondents' subjective assessment of whether they will be able to transfer their land through mortgage or sale.

Our results are in line with the recent literature by confirming that the impact of tenure security varies across types of investment; insecure tenure (as measured by past redistribution) encourages planting of trees but discourages terracing. At the same time, both the perception of future risk of redistribution and lower levels of transferability clearly reduce the propensity to invest, especially in non-visible activities that can enhance future productivity. The effects found are not only highly significant statistically but also of considerable magnitude; eliminating the risk of future redistribution and resolving conflicts over land with local authorities would increase the propensity to invest in terraces by 28%; making land rights fully transferable is predicted to add an additional 38%. The fact that the impact on planting of trees is much smaller (4% and 7%, respectively, for the two types of interventions) suggests that, in addition to limited variation in levels of tenure security, large part of the failure to find a significant impact of tenure security in the literature may have been due to a focus on short-term investments.

To assess the potential impact which changes in property rights may have on investment incentives and thus productivity of land use, we estimate a net farm income function containing the investments in question. Use of the predicted levels of investment with and without higher levels of tenure security suggests that changes in the property rights regime could have a quantitatively large impact on rural productivity. Credible elimination of the risk of redistribution and resolution is estimated to result in a 1.5% increase in net farm income and full transferability of land rights would greatly increase the extent of benefits, by an additional 4.4%. Compared to an average rate of growth of agricultural value added of 3.34% over the last decade of economic liberalization (as compared to growth of 0.84% for the decade of the 1980s),[1] these are large figures that could considerably enhance the value of the asset endowment of the poor. Moreover, as we considering only investments in terracing and abstract from gains in allocative efficiency likely to come about with more secure and transferable land rights, implying that our estimate is a lower bound of the true impact of tenure security. This illustrates the continuing high levels of tenure insecurity and the scope for land policy to make a significant contribution to poverty reduction in this country. Methodologically, this suggests that some of the conclusions derived in the literature on the subject may have to be revisited.

The paper is structured as follows. Section two provides a brief review of the literature, a discussion of land tenure arrangements in Ethiopia, the conceptual model and the estimation strategy. Section three discusses data source and descriptive statistics. The econometric results, both for the determinants of land related investment and the simulation of the impact of greater tenure security, via investment, on net farm income are presented in section four. Section five closes with a number of policy implications.

2. Conceptual Model and Econometric Approach

To provide the conceptual framework for our empirical approach, we put investment decisions within the context of a standard two-period household model. Regarding the impact of tenure security on agricultural production, we distinguish between security and transferability of land rights. We note that the standard result of higher tenure security leading to higher investment will hold if investment is to increase productivity but that the impact becomes ambiguous if investment is also undertaken to enhance future tenure security. By contrast, the impact of greater transferability of land rights, at any given level of tenure security, is unambiguously positive as it allows farmers to capitalize on their investment even if they are not able to self-cultivate in the second period.

[1] Data on agricultural value added are from the World Bank's World Development Indicators.

2.1 Background and motivation

The importance of secure and transferable land rights to provide the incentives for long-term investment and decisions based on such investments has long been recognized. Where tenure is insecure, functioning of land markets (and off farm migration) as well as use of land as collateral will be impaired and the risk of losing land will create a disincentive for households to undertake investments even if the present value of the productivity benefits from such investments would, under full tenure security, be higher than their cost. This implies that, even in situations where, for example due to lack of credit markets, there is little scope for land ownership to increase credit supply, one would expect tenure security to increase investment. Indeed, significant investment effects of land title are reported from Latin America (Deininger and Chamorro 2002; Carter and Olinto 2002; Lopez 1997; Lanjouw and Levy 1998; Alston *et al.* 1995; Alston *et al.* 1996) and Asia (Feder 1988; Do and Iyer 2002). These results have been used to justify large scale intervention in titling programs to increase owners' tenure security and provide the basis for formal market transactions and use of land as collateral in credit markets. Studies show that public investment in titling can be financially self-sustaining (Brits *et al.* 2002).

This strong evidence in favor of a positive investment impact of higher levels of tenure security in many parts of the world sharply contrasts to the experience in Africa which has led observes to characterize the impact of awarding title as, at best, "unimportant" (Pinckney and Kimuyu 1994). The reason is that titling was generally found to have little or no effect on investment and subsequent farm income (Atwood 1990; Carter and Wiebe 1990; Migot-Adholla 1993; Migot-Adholla *et al.* 1994). Moreover, a number of studies have argued, both conceptually and empirically, that households undertake investments that can range from marking of boundaries and planting of trees and hedges to the building of houses or sheds, with the primary purpose of establishing more secure property rights to land (Brasselle *et al.* 2002; Gray and Kevane 2001; Place and Otsuka 2001).[2]

This, together with the finding of a statistically significant but quantitatively small impact of higher levels of tenure security by a number of studies from China (Carter and Yao 2002; Jacoby *et al.* 2002; Li *et al.* 1998) has led observers to conclude that interventions to improve tenure security may be misguided (Kung 2000; Kung 2002) or at least less important (Dong 1996), a claim that is hotly disputed by others (Chen and Davis 1998). This has far-reaching implications for policy especially in Asian countries such as China and Vietnam where households have only use rights to land and there is considerable policy discussion about the scope of improving productivity by enhancing the security or transferability of these rights. This

[2] The existing literature does not give a clear-cut answer to the question whether this implies that there is no need for mechanisms to exogenously increase the level of tenure security enjoyed by households or whether the fact that households undertake investment to increase tenure security an indication of their low expectations regarding the state's ability to provide them with more secure property rights. For example in Cameroon, while there is a demand for higher tenure security, the fact that government programs were able to only partially satisfy it prompted households to search for less expensive ways to increase tenure security (Firmin-Sellers and Sellers 1999).

is in sharp contrast to the significant impacts of giving secure control rights to producers in other settings (Banerjee *et al.* 2002; Banerjee 2001). The policy relevance of the issue, and the lack of conclusive evidence on this subject, would make in-depth study of this subject for Africa of particular importance.

Although a large number of studies have aimed to address this question, they are affected to varying degrees by three main shortcomings. First, in the absence of exogenous variation, most studies rely on indicators of tenure security which are, at best, a noisy measure for the variable of interest. For example, variation in the length for which a plot has been used could, in the presence of a legally stipulated fixed length of ownership, indicate either high or low levels of tenure security (Jacoby *et al.* 2002). Also, as many investments mature slowly, making it difficult to clearly disentangle cause and effect, especially where tenure security is subjective making it difficult to obtain precise retrospective information. Second, it is not clear that results obtained for relatively minor "investments" such as application of manure (Yao 1996; Li *et al.* 1998; Jacoby *et al.* 2002) carry over to ventures that are of a larger-scale. In fact, if anything one would expect tenure security to be much more important for large-scale investment. Finally, much of the literature is characterized by small samples. Both the smaller sample size and the more limited variation in land rights which this implies would tend to bias coefficient estimates towards zero (Deaton 1997).

2.2 Conceptual Model

We use a standard two-period household model to assess the impact of greater tenure security and of higher transferability on land-related investment as the conceptual basis for our empirical investigation. We show that, with exogenous tenure security, more secure land rights will have an unambiguously positive impact on investment, this is no longer true if it is acknowledged that investment can be used to increase tenure-security. While investments such as fencing whose only purpose is to enhance tenure security, without any impact on productivity would, in this case, be negatively related to higher levels of tenure security, the relationship becomes ambiguous for investments with a potential to both enhance security and productivity. At the same time, higher levels of transfer rights, modeled as a reduction in the transaction cost of land rental in the second period, will always increase the benefits from investments and thus the incentives for spending time and effort on such activity in the first period. We present key elements of the model below, referring to the annex for a more elaborate version.

Consider a two-period model where households are endowed with identical amounts of land A, labor in each of the periods ($\overline{L}_1$ and $\overline{L}_2$), and initial capital K_1. Utility is defined on consumption in any period, c_t by a standard utility function of the form $U(c_1, c_2) = ln\,(c_1) + \delta ln\,(c_2)$ where δ is a discount factor. Income can be derived either from spending time l^o in off-farm employment at a given exogenous wage rate w_t or

from agricultural production according to a production function $y_t = f(\bar{A}, K_t, l^a_t)$ where K_t, is the stock of available capital and l^a_t denotes the amount of labor time spent on agricultural production. In the initial period, households can spend time l_1^I to increase the second-period capital stock according to $K_2 = K_1 + g(l_1^I)$.[3] Tenure security is given by ρ, a variable that denotes the risk of the land being redistributed in the second period in which case the household will lose all the specific investment that has been made. As explained in more detail in the appendix, the household's problem can be reduced to the maximization of discounted income

$$\underset{l_1^a, l_1^I, l_1^o, l_2^a, l_2^o}{Max} \; (1+\gamma)(f(K_1, l_1^a) + l_1^o w_1) + \rho(S_2(S_1, l_1^I))\, f(K_1 + g(l_1^I), l_2^a) + l_2^o w_2 = 0$$

$$\text{s.t. } l_1^a + l_1^o + l_1^I \le \bar{L}_1,\; l_2^a + l_2^o \le \bar{L}_2$$

As the two labor constraints will always be binding, we substitute them into the objective function and derive first order conditions as follows:

$$(\text{F1}) \quad -(1+\gamma) f'(K_1, l_1^a) + \rho'(S_2(S_1, l_1^I) S_2'(S_1, l_1^I) f(K_1 + g(l_1^I), l_2^a) + f'(K_1 + g(l_1^I), l_2^a) g'(l_1^I) \rho(S_2(S_1, l_1^I)) = 0$$

$$(\text{F2}) \quad f'(K_1, l_1^a) = w_1 \text{ and}$$

$$(\text{F3}) \quad f'(K_1 + g(l_1^I), l_2^a) = w_2$$

The economics of the FOC equations are quite intuitive; (F2) and (F3) imply that the marginal product of labor used in agricultural production should be equal to the off-farm wage (the marginal opportunity cost of working off-farm) in both periods. (F1) implies that marginal cost of making investments in the first period which, under the above assumptions equals the wage rate, will be equal to the discounted value of benefits from doing so. As can be seen, these benefits are composed of two terms, the marginal increase in tenure security (if any) in the second period plus the marginal benefit of the investment-induced increase in the capital for second-period production. Manipulating FOC provides us with comparative statics concerning the impact of tenure security on land-related investment under different conditions.

Case 1: If tenure security is exogenously given, the standard case considered in the literature, the second part of (F1) will drop out, allowing us to write:

$$-(1+\gamma) f'(K_1, l_1^a) + f'(K_1 + g(l_1^I), l_2^a) g'(l_1^I) \rho(S_2) = 0$$

[3] While we implicitly assume that there is zero depreciation of capital to keep the exposition simple, accommodating such depreciation is straightforward conceptually although and will not affect the substantive results.

Substituting from (F2) and (F3) yields: $-(1+\gamma)w_1 + w_2 g'(l_1^I)\rho(S_2) = 0$

And after total differentiation with respect to l_1^I and S_2 and collection of terms, we obtain

$$\frac{\partial l_1^I}{\partial S_2} > 0$$

which is the standard result that higher levels of tenure security will lead to more land-related investment due to the productivity effect.

Case 2: Consider the case where ρ is endogenous, i.e. can be enhanced through investment, but $g(l_1^I) = 0$, i.e. investment do not enhance productivity. This implies that (F1) will be replaced with:

$$-(1+\gamma) f'(K_1, l_1^a) + \rho'(S_2(S_1, l_1^I) S_2'(S_1, l_1^I) f(K_1, l_2^a) = 0$$

Substituting in from (F3) yields $-(1+\gamma)w_1 + \rho'(S_2(S_1, l_1^I) S_2'(S_1, l_1^I) f(K_1, l_2^a) = 0$

and total differentiation with respect to S_1 and l_1^I yields, after reorganizing terms:

$$\frac{\partial l_1^I}{\partial S_1} < 0$$

implying that, opposite from the above, tenure insecurity will lead to more investment on the land as farmers try to increase their tenure security.

Case 3: If investment can increase productivity and future tenure security, the impact of tenure security on investment will be ambiguous. As shown in the appendix, total differentiation of (F2) with respect to S_1 and l_1^I, indicates that the sign of $\frac{\partial l_1^I}{\partial S_1}$ is indeterminate, depending on the relative magnitude of the two effects.

To analyze the impact of transfer rights, we assume that tenure security is given but that there is non-zero probability θ that after the first period, the household will be hit by a shock that will rule out self-cultivation (one can think of sickness). In this case, the investment will be lost unless it is possible to transfer the land to another cultivator. The solution to the ensuing problem can found by either applying bargaining theory (Besley 1995) or in a framework of non-zero transaction costs (Carter and Yao 1999). We chose the latter, assuming that rental (or sales) markets are competitive and investment can actually be observed. In this case, the market rent *r* depends on the stock of land investment, i.e.,

$r = r(K_1 + g(l_1^I))$ but, due to the transaction cost, owners forced to rent out will receive only *(1-T) r*. Using the above notation and dropping the off-farm labor market for simplicity yields the problem

$$\max_{l_1^a, l_1^I} \quad (1+\gamma)(f(K_1, l_1^a) + \theta f(K_1 + g(l_1^I), \bar{L}_2) + (1-\theta)(1-T)r(K_1 + g(l_1^I))$$

$$\text{s.t} \qquad l_1^a + l_1^I \leq \bar{L}_1$$

with first order condition

$$-(1+\gamma) f_{l_1^a}(K_1, \bar{L}_1 - l_1^I) + \theta f_{K_2}(K_1 + g(l_1^I), \bar{L}_2) g'(l_1^I) + (1-\theta)(1-T) r'(K_1 + g(l_1^I)) g'(l_1^I) = 0$$

yielding $\frac{\partial l_1^I}{\partial T} < 0$ after total differentiation with respect to *T*. This implies that greater transferability of land rights will always increase land-related investment.

2.3 Evolution and status of land tenure in Ethiopia

Ethiopia is of particular interest, and appropriate to test the predictions from our model, for two main reasons. First, the country is characterized by considerable variation in tenure security. Contrary to other countries such as China where, even though producers can obtain only use rights, the existing level of investment especially in irrigation is already high (Dong 1996), most of Ethiopia's land is rainfed implying that there comparatively large benefits can be had from land-related investment. At the same time, land tenure appears to be quite insecure and the rights to transfer land are severely restricted in ways beyond the control of producers.

In the recent past, Ethiopia implemented different types of interventions in the area of land tenure and reform. Before 1975, land was concentrated in the hands of absentee landlords, tenure was highly insecure, arbitrary evictions posed a serious threat, and many lands were severely underutilized. The land tenure system was characterized by great inequality which, through its impact on production and investment, not only affected productivity but was also considered to have been the most important cause of political grievances that eventually led to the overthrow of the regime (Adal 2001).

Following the overthrow of the imperial regime, the Marxist government (the *Derg*) transferred ownership of all rural land to the state for distribution of use rights to cultivators through local peasant associations (PAs). The transferability of rights received was highly restricted; transfer through lease sale, exchange, or mortgage, among others, was prohibited and inheritance allowed only to immediate family members. The ability to use land was contingent on proof of permanent physical residence, thereby for example preventing migration. More importantly, tenure security was undermined by the PAs' and other

authorities' ability to redistribute land, often for political reasons, something that is well documented for the case of Amhara (Ege 1997).

The government taking power in 1991, though committed to a free-market philosophy, has, with three notable exceptions, made few substantive changes to Ethiopian farmers' land rights which are therefore still considered to be quite inadequate (Hoben 2000). First, land was made a regional responsibility, implying that regional governments can enact laws relating to the nature of land rights and their transferability as well as land taxation. Second, the frequency of land redistribution was to be reduced; in fact Tigray declared an end to administrative land redistribution while Oromia restricted the scope for redistribution to irrigated land. Finally, rentals have been officially allowed (Pender and Fafchamps 2000) although local leaders and governments seem to have great discretion to impose restrictions on land transfers. For example, the region of Oromia allows farmers to rent out only up to 50% of their holding and stipulates maximum contract terms of 3 years for traditional and 15 years for modern technologies (Regional Government of Oromia 2002).

The political sensitivity of land issues is illustrated by the fact that the Government's Poverty Reduction Strategy emphasizes as a guiding principle that every farmer who wants to make a livelihood from farming is entitled to have a plot of land free of charge (Federal Republic of Ethiopia 2002). While some of the issues, such as the need for greater tenure security and land rental, are mentioned, there is no clear policy directive and instead responsibility is left to regional states.[4]

2.4 Estimation Strategy

Let households be denoted by i and the two types of investment, i.e. trees and terracing, by j. The methodological discussion above then reduces to the estimation of the relationship between I_{ij} and the level of tenure security (S_i) and transfer rights (T_i) enjoyed by the household, as well as a vector of other characteristics $\boldsymbol{X}_i$. The general equation to be estimated is

$$I_{ij} = \alpha + \beta T_i + \gamma S_i + \eta \boldsymbol{X}_i + \varepsilon_i$$

The two investments represented by I_{ij} are the planting of trees and the establishment of terraces in the 1999-2001 period. Information on whether such investment was undertaken, but not the amount of investment, was elicited directly from respondents, leading us to adopt a probit specification. As discussed, we expect β, the net impact of transferability, to be unambiguously positive. By contrast, γ denotes the sum of the productivity effect which increases with tenure security and the "security enhancement" effect that declines in tenure security. The sign of γ, then, is indeterminate and likely to be

[4] 'In order to protect the user rights of farmers, their land holdings should be registered and provided with certificate of user rights. In this regard, a guarantee *may* be given to the effect that land will not be re-divided for a period ranging from 20-30 years. Some regional states have already started this aspect of the land use policy and it is a step in the right direction." (Republic of Ethiopia, 2002:p.53; italics added).

investment-specific. Indeed, the possibility of the two effects canceling each other out could account for the fact that much of the literature reviewed earlier does not find a strong impact of tenure security on investment.

We use two types of variables to represent tenure security S_i. The first one relates to the experience of land redistribution in 1991-1998 inclusively, a period during which redistribution was discouraged, though not explicitly prohibited, by the state. This includes both households who gained and who lost land through redistribution. To ensure that the measure is truly exogenous to our investment indicators, we consider only redistributions that happened before 1999. As redistribution is imposed by local administrators often in response to political pressure, it is safe to assume that having had land redistribution in the past increases the likelihood of having another one in the future. We use both a household-specific indicator of redistribution as well as the share of households in the village, excluding the one under concern, who were affected by land redistribution. In addition to past redistribution experience, we have information on households' expectations about future land redistribution at the village level which can be expected not to be affected by their individual investment decision.[5] We use this to construct two dummies, one for households who expect land in the village to be redistributed within the next five years and one for households who are unsure about future redistribution, i.e. those who do not clearly indicate that they do not expect a redistribution in the future.

Transfer rights T_i are proxied by households' perception about whether they have the right to mortgage the land or transfer it permanently through sale. Even though both are not allowed by the letter of the law, the local autonomy results in some gray zone regarding application of the law. To the extent that they can be disguised as rentals, temporary "mortgages", i.e. transfer of the usufruct in return for a cash transfer on the understanding that the land has to be returned once this credit has been repaid are likely to be easy. Similarly, a sale can easily disguised as a long-term lease, possibly with an upfront payment of the "rent", and may be tolerated by local authorities. Other variables included in the vector $\boldsymbol{X}_i$ include the per capita size and fragmentation of the household's land endowment, the head's age and education, demographic composition, and whether the household had access to government-sponsored extension services.

In addition to exploring the impact of tenure security on investment, it is of interest to explore the impact of such investment on productive outcomes to assess the extent to which the issues discussed here are of broader economic relevance. To do so, we estimate determinants of net farm income, Y_i, as follows:

$$Y_i = \beta_0 + \beta_1 \mathbf{Q}_i + \beta_2 \mathbf{Z}_i + \beta_3 \hat{I}_{ij} + \eta_i$$

[5] The fact that the maximum share of households who were affected by redistribution at the *woreda* level was about 75% clearly illustrates that having a redistribution does not mean that every household will be affected. This implies that, while households' investment decisions are unlikely to alter the probability of aggregate redistribution, they are likely to be affected by households expectations about village level redistribution in the future.

where Y_i denotes net revenue from farm crop and livestock production, i.e. the difference between total output and variable cash costs including spending on hired labor, animals, machinery rental and fixed factors, but excluding family labor. $\boldsymbol{Q}_i$ is a vector of inputs and fixed factors (i.e. land cultivated and the land and labor endowments) and $\boldsymbol{Z}_i$ is a vector of household characteristics including education and whether the household has a non-farm wage job. Finally, $\hat{I}_{ij}$ denotes the predicted value of investment *j* as derived from a linear probability model, as is commonly applied in the literature.

3. Data and descriptive statistics

Our empirical estimation is based on a nationally representative survey of 8,540 farm households conducted in 2001 by the Ethiopian Economic Association's Economic Policy Research Institute (EEA/EEPRI). The sample was chosen to represent the country's main agro-ecological regions and to account for differences in population density, farming systems, and access to markets. We use them to provide descriptive statistics, for the country as a whole and its major regions, Tigray, Amhara, Oromia, SNNPR, and the mainly pastoral areas of Benshangul-Gumz, Afar and Somali which we classify under "others". Descriptive evidence demonstrates the importance of tenure security but also suggest that changes in these arrangements could have an important impact on economic outcomes.

3.1 Household characteristics

General household characteristics point towards a high level of poverty, dependence on agricultural income, and considerable rationing in labor-markets. Table 1 illustrates that the average household is composed of 5.11 persons (in adult equivalents), primarily male-headed (only 8% are headed by females), and has a head who is 45.3 years old. Illiteracy among the older generation is pervasive; in fact only 28% of the household heads in the sample are literate although the much higher level of formal education among the younger generation testifies to the rapid recent expansion of educational opportunities. In fact, the most educated person in a household has, on average, 5.18 years of schooling, varying between 3.9 years in pastoral areas and 5.78 in Oromia.

Income data, although less than ideally measured, suggest that 54% of the households have income below the national poverty line, with considerable regional variation; [6] 26% of the households reported to have received food aid during the survey year and 12% got remittances or help from others. The fact that, with 75% of the total (out of which 72% cam from crop farming), agriculture made a very important contribution to household income, highlights not only the potentially large impact of increasing

[6] It is admitable that this highest share of population below poverty line in Southern regions may be due to underestimation of the value of *Enset* production which is a dominant crop produced in the region mainly for home consumption.

agricultural investment and land productivity on household welfare but also implies that exploring agricultural activities in more detail will be appropriate.

3.2 Agricultural activities and land tenure arrangements

Data on agricultural production activities in the bottom panel of table 1 illustrate that the average land holding per household is, with 1.01 ha on 2.36 plots (or 0.18 ha per capita), very small, with regional variations (from 0.51 ha in Tigray to 2.25 ha in predominantly pastoral areas). Only 22% of households reported that their current holding allows them to obtain food self-sufficiency and 39% consider land shortage to be the major constraint to increased agricultural production, suggesting that expanding the effective land area through land-related investment should indeed constitute an attractive option. 71% report having one or more oxen, something less dominant (with 45%) in the South where hoe culture and perennial cropping systems dominate. 35% of farmers participated in the government sponsored extension program which is linked to the provision of improved seed, fertilizer, and chemicals - which are used by 37%, 13% and 10% of households, respectively. Land productivity, at about 170 US$/ha (1458 ETB/ha) on average, is lowest (123 US$) in the Southern regions and highest in (288 US$) in Tigray.

Information on subjective land rights perceived by the farmers, their land tenure preferences, as well as actual and hypothetical investment in land improvements in table 2 suggests not only that tenure security remains low but also that most farmers would prefer higher levels of land tenure security. Although many producers have undertaken land-improving investment, a surprisingly large share declares that they would change their farming practices and undertake more investments if land tenure were changed to provide more tenure security to cultivators.

In the 1991-98 period, 9% of the farmers nationally and 18% in Tigray and 21% in Amhara were affected by land redistribution. Although there is an intent for policy to discourage such practices, there is neither a law nor a clear policy statement at the national level to eliminate or prohibit land redistribution. In fact, only 27% of farmers are confident that there will not be a land redistribution in the future and 9% expect one to happen within the next 5 years. 23% report to have conflicts with local authorities that revolve around land redistribution, again illustrating that tenure insecurity in Ethiopia remains high. With respect to transfer rights, we note that more than 91% of farmers indeed perceive the right to rent or sharecrop whereas 23% indicated that they would be able to temporarily mortgage their land and 4% indicated that they would be able to permanently transfer the rights to their land through sale.

Given the high levels of tenure insecurity and restricted transfer rights, it is not surprising to find strong support for more secure rights; in fact 79% of farmers nation-wide (83% and 84% in Tigray and Amhara) indicate that they would prefer an alternative to the current tenure system. Of these, 48% (61% in Tigray)

opt for higher levels of tenure security while maintaining state ownership whereas 31% (38% in Amhara) indicate to prefer a transition towards private land ownership. It is also worth noting that 4% of the population (10% in Amhara) would prefer a system that offers regular redistribution of land while 17% see the current system as the most desirable alternative.[7]

Even at the descriptive level, there is evidence that transition to private rights would lead to significantly higher levels of investment; 47% of the farmers interviewed (68% in the pastoral regions) indicated that they would undertake investments or change their land management practices if land were privatized. Specifically 81% of those who would make improvements (or 38% of the total sample) indicated that they would build terraces, 28% (13% of the total sample) would plant trees, and 23% (11% of the total sample) would adopt conservation and land improvement practices recommended by extension.

Of course, framing may easily affect the results of such hypothetical questions (Kahneman 2000; Druckman 2001; Rolfe *et al.* 2002). This makes it essential to complement descriptive evidence with analysis of real-world actions. Doing so can not only help to assess whether security of property rights has a statistically significant impact but also to relate it to other variables of interest. Before discussing the results from our analysis, we note that the investments used as dependent variables in our analysis are indeed sufficiently frequent in the sample so as to make such analysis meaningful. As illustrated in the bottom of table 2, 47% of the farmers reported that they have practiced terracing during the recent 2-3 years with participation varying between 20% in pastoral areas and 88% in Amhara; similarly 39% reported that they had planted trees during the same period.

4. Econometric estimates

Our empirical discussion focuses first on determining the impact of land rights and subjective perceptions of tenure security on tree planting and terracing. Based on this we then estimate the potential impact which greater tenure security or transferability could, through higher levels of land-related investment, have on agricultural productivity and thus household welfare. Although we find that investments with limited impact on productivity may be undertaken to enhance tenure insecurity, there is strong evidence for a significant and quantitatively large investment-enhancing effect of higher tenure security.

[7] Satisfaction with the current system was measured with a sequence of three questions, namely (i) by first asking farmers whether they are satisfied with the current system, a question that was answered affirmatively by 61%; (ii) by then obtaining the same information for other villagers ("Do you think other villagers are satisfied with the current system", a question answered affirmatively by only 30%; and (iii) by finally inquiring whether they would prefer any alternative to the current system, giving different options. As there is strong reason to believe that households will overstate their support for the system, and since they can be satisfied even if they think that there would be a not better alternative, we use the last one for our analysis.

4.1 Determinants of land-related investment

To deal with concerns about possible endogeneity in households' subjective assessment of tenure security, we first present a "basic" model that includes only the level of past redistribution (at the individual or the village level) as right hand side variables. This simple model is then complemented by a more expanded set of right hand side variables containing information on land transfer rights as well as households' expectation regarding future village-level redistributions. The results allow to draw a number of conclusions.

First, we note that, as one would expect if land rights are endogenous, having been affected by redistribution in the past, has a strongly *positive* impact on planting of trees (column 1 of table 2). While this positive sign appears for both, whether the individual was affected by redistribution, and the share of households in the *woreda* who either lost or gained land through redistribution (equations not reported), entering both variables simultaneously suggests that the village-level variable is empirically of greater importance.[8] The point estimate implies that, for the mean *woreda* in the sample where about 8% of households were affected by redistribution, the propensity for tree planting is 2% higher than in one where there was no redistribution after 1990.

In the case of terracing, the exact opposite is true, i.e past redistribution is found to greatly discourage investment, presumably through the higher tenure insecurity brought about by this experience. Column 2 illustrates that the magnitude of the estimated coefficients is several times than for tree planting and that both individual and *woreda* level experience of redistribution are of significance. A household affected by land redistribution will, according to the estimates, be 7% less likely to invest in terracing than one who was not and that the propensity to invest is reduced by 2% for households in a *woreda* with the mean level (8%) of land redistribution in the sample, as compared to a *woreda* without redistribution, irrespectively of whether the households were themselves affected or not. Also, contrary to what one might expect, the household-specific effect of past redistribution is not limited to those who lost land; in fact even though the point estimates are close to each other, the effect is much more significant for households who gained land while being virtually indistinguishable from zero at conventional levels of significance for those who lost (results not reported). The presence of land conflicts, which was insignificant for tree planting is negative and highly significant for terrace investment, pointing again to the investment-reducing impact of tenure insecurity in the latter case.

The difference between terracing and tree planting suggests that the impact of past redistribution varies across types of investments, in line with the notion that some investments can be used to establish or

[8] This is consistent with this result that distinguishing between households who received land and those who lost land makes little difference (regression not reported).

visibly manifest land rights, something that is not more difficult for others. Before moving to discuss a fuller specification that includes transfer rights, we note that the signs of most other variables in the regression are as expected. Access to extension at the village level (excluding the individual under concern to avoid concerns of endogeneity) promotes both tree planting and building of terraces, as would be expected. Higher endowments of family labor, especially in the 14-60 year group, greatly encourage both types of investment, confirming that, with labor market imperfections, the presence of which was already noted in the descriptive statistics, land-related investment is a good way to make better use of otherwise underutilized family labor. Higher levels of education are also estimated to increase the propensity to invest, although the magnitude of the coefficient is small.

The regression also indicates that there seem to be few or no wealth-related barriers to undertaking both types of investment. Neither ownership of oxen nor the share of household income derived from off-farm sources, both of which could proxy for the ability to overcome capital market imperfections through implicit credit, are significant. Per capita land holding is negative in both cases (though insignificant for terracing), highlighting that investment to augment land constitutes a strategy that can be used by the poor to enhance their incomes. Fragmentation of the holding, as measured by the number of plots, is positive and significant in both cases, possibly because smaller plots may be less likely to be affected by redistribution, because the amount of investment required for these is less (especially in the case of terracing), or for other reasons.

Adding transfer rights and expectations about future redistribution to these regressions (columns 3 and 4 of table 3) highlights that transfer rights and more secure tenure for the future will increase investment incentives. Being unsure about whether or not a redistribution may happen in the village reduces a household's incentive to plant trees and establish terraces by about 5% and 4% respectively. The time at which such redistribution is expected does not seem to affect tree planting but for terracing, the expectation of a redistribution within the next 5 years reduces investment incentives by an additional 18 percentage points.

Rather large effects that would be consistent with the descriptive evidence provided earlier are also found for the investment effect of land transfer rights, over and above those already identified for tenure security.[9] The ability to mortgage land will, according to our estimates, increase incentives to plant trees by 7% and to build terraces by 5.5%. Adding the right to transfer land, while not having a significant impact for tree planting, is estimated to increase the probability of terracing by an additional 32 points. Even without accounting for elimination of land conflicts (which would add another 6.5 points), a

[9] Analysis of the data (not reported) confirms that having security of tenure is indeed a precondition for transfer rights, i.e. there are virtually no people who believe that a redistribution will happen within the next 5 years but who still believe they have the right to transfer their land.

household with fully secure and transferable land rights is estimated to be 59.8% more likely to invest in terracing than one who expects a redistribution in the village within the next 5 years. At the same time, the incentive to plant trees is actually higher in *woredas* where land was redistributed in the past and even making land rights fully secure and transferable will increase the probability of tree planting by only about 11%.

Clearly, then, the impact of tenure security seems to depend on the specific type of investment considered. Also, the fact that the estimated effects are several orders of magnitude larger than what has been reported in the literature suggests that households' expectations affect their investment behavior even in settings where formal title is, at present, only a remote possibility. One explanation for the large difference to the existing literature is that in Ethiopia tenure is at present indeed very insecure. At the same time, the highly significant results illustrate that there is indeed need for careful assessment of households' subjective assessment of tenure security, in addition to careful assessment of the specific investments that have been undertaken.

4.2 Impact on agricultural profits

To illustrate that, in the case at hand, increasing tenure security could have a perceptible impact on economic outcomes, we estimate a net income function with the predicted level of terracing and planting of trees for each household as derived from a linear probability model as right hand side variables, correcting for standard errors. As noted in the literature, doing so yields consistent estimates of the parameters in question (Hoxby 1996; Angrist 1991; Heckman and MaCurdy 1985). Results from doing so are reported in table 4.

We note that, in line with our earlier results which suggest that tree planting is undertaken less for productive value, the coefficient on tree planting is negative, though not statistically significant. . Part of this could be explained by the fact that trees planted during the 1999-2001 period would still be in their gestation period, thus not making a significant contribution to agricultural output or revenue. At the same time, we note that most of the trees planted were actually eucalyptus which offer very limited potential for generating marketable output. Also, concern about a downward bias of the estimated coefficient because of trees not yet being in their productive stage are allayed by the fact that the dummy for having perennials (mostly coffee) on the plot is also insignificant.[10]

Compared to the insignificant results for trees, the impact of terracing is estimated to be both positive and highly significant, something that can be explained by the increased water holding capacity and other soil conservation benefits from terracing. We also note that the statistical fit of the production function is

[10] The lack of significance for the perennial dummy can be explained by the very low coffee prices when the data was collected.

adequate, with an adjusted R^2 of 0.63 and estimated elasticities of 0.46, 0.18, and 0.15 for land, labor, and livestock, respectively. While estimation of a simple production function suggests that extension has a highly significant impact on input use (results not reported), it does not seem to increase profits. At the same time, education by the household head as well as the children has a positive effect while the household head having an off-farm job, reduces net revenue from agricultural production, presumably because of the limited attention that can be devoted to this.

Although the fact that the survey was not designed with the explicit purpose of collecting information on production, implying for example that we do not have information on stocks of trees or terraces available to the household, it allows to obtain an indication of the order of magnitude of the effects that can be expected from such investments. We simulate production outcomes for different levels of tenure security, starting with the assurance that no more redistribution will occur to the full transferability of land rights, and the (possibly somewhat fictitious) elimination of land conflicts.

Results from the simulation as reported in table 5 illustrate that increasing tenure security can have a clear impact on agricultural performance. Through its impact on investment in terraces alone, abolition of further redistribution is estimated to increase annual output by about 1.5% overall, with the impact being lowest in SNNPR and highest in Amhara. Adding transferability of land rights would, according to our estimates, increase output by an additional 4.4%. Taken together, and capitalized into future land values at a standard rate of discount, the security-induced increase in terrace investment alone could thus increase land values by about 5%, quite apart from improvements associated with other investments or the improvement in allocative efficiency and productivity associated with higher levels of transferability. All of this suggests that, in the case of Ethiopia, improving security of land ownership and transferability of land can have a significant impact on overall output and household welfare. This is of particular interest in view of the fact that the high levels of underemployment in the sample villages would allow additional investment be undertaken at very low additional cost to the economy.

5. Conclusion and policy implications

The evidence from Ethiopia presented here adds to the literature on land rights and investment in three respects. First, we show that the impact of land rights on investment incentives varies significantly across different types of improvements and the balance between their productivity- and security-enhancing effect. This implies that, even in situations where households undertake certain investments (in our case tree planting) with the express purpose of enhancing tenure security, it can not be concluded that government interventions to better define and enforce land rights will be superfluous. To the contrary, in Ethiopia, households' efforts to increase tenure security through visible investments remain *ad hoc* and need not be socially efficient (De Meza and Gould 1992). While registration of land rights without prior

legal clarification of the nature of such rights may not increase tenure security, a clear policy statement as to the nature of land rights would not only do so but could also provide tenure security in a more-cost effective way, thereby freeing households to focus on truly productivity-enhancing activities.

Second, while most of the literature has not differentiated between tenure security and transferability but treated them largely as interchangeable, we find that, while both are important, transferability has a larger impact on households' investment incentives in the context studied here. Exploration of the determinants of households' perception of their land rights would be of interest to uncover possible reasons underlying this rather surprising phenomenon and the implications it has for land policy. It also implies that attention to the scope, determinants, and impact of different modalities of land transfers would be warranted.

Third, in addition to the robustness of the investment-enhancing impact of greater tenure security and transferability of land rights across specifications, the magnitude and potential productivity-enhancing impact of this effect is surprising and in contrast to most of the recent literature which finds that investment effects, if at all significant, are often quantitatively very small. We have already noted that most of these conclusions are based on short term investments using relatively small and regionally concentrated samples. Methodologically, it would be of considerable interest to explore whether a focus on investment with a longer gestation period, incorporation of producers' subjective perception of their land rights, and greater regional variation, may lead to a revision of the conclusions from this literature in other African countries as well. These issues notwithstanding, our results highlight not only that land rights in Ethiopia are highly insecure but also that higher tenure security and transferability could enhance investment and agricultural productivity. Trying to identify and implement measures to increase producers' tenure security could have a large pay-off in terms of rural productivity and poverty reduction.

Table 1: Basic characteristics of the sample

				Region		
	National	Tigray	Amhara	Oromia	SNNPR	Others
Household characteristics						
Household Size (adult equiv)	5.11	4.81	4.45	5.24	5.57	5.14
Members younger than 14 years	2.72	2.51	2.35	2.73	3.05	3.16
Members 14-60 years	3.50	3.29	3.01	3.65	3.77	3.33
Members older than 60 years	0.19	0.24	0.21	0.19	0.20	0.09
Age of household head	45.30	48.87	46.10	44.60	45.94	41.47
Head illiterate	72%	82%	74%	66%	79%	84%
Max. years of education	5.18	4.65	4.55	5.78	4.98	3.91
Female headed	8%	17%	11%	6%	6%	2%
Income and its composition						
Income in US $	207.9	198.0	181.5	216.9	110.4	248.3
Poor	54%	41.6%	48.9%	50.4%	83.6%	33%
Share from agriculture	75%	72%	79%	76%	68%	72%
Share from crop farming	72%	67%	75%	74%	61%	30%
Has non-agricultural income	25%	28%	21%	24%	32%	28%
Would like wage employment	73%	65%	67%	73%	84%	70%
Employment locally available	22%	55%	18%	20%	15%	38%
Received food aid	26%	56%	37%	9%	44%	29%
Received remittances	12%	16%	12%	10%	13%	14%
Agricultural production						
Net Revenue (B/ha)	1458	2465	2132	1082	1056	1722
Total land held (ha)	1.01	0.51	0.75	1.14	0.89	2.25
Land per capita (ha)	0.18	0.10	0.15	0.19	0.15	0.42
Number of plots	2.36	2.46	2.84	2.44	1.77	1.95
Access to extension	35%	50%	41%	39%	20%	14%
Uses fertilizer	37%	43%	37%	43%	30%	8%
Uses improved seeds	13%	2%	14%	14%	9%	23%
Uses chemicals	10%	13%	5%	15%	4%	5%
Own oxen	71%	75%	76%	78%	45%	82%
Land shortage most important	39%	44%	43%	38%	42%	16%
No. of observations	8162	596	1680	3826	1630	430

Table 2: Subjective land rights, tenure security, and investment

		Region				
	National	Tigray	Amhara	Oromia	SNNPR	Others
Land tenure security						
Woreda had redistribution since 1990	9%	14%	18%	6%	4%	4%
Affected by redistribution since 1990	8%	17%	20%	4%	2%	4%
Expects redistribution next 5 years	9%	10%	10%	10%	6%	12%
Expects no redistribution	27%	42%	26%	23%	30%	37%
Has land conflict w. authorities	23%	23%	23%	26%	14%	22%
Perceives right to rent/sharecrop	91%	98%	89%	92%	85%	95%
Perceives right to mortgage/inherit	23%	18%	32%	18%	26%	35%
Perceives right to sell	4%	1%	1%	4%	3%	12%
Land tenure preferences						
Prefers higher tenure security	48%	61%	43%	51%	41%	48%
Prefers private ownership	31%	22%	38%	31%	30%	26%
Prefers redistribution	4%	10%	4%	3%	5%	4%
Would invest if land privatized	47%	29%	47%	49%	44%	68%
• build terraces	38%	24%	41%	39%	35%	56%
• plant trees	13%	12%	19%	14%	7%	8%
• adopt other improvements	11%	6%	10%	12%	15%	11%
Actual investment since 1999						
Built or maintained terraces	47%	81%	88%	34%	31%	20%
Planted trees	39%	50%	43%	41%	36%	8%

Table 3. Determinants of Investments of Land Improvement in the last 2-3 years.

	Basic Model		Augmented Model	
	Planted trees	Built terrace	Planted trees	built terrace
Affected by redistribution 1990-98	0.003	-0.071**	0.004	-0.059*
	(0.13)	(2.37)	(0.17)	(1.95)
Woreda level redistribution 1990-98	0.235***	-0.239***	0.242***	-0.161**
	(4.77)	(3.88)	(4.85)	(2.54)
Perceives risk of future redistribution			-0.049***	-0.041**
			(3.37)	(2.50)
Expects redistribution within 5 years			-0.013	-0.178***
			(0.56)	(6.43)
Perceives right to mortgage land			0.069***	0.055***
			(4.54)	(3.20)
Perceives right to sell land			-0.047	0.324***
			(1.38)	(10.66)
Has land conflict with authorities	-0.010	-0.075***	-0.013	-0.065***
	(0.71)	(4.56)	(0.89)	(3.86)
Extension access (*woreda* level)	0.191***	0.592***	0.201***	0.623***
	(6.61)	(16.33)	(6.90)	(16.99)
Own oxen	0.023	0.011	0.023	0.022
	(1.57)	(0.67)	(1.58)	(1.30)
Age of household head	-0.000	-0.002***	-0.000	-0.002***
	(0.71)	(3.40)	(0.75)	(2.94)
Members younger than 14 years	0.008**	-0.004	0.008**	-0.004
	(2.28)	(1.03)	(2.26)	(0.96)
Members 14-60 years	0.014***	0.019***	0.014***	0.018***
	(3.16)	(4.04)	(3.23)	(3.75)
Members older than 60 years	0.043**	0.021	0.041**	0.017
	(2.51)	(1.08)	(2.39)	(0.86)
Maximum years of education	0.006***	0.005**	0.006***	0.005**
	(3.38)	(2.35)	(3.28)	(2.13)
Per capita land holding (log)	-0.017**	-0.002	-0.016**	-0.006
	(2.19)	(0.28)	(2.16)	(0.65)
Number of plots	0.009**	0.021***	0.009**	0.024***
	(1.99)	(4.19)	(1.96)	(4.72)
Share of off-farm income in total	0.001	-0.002	0.002	-0.002
	(0.87)	(1.37)	(0.91)	(1.51)
Observations	6861	6861	6847	6847
Pseudo-R^2	0.04	0.25	0.05	0.27

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4. Instrumental Variable estimation of household net farm income

	Specification		
	Tree planted	Terrace built	Combined
Planted trees last 2-3 years	-0.145		-0.329
	(0.44)		(0.95)
Built terrace last 2-3 years		0.293**	0.331**
		(1.97)	(2.11)
Log of total cultivated area (mehr, belg, perennial)	0.461***	0.460***	0.460***
	(26.11)	(25.93)	(25.47)
Log of amount of livestock holding	0.149***	0.149***	0.150***
	(10.62)	(10.56)	(10.41)
Log of household labor force	0.168***	0.151***	0.178***
	(3.69)	(4.11)	(3.81)
Dummy of perennial crop	-0.015	-0.016	-0.016
	(0.38)	(0.39)	(0.39)
Woreda has extension service	1.161	5.585	6.165
	(0.38)	(1.47)	(1.57)
Household head worked off-farm	-0.077**	-0.077**	-0.076**
	(2.34)	(2.33)	(2.29)
Age of household head	0.001	0.001	0.001
	(0.53)	(0.80)	(0.84)
Years of education of household head	0.021***	0.021***	0.022***
	(3.36)	(3.37)	(3.34)
Maximum years of education of children	0.010**	0.007*	0.009**
	(2.40)	(1.92)	(2.11)
Dummy of oxen ownship	0.031	0.029	0.038
	(0.80)	(0.77)	(0.94)
Constant	7.923***	7.705***	7.734***
	(20.41)	(19.31)	(19.01)
Observations	5621	5621	5621
R-squared	0.63	0.63	0.63

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5. Simulation of gains in net farm income due to terracing resulting from more secure land tenure, different scenarios

Region	***Baseline***	***Threat of redistribution eliminated; conflicts resolved***		***Transfer rights (mortgaging and sale)***		***No redistribution and Transfer rights***	
	Net income	Net income	Gain in %	Net income	Gain in %	Net income	Gain in %
Tigray	1027.9	1040.8	1.3%	1053.5	2.5%	1064.7	3.6%
Amhara	1143.3	1161.8	1.6%	1194.7	4.5%	1210.3	5.9%
Oromia	1361.6	1382.6	1.5%	1426.1	4.7%	1440.9	5.8%
SNNPR	280.0	282.6	0.9%	290.3	3.7%	292.3	4.4%
National	*1093.9*	*1110.5*	*1.5%*	*1142.6*	*4.4%*	*1155.0*	*5.6%*

Appendix: Conceptual model

Consider a two-period household model with periods indexed by *t*. The household's utility function is $U(C_1, C_2) = \ln(C_1) + \delta \ln(C_2)$, where C_1 and C_2 are consumption level in period 1 and 2 and $\delta \in [0,1]$ is a discount factor. Let households be endowed with fixed amount of labor in each period, i.e., $\bar{L}_1$ and $\bar{L}_2$, and a given land-related capital stock in period 1 K_1. In the first period, the household can employ K_1 and labor l_1^a to produce output Y_1 according to a standard production technology $Y_1 = f(K_1, l_1^a)$. Labor not used in agricultural production can be allocated to off-farm employment (l_1^0) and land-related investments (l_1^I). If land is not redistributed, second period production, $Y_2 = f(K_2 + g(l_i^I), l_2^a)$, uses the same technology with the augmented capital stock $K_2 = K_1 + g(l_1^I)$ [11] and l_2^a. All labor not used in agriculture will be devoted to off-farm employment. Tenure insecurity is a probability $\rho \in [0,1]$ that land is taken away in the second period. We let $\rho(S_2(S_1, l_1^I))$ be a function of tenure security in the first period and assume that $\partial\rho/\partial S_2 > 0$, $\partial^2\rho/\partial {S_2}^2 < 0$, $\partial S_2/\partial S_1 > 0$, $\partial S_2/\partial l_1^I > 0$, $\partial^2 S_2/\partial {S_1}^2 < 0$, $\partial^2 S_2/\partial l_1^I \partial l_1^I < 0$, and $\partial^2 S_2/\partial S_1 \partial l_1^I < 0$.

The household's utility maximization problem can be written up as:

$$\text{Max } U(C_1, C_2) = \ln(C_1) + \delta \ln(C_2) \tag{1}$$

$$\text{s.t } (1+r)[(f(K_1, l_1^a) + l_1^o w_1 - C_1)] + [\rho(S_2(S_1, l_1^I))\, f(K_1 + g(l_1^I), l_2^a) + l_2^o w_2 - C_2] = 0$$

$$\text{and } l_1^a + l_1^o + l_1^I \le \bar{L}_1,\ l_2^a + l_2^o \le \bar{L}_2$$

With separability between consumption and production, this simplifies to:

$$\underset{l_1^a, l_1^I, l_1^o, l_2^a, l_2^o}{Max} \ (1+r)(f(K_1, l_1^a) + l_1^o w_1) + \rho(S_2(S_1, l_1^I))\, f(K_1 + g(l_1^I), l_2^a) + l_2^o w_2 = 0$$

$$\text{s.t. } l_1^a + l_1^o + l_1^I \le \bar{L}_1,\ l_2^a + l_2^o \le \bar{L}_2$$

To solve the maximization problem, we will have the following first order conditions (FOC) after the labor binding conditions $l_1^a = \bar{L}_1 - l_1^0 - l_1^I$, and $l_2^a = \bar{L}_2 - l_2^0$ are substituted into the objective function.

(F1) $-(1+\gamma) f'(K_1, l_1^a) + \rho'(S_2(S_1, l_1^I) S_2'(S_1, l_1^I) f(K_1 + g(l_1^I), l_2^a) + f'(K_1 + g(l_1^I), l_2^a) g'(l_1^I) \rho(S_2(S_1, l_1^I) = 0$

[11] For simplicity we assume that $g(l_1^I)$ is non-decreasing in l_1^I and abstract from depreciation.

(F2) $f'(K_1, l_1^a) = w_1$ and

(F3) $f'(K_1 + g(l_1^I), l_2^a) = w_2$

These allow us to derive comparative statics for the impact of tenure security on land-related investment.

Case 1: If tenure security is exogenously given, the second term of (F1) drops out. (F1) becomes:

$$-(1+\gamma) f'(K_1, l_1^a) + f'(K_1 + g(l_1^I), l_2^a) g'(l_1^I) \rho(S_2) = 0$$

Substituting (F2) and (F3) in yields: $-(1+\gamma) w_1 + w_2 g'(l_1^I) \rho(S_2) = 0$

and total differentiation with respect to l_1^I and S_2 provides:

$$g''(l_1^I) w_2 \rho(S_2) \partial l_1^I + w_2 g'(l_1^I) \rho'(S_2) \partial S_2 = 0$$

$$\Rightarrow \frac{\partial l_1^I}{\partial S_2} = -\frac{g'(l_1^I)\rho'(S_2)}{g''(l_1^I)\rho(s_2)} > 0 \text{ (given } g'(.) > 0,\ \rho'(.) > 0 \text{ and } g''(.) < 0)$$

This implies that better land security will lead to more invisible land investment.

Case 2: Suppose that, contrary to the above, tenure security is endogenous. In the extreme case where investment is only to enhance future tenure security, the third term of (F1) drops and we obtain

$$-(1+\gamma) f'(K_1, l_1^a) + \rho'(S_2(S_1, l_1^I) S_2'(S_1, l_1^I) f(K_1, l_2^a) = 0$$

Substituting (F2) in will reduce it to $-(1+\gamma) w_1 + \rho'(S_2(S_1, l_1^I) S_2'(S_1, l_1^I) f(K_1, l_2^a) = 0$

and total differentiation above with respect to S_1 and l_1^I yields:

$$\rho''(S_2)(\partial S_2 / \partial S_1 \cdot \partial S_1 + \partial S_2 / \partial l_1^I \cdot \partial l_1^I) S'(.) f(K_1, l_2^a) + \rho'(S_2) f(.)(\partial^2 S_2 / \partial l_1^I \partial S_1 \cdot \partial S_1 + \partial^2 S_2 / \partial l_1^{I\,2} \cdot \partial l_1^I) = 0$$

$$\Rightarrow \frac{\partial l_1^I}{\partial S_1} = -\frac{\rho''(S_2)(\partial S_2 / \partial S_1) + \rho'(S_2)(\partial^2 S_2 / \partial l_1^I \partial S_1)}{\rho''(S_2)(\partial S_2 / \partial l_1^I) + \rho'(S_2)(\partial^2 S_2 / \partial l_1^I \partial l_1^I)} = -\frac{(-)(+) + (+)(-)}{(-)(+) + (+)(-)} < 0$$

i.e. tenure insecurity will prompt farmers to make investments as a means of enhancing security of tenure.

Case 3: If investments increase both productivity and future tenure security, the impact of current tenure security is ambiguous. Total differentiate (F1) with respect to S_1 and l_1^I allows to express $\partial l_1^I / \partial S_1$ as:

$$\frac{\partial l_1^I}{\partial S_1} = -\frac{\rho''(S_2)S_2'(S_1,l_1^I)f(K_2,l_2^a)(\partial S_2/\partial S_1)+\rho'(S_2)f(K_2,l_2^a)(\partial^2 S_2/\partial l_1^I \partial S_1)+w_2 g'(l_1^I)\rho'(S_2)\partial S_2/\partial S_1}{\rho''(S_2)S_2'(S,l_1^I)f(K_2,l_2^a)\partial S_2/\partial l_1^I+\rho'(S_2)f(K_2,l_2^a)(\partial^2 S_2/\partial l_1^I \partial l_1^I)+w_2(g''(l_1^I)\rho(S_2)+g'(l_1^I)\rho'(.)\partial S_2/\partial l_1^I)}$$

which has an indeterminate sign. It can be seen that that the combination of the first two terms in the denominator and the first three term in the numerator illustrates case 1, while the combination of the last term in the denominator and the last term of numerator give the condition for case 2. As the two effects have opposite signs, the net effect of tenure security depends on their relative weight.

Case 4 - Land transfer rights: To illustrate the impact of transfer rights, at any given level of tenure security,[12] we assume a non-zero probability θ that a household will be affected by a negative labor shock (e.g. become sick and thus be unable to cultivate its land). While we assume that households can rent out their land at a rental rate *r* that reflects the value of the land-attached capital stock, i.e. $r = r(K_1 + g(l_1^I))$, greater transferability is modeled as a proportional transaction cost *T* with $0<T\leq 1$ so that owners receive *(1-T) r*. Maintaining the notation introduced earlier, the simplified maximization problem is:

$$\underset{l_1^a, l_1^I}{Max} \quad (1+\gamma)(f(K_1,l_1^a)+\theta f(K_1+g(l_1^I),\bar{L}_2)+(1-\theta)(1-T)r(K_1+g(l_1^I)) \text{ s.t } l_1^a + l_1^I \leq \bar{L}_1$$

Substitution of the binding labor constraint and taking the derivative with respect to l_1^I yields FOC

$$-(1+\gamma)f_{l_1^a}(K_1,\bar{L}_1-l_1^I)+\theta f_{K_2}(K_1+g(l_1^I),\bar{L}_2)g'(l_1^I)+(1-\theta)(1-T)r'(K_1+g(l_1^I))g'(l_1^I)=0$$

Total differentiation with respect to *T* yields:

$$(1+\gamma)f_{l_1^a l_1^a}\frac{\partial l_1^I}{\partial T}+\theta(f_{k_2k_2}(g')^2+f_{k_2}g'')\frac{\partial l_1^I}{\partial T}-(1-\theta)r'g'+(1-\theta)(1-T)(r''g'+r'g'')\frac{\partial l_1^I}{\partial T}=0$$

$$\Rightarrow \frac{\partial l_1^I}{\partial T}=\frac{(1-\theta)r'g'}{(1+\gamma)f_{l_1^a l_1^a}+\theta(f_{k_2k_2}(g')^2+f_{k_2}g'')+(1-\theta)(1-T)(r''g'+r'g'')}<0$$

demonstrating formally that stronger transfer rights, i.e. lower transaction cost associated with transferring out land, will encourage land-related investment.

[12] To simplify the subsequent presentation we assume, without loss of generality, that tenure is perfectly secure. In fact, inspection of the data illustrates that the large majority of households who perceive the right to transfer land are indeed convinced that these rights will not be redistributed through administrative fiat.

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