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Does tenure insecurity explain the variations in land-related investment decisions in rural Ethiopia?

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Does tenure insecurity explain the variations in land-related investment decisions in rural Ethiopia?

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Abstract

We examine the relationship between land tenure security and land-related investments in rural Ethiopia. We control for both household heterogeneity and possible endogeneity of tenure security in estimating the impact of tenure security on investment. Empirical results show that variations in levels of tenure security do not explain the observed differences in investment behaviour among farm households in rural Ethiopia. In contrast, land size, access to labour and extension services, and location are seen to be important determinants of land-related investments. The results suggest that without addressing other barriers to investment, land reforms (titling) may not be sufficient to improve land-related investments.

JEL Classification: P14, Q15, Q16

Key words: Property rights, land tenure, land titling, agricultural extension services, Africa

1. Introduction

Despite agriculture being the main economic activity in most Sub-Saharan African countries such as Ethiopia, the sector is characterized by low investment and agricultural productivity growth (Diao, Hazell, & Thurlow, 2010). In this regard, there is a strong argument that, among other factors, the lack of secure land rights has adversely affected agricultural productivity and perpetuated poverty in rural areas of these countries (Deininger, 2003; Rahmato, 1993). For this reason, both government and donor agencies have invested in various measures aimed at improving property rights. However, existing empirical evidence on the impact of secure property rights on land-related investment incentives is inconclusive (Brasselle, Gaspart & Platteau, 2002; Fenske, 2011; Gavian & Fafchamps, 1996; Place, 2009; Lawry et al., 2014). Thus, it is not yet clear whether land administration interventions to strength property rights can contribute towards improving agricultural productivity in developing countries (Sjaastad & Cousins, 2009).

A number of potential reasons are proposed for such mixed results in the literature: lack of clarity in the definition of tenure security, measurement error, and endogeneity of land rights in estimating the impact of tenure security on land-related investments to mention a few (Arnot, Luckert & Boxall, 2011; Brasselle et al., 2002; Fenske, 2011). There is indeed empirical evidence in Africa showing that insecurity of land tenure might lead to more investment in land, especially in the case of tree planting (Brasselle et al., 2002; Deininger & Jin, 2006; Mekonnen, 2009; Place, & Otsuka, 2002; Sjaastad & Bromley, 1997). These researchers suggest that under weak tenure security conditions tree planting plays a significant role as a means to enhance security of tenure in addition to its productivity enhancing and other roles. Furthermore, some of these studies show that once such endogeneity of tenure security is taken into account, improvement in tenure security has no significant effect on land-related investment decisions (see for example, Brasselle et al, 2002 in Burkina Faso; Place, & Otsuka, 2002 in Uganda). This suggests that constraints other than tenure insecurity may adversely affect farmers' ability to invest in Africa (Sjaastad & Bromley, 2000).

As a consequence of the foregoing factors, even studies that reported a significant impact of tenure security on investment decisions have documented conflicting results on how tenure insecurity affects investment decisions in a particular country. For example, a study by Holden, Deininger and Ghebru (2009) found that ownership of land titling (tenure security) was associated with more likelihood of tree planting decisions in Ethiopia. In contrast, others found that farmers' perceived degree of tenure insecurity was not a significant factor in their decision to grow perennials (Ali, Dercon, & Gautam, 2011; Holden & Yohannes, 2002) or to invest on soil conservations (Hagos & Holden, 2006), while this factor had a positive and significant impact on the likelihood of tree planting decisions in another study by Mekonnen (2009).

In line with Mekonnen's findings, Deininger and Jin (2006) found that past redistribution experiences at district (village) level increased households' likelihood of tree growing, while past land redistribution experiences measured at household level had no impact on households' tree growing decisions. The perception, at household level, of possible future land redistribution had decreased the likelihood of growing trees by the same households. However, unlike the other studies, Deininger and Jin (2006) made no distinction between households who expected to lose land and

households who expected to gain land through land redistribution when measuring household level tenure insecurity.

Studies that used transfer rights as an indicator of tenure security also reported mixed results in Ethiopia. Deininger and Jin (2006) reported that at household level, a perceived right to mortgage land significantly increased the likelihood of tree planting (all types of trees) and increased the likelihood of applying soil conservations, while the perceived right to sell land had affected only soil conservation practices. In contrast, Ali et al. (2011) found that perceived transfer rights (not specified and measured at plot level) affected investment decisions positively in coffee and chat crops but had no significant impact on the decision to grow eucalyptus trees. However, the study by Ali et al. (2011) did not specify which aspect of the transfer right they actually measured. Thus, it is not clear whether their term 'transfer right' refers to the right to sell or mortgage, the right to rent out, or give it as a gift, or any combination of these.

The preceding empirical uncertainty suggests that the relationship between the degree of tenure security and farmers' investment decisions needs further scrutiny. With this purpose in mind, this paper examines whether the lack of tenure security or perhaps other, and more binding issues are the main constraints to land-related investments in rural areas in Ethiopia. This country provides an ideal case study of the relationship between tenure insecurity and land-related investment decisions because of its unique land tenure system. All land is owned by the state and farmers have usufruct rights only. They are not allowed to sell or mortgage their land.[1] This means improvements in tenure security in Ethiopia are expected to affect willingness to invest, but not ability to invest; since there is no collateral effect. In addition, during both previous and current regimes, government sponsored land redistributions have been widely used to equalize the distribution of operational land holdings (Benin & Pender, 2001) and are, themselves, a main source of tenure insecurity among farmers in rural Ethiopia (Rahmato, 1993). Yet, such land redistribution experiences vary across regions (Table 1A) and are largely exogenous in that an individual farmer has little control over them. This is the source of variations in land tenure security in our analysis.

Unlike many of the existing studies in Ethiopia which relied on small samples and/or cross-sectional data with limited geographical representativeness, this study uses a panel data set covering four regions of the country.[2] The use of panel data estimates allow us to deal with various sources of unobserved household heterogeneity such as farming ability, the farmer's attitude towards risk, and time preferences which are expected to affect farmers' decisions in land-related investments (Hagos & Holden, 2006; Pender & Fafchamps, 2005). In addition, the panel data design allows us to examine the relationship between farmers' perception of tenure security that is measured at one time and subsequent investment behaviour. In some of the existing panel data studies in Ethiopia, such temporality was violated.[3] Furthermore, this study augments the econometrics analysis of the

[1] In many other Sub-Sahara African countries, both statutory and customary laws determine land tenure (Firmin-Sellers & Sellers, 1999).

[2] The regions are Amhara, Tigray, Oromia, and the Southern Nations, Nationalities, and Peoples' Region (SNNP).

[3] For example, panel data studies by Mekonnen (2009) and Ali et al., (2011) examined the relationship between current perceptions of tenure security and investment activity occurring in the past. Unless we

impact of tenure insecurity on land-related investments with additional evidence based on the analysis of farmers' perceptions of factors affecting their investment decisions. Such an analysis can help identify directly, households' major investment constraints as mentioned by the farmers themselves.

Following Wooldridge (2012; 2013), we use a pooled bivariate probit model with correlated random effects in estimating the impact of tenure security on investment decisions. This approach controls for both household heterogeneity and possible endogeneity of land rights. Estimation results and an analysis of farmers' perceptions of factors affecting their investment decisions show that tenure insecurity has no significant impact on their decisions to invest in tree planting or soil conservation in rural Ethiopia. We find that factors such as land size, access to labour and extension services, and location are important determinants of these land-related investments. The results suggest that farmers' tree planting and soil conservation decisions in rural Ethiopia are mainly determined by the cost and availability of recourses, not by the incentive structure of the land tenure system. Thus, tenure security may be a necessary, but not a sufficient condition to increase investment.

The rest of the paper is organised as follows. An overview of the land tenure system in Ethiopia is presented in section 2. In section 3, we discuss the theoretical model on land tenure and investment relations. In section 4, we describe the data used. Section 5 presents the econometrics approach used. Section 6 discusses the results, while the final section presents some concluding remarks.

2. Overview of the Land Tenure System in Ethiopia

The current land tenure system in rural Ethiopia has been shaped by historical land reforms. Following the overthrow of the imperial regime by the military regime (Derg), the government announced a radical land reform in 1975. This reform nationalised all rural and urban land, as well as all natural resources in the country. Land was redistributed to individual households based mainly on family size, and the land holding per household was restricted to no more than ten hectares. Peasants were granted only usufruct rights depending on a peasant's continued residence in the village and inheritance was possible only among immediate family members (Rahmato, 1993). The land reform banned land transfer through sale, rental, or the mortgage market. It also restricted the hiring of agricultural labour in family farming (unless the individual was sick or weak). Formally, family inheritance and administrative land redistribution were the main instruments used to adjust land holdings and address landlessness problems in rural areas (Pender & Fafchamps, 2005; Rahmato, 1984).

After the downfall of the socialist regime in 1991, a new Constitution in 1995 (Proclamation No. 1/1995) asserted that all rural and urban land belonged to the state and the people of Ethiopia and individuals had only usufruct rights. This, once again, limits transfer of land through sale or mortgage. However, the current land policy officially allows farm households to rent out their land

assume that perception of tenure insecurity have not changed over time, it is not clear from these inverse correlations whether the observed relationship measures the effect of perceived tenure insecurity on land-related investments.

on a short-term basis, hire agricultural labour, and to claim compensation for investment on their land in cases of displacement from that land. In addition, the current land policy gave some power to regional governments to formulate their own land legislation within the framework of the general principles provided in the federal law (Proclamation No. 87/1997).This resulted in some regional variation with regard to some land laws. For example, different regions imposed different restrictions on the size of the land to be rented out and the rental duration (Rahmato, 2004).

Despite the fact that land renting is permitted, land access through market channels is very limited. Data used in this study show that the majority of operated plots in rural areas are acquired through government allocation and inheritance (Table 2A). Also, in some regions, land redistribution has been widely used under the current regime as an instrument to address landlessness problems. For example, 20.9% of households in Tigray and 22.7% of them in Amhara reported land losses due to land redistributions in 1983-1994 and 1994-1999 respectively (Table 1A). These figures are consistent with the fact that during these periods there were major land redistributions in the two regions (Benin & Pender, 2001). Such land redistributions are expected to undermine farmers' tenure security and lead to fragmented land holdings in rural areas (Rahmato, 2004). Additionally, the Constitution guarantees access to land free of charge for any individual aged 18 and above who wishes to take farming as the main livelihood activity. This leaves open the possibility of future land redistribution and suggests that perceptions of land tenure security will vary among households, mainly due to past land redistribution experiences and expectations about potential land redistributions in the future. For example, in 1999, 11.4 % of households in Tgiray, 14.4% in Amhara, and 13.2% in Oromia have expected land losses because of land reform in the next five years, while the figure is only 6.4% in SNNP (Table 1A).

The forgoing shows that because of regular land redistribution experiences during both the past and current regimes, land appropriation by government officials is the main source of tenure insecurity in Ethiopia. In response to such criticism and with the objective of increasing tenure security, starting in 1998, the current government begun implementation of the first stage of a land titling programme in various parts of the country. As of 2008, close to 20 million plots (6.3 million households out of about 13 million rural households) have registered titles (Deininger, Ali, Holden, & Zevenbergen, 2008).

The few empirical studies, which examined the early economic impacts of land titling in Ethiopia found that land title ownership had significant and positive impact on tenure security, investment, and land productivity (Deininger Ali & Alemu, 2011; Holden et al., 2009:2011). For example, Deininger et al. (2011) found that farmers' perception of tenure security had increased with land title ownership as these households had expected less administrative redistributions in the future. Ownership of land titling in Ethiopia also significantly improved participation in land rental markets (Holden et al., 2011; Deininger et al., 2011). In contrast, based on their study from Tigray region of the country, Segers et al. (2010; p.1025) argued that there is no "evidence that farmers' land rental decisions are influenced by the level of legal or perceived tenure security."

In this study, we do not use land title ownership to measure tenure security in our empirical analysis because information on land title ownership is not available in our data set. In addition, provision of land titling in Ethiopia does not provide benefits, which are linked to credit markets because farmers

are not allowed to sell or use their land as collateral in credit markets. This means that the main mechanism by which land titling contributes to increased investment or productivity is by improving tenure security (Deininger et al., 2011; Holden et al. 2009).Thus, we use farmers' subjective evaluation of their tenure situation as an indicator of tenure security. It is argued that irrespective of *de jure* land policies, it is the perceived tenure situation that is considered important for farmers' decisions to invest on their land (Sjaastad & Bromley, 2000).

In particular, we define insecurity of tenure in terms of households' perceptions of the probability of losing land (i.e reduction in land size) within the next five years due to government sponsored land redistribution. This approach is used by earlier studies in Ethiopia (e.g. Ali et al., 2011; Holden & Yohannes, 2002; Mekonnen, 2009).[4] However, some writers have argued that government expropriation of land should not necessarily be associated with tenure insecurity as long as there is an institutional setting that guarantees fair compensation (Sjaastad & Bromley, 2000). In Ethiopia, redistributions to date have generally taken place without fair compensation (Ambaye, 2013; Holden & Yohannes, 2002; Rahmato, 2009). In particular, as land belongs to the state, farmers have not been compensated for the lands they lost during land redistributions and in events when farmers were moved, often they received land which was of poor quality (Rahmato, 2009).This means farmers can lose their investments in improving soil fertility. Therefore, we expect that government's power to expropriate land might negatively affect farmers' perception of tenure security, resulting in less incentive to invest.

3. Theoretical Analysis

The theoretical framework used for this study is based on a simple model developed by Besley (1995) to explain how improvements in land rights could enhance investment incentives. The principal arguments for a positive link between secure property rights and investment include the following three points. First, secure property rights remove disincentives to invest as such rights give the assurance that individuals would not be expropriated from their property (Binswanger, Deininger & Feder, 1995; Demsetz, 1967; Feder & Onchan, 1987). Second, secure property (usually land) can be used as collateral in the credit market, which may increase access to funds for investment through formal credit markets (Feder & Onchan, 1987). Third, improvement in transfer rights due to tenure security allows individuals to sell or rent their investment, which increases the incentive to invest and benefit from trade (Besley, 1995; Besley & Ghatak, 2010; Platteau, 1996). According to Brasselle et al.(2002:374), these effects are called the 'assurance effect', the 'collateralisation effect', and the 'realizability effect', respectively. In the context of Ethiopia, it is mainly the assurance aspect of tenure security that is important because farmers are not allowed to

[4] In the literature, tenure is defined as "a bundle of rights" and tenure insecurity can be narrowly defined as the perception of losing land in some future time. Or it can be broadly defined as "...the fear of not being able to benefit in full from the set of rights to which one lays claim, and the uncertainty associated with the nature of this set of rights" Sjaastad and Bromley (2000:373). See Simbizi, Bennett, & Zevenbergen (2014) for a recent discussion on this issue.

sell or use their land as collateral in credit markets even if they have land titling. This makes it possible to test the 'assurance effect' in isolation from the other effects.

Following Besley (1995), consider a farm household deciding at each period t how much capital, k_t, to invest in land. The returns' function for time $t+1$ is given by V (k_t, R_{t+1}), and depends on property rights at period $t+1$ denoted by R_{t+1}. It is assumed that the returns' function, V (k_t, R_{t+1}) is increasing in both arguments and concave in k_t. The cost of the investment is denoted by C (k_t, R_{t+1}), which is assumed to be increasing in k_t and non-increasing in R_{t+1}. This means investment cost increases as farmers use more capital to invest, but it does not necessarily increase as degree of tenure insecurity increases.The optimal investment choice thus satisfies:

$$\underset{K_t}{Max} \ \{ \ W(k_t, R_{t+1}) \ \} \equiv V(k_t, R_{t+1}) - C(k_t, R_{t+1}) \qquad [1]$$

where $W(k_t, R_{t+1})$ indicates net returns. From equation 1 we obtain:

$$\frac{\partial k_t}{\partial R_{t+1}} = -\frac{W_{12}(k_t, R_{t+1})}{W_{11}(k_t, R_{t+1})} \qquad [2]$$

With $W_{11} < 0$ at a maximum, equation [2] implies that investment increases as rights are improved, provided that $W_{12} > 0$. Based on the assurance aspect of tenure security argument, let us assume that in the period $t+1$ there is a finite probability that a household will have its land expropriated and that this probability is a decreasing function of the rights that the household enjoys. The probability of expropriation function is given by $\tau(R_{t+1})$ ($\in [0,1]$), where $\frac{\partial \tau}{\partial R_{t+1}} < 0$. The expected return on investment is $V(k_t, R_{t+1}) = [1-\tau(R_{t+1})]F(k_t)$, where $F(k_t)$ is the physical return on the investment and it is assumed that the farmer keeps none of the return after an expropriation. By differentiating the returns' function with respect to capital first and then with respect to property rights, we obtain.

$$V_{12} = -\tau'(R_{t+1})\, F'(k_t) > 0 \qquad [3]$$

In addition, under the assumption that costs are independent of R_{t+1}, the result implies that, $W_{12} > 0$. Furthermore, if we assume land rights are exogenously given the returns' function can be written as V (k_t, R_t), in which case the decision to invest during one period does not affect future land rights. The optimal investment choice thus satisfies:

$$\underset{K_t}{Max} \ \{ \ W(k_t, R_t) = V(k_t, R_t) \ \} \equiv V(k_t, R_t) - C(k_t, R_t) \qquad [4]$$

We do not expect reverse causality in estimating the relationship between tenure insecurity and land-related investment decisions. This is a plausible assumption in our case because land-related

investments such as tree planting do not prevent the government from practising land redistributions or expropriations. Indeed, there is some evidence suggesting that land loss due to redistribution could happen even though households planted trees on their land, and in some cases without fair compensation (Holden & Yohannes, 2002; Rahmato, 2009). This means farmers may not expect that they can change their tenure status by growing trees. Supporting this claim, Gebremedhin, Pender and Ehui (2003: p. 10) using data from Tigray region documented that "farmers in the study area do not believe that their land investment decisions do influence their tenure security".[5] In our sample, none of the sample households who were asked why they had planted trees reported that they did it in order to improve their tenure security status. Therefore, we can hypothesise that tenure insecurity is expected to have a non-ambiguous negative impact on land-related investment decisions.

4. Data and Measurement Issues

4.1. Data Sources and Sample Design

The data for this research are obtained from the Ethiopian Rural Household Survey (ERHS). The ERHS is a rich panel dataset made available by the International Food Policy Research Institute (IFPRI).[6] The initial survey was conducted in 1989. It covered seven Peasant Associations (PAs) and 450 households located in three regional states: Amhara, Oromia, and SNNP. The panel survey began in 1994. It incorporated six areas surveyed in 1989 and an additional nine new areas that were selected to account for diversity in the farming system. Farming systems were used as a stratification base to select the fifteen PAs from the Amhara, Oromia, SNNP, and Tigray regions of the country. Random sampling was then used to select households within each PA (Dercon & Hoddinott, 2011).

In the 1994 survey, 1477 sample households were selected from the 15 PAs using a self-weighting sampling. Accordingly, each person represents approximately the same number of persons from the same farming system (Dercon & Hoddinott, 2011). Although the self-weighting sampling is considered adequate for regional representation, it is suggested that the data should not be considered as nationally representative as sample households only represent the non-pastoralist farming systems in the country (Dercon & Hoddinott, 2011). Further rounds were conducted in 1995, 1997, 1999, 2004, and 2009. The attrition rate between the 1994 and 1999 survey rounds was 7.89%, 5% between 1999 and 2004, and 3% between 2004 and 2009.[7]Some important variables are not available in the other survey years and the study uses data from the last three rounds of the survey, 1999, 2004, and 2009. Table 1 provides descriptive statistics for the variables of interest in 2004 and 2009.

[5] This is mainly regarding long-term land-related investment decisions.

[6] The data set is available at: http://www.ifpri.org/dataset/ethiopian-rural-household-surveys-erhs.

[7] According to Dercon & Hoddinott (2011), these attrition rates were partly caused by some site-specific factors such as the loss of agricultural land in some villages because of expansion work on Lalibela airport, and households in some resettlement villages deciding to return to their original villages. Although we find some evidence of non-random attrition rates, there is little evidence that parameter estimates on non-attriting samples be biased (result not reported here).

Table 1: Descriptive statistics of variables used in the regression models.

Variable	2004 (n=1168)		2009(n=1205)	
	Mean	S.D.	Mean	S.D.
Dependent variables (all dummy, 1 if household invested on land)				
Soil conservation(any type)	46.0	0.5	0.57	0.49
Soil conservation(stone terraces)	26.0	0.44	0.33	0.47
Soil conservation(soil bund)	15.0	0.36	0.19	0.39
Grow permanent crops	74.0	0.44	0.76	0.43
Grow permanent crops(5 year)	38.0	0.49	0.37	0.48
Grow Eucalyptus	46.0	0.5	0.53	0.5
Grow Eucalyptus(5 year)*	0.22	0.42	0.36	0.48
Tenure security variables				
Expected land loss	0.11	0.31	0.06	0.24
Have plot transfer rights	0.73	0.45	0.89	0.32
Household characteristics				
Male family labour (numbers)	1.44	1.07	1.46	1.1
Female family labour(numbers)	1.49	0.95	1.57	0.94
Head sex (1 , if female)	0.29	0.45	0.32	0.47
Head age(years)	50.89	14.85	52.8	15.15
Head can read and write	0.37	0.48	0.48	0.5
Livestock holdings(real value)	2369.36	2908.78	2232.48	3051.84
Labour sharing (1, if yes)	0.43	0.5	0.4	0.49
Access to Extension services (1, if yes)	0.16	0.37	0.56	0.5
Plot size(hectares):				
Land size(< 0.5)	0.23	0.42	0.20	0.40
Land size (>0.5 and <=1)	0.16	0.37	0.19	0.39
Land size (>1 and <=3)	0.49	0.50	0.46	0.50
Land size (>3)	0.12	0.33	0.15	0.35

Source: Own calculations using ERHS data. Note: * planted within five years' time before each survey year.

About 30% of the households in the sample are female-headed households, and close to 50% have land holding size between one and three hectares. During both periods, about 40% of the households have participated in local labour sharing arrangements, while the percentage of households getting access to extension services increased from 16% in 2004 to 56% in 2009. In the 2009 survey year, 53% of the households reported that they have planted eucalyptus trees on their plots (without time reference), while 36% planted eucalyptus trees between 2004 and 2009. During the same period, 46% and 57% of the sample households reported that they have practised some kind of soil conservation on their land, respectively. However, there are significant regional variations during both years. For instance, the data for 2004 show that participation in soil conservation practice is relatively high in Tigray (89%), while the figure is only 12% in SNNP.

4.2. Indicators of land tenure security

Two tenure security indicators are available in the data set. The first one indicates whether a household have expected to lose land due to land redistribution during 1999–2004 and 2004–2009. These data were collected in the 1999 and 2004 survey years, respectively. About 11% of the

households have expected land losses due to land reform in 1999–2004, and this figure reduced to 6% in 2004–2009 (Table 1A). The marked decline in the percentage of farmers' fear of losing land because of land redistributions may be related to the fact that the actual experience of losing land because of land reform had significantly declined in most regions. However, fear of losing land because of land redistribution remains relatively high in Tigray region where land redistribution has been banned since 1997, and the actual redistribution experience is zero in the sample after 1997. This suggests that aside from actual land redistribution experiences expected land redistributions continued to play a role in explaining existing variations in farmers' perception of tenure insecurity.

The other tenure security indicator available in the data set was obtained by asking respondents to answer the following question: "Does anyone in the household have the right to transfer this land to someone else?" However, it is not clear from the questionnaire which aspects of the transfer right were measured in each survey year. For example, was reference being made to the right to sell or mortgage, the right to rent out or to give it as a gift to someone else, or any combination of these? In addition, the question was posed in respect of all the plots that a farmer had cultivated, including plots that were sharecropped or rented-in from other households. In such cases, it is not clear whether the researcher was expecting the farmer to answer the question on behalf of the owner of the plot, who was renting it to the farmer.[8] Thus, households can report different transfer rights for the various plots that they cultivated. Table 3A shows that 84.1% of the households in 2004 reported no variations in transfer rights for the different plots they had cultivated, while 14% of the households reported within-household variations in transfer rights because those households have at least one plot they had leased from other farmers. The percentage of plots with transfer rights is only 2.7% for leased-in plots (using cash rental) and 1.2 % for sharecropped-in plots in 2009.

In 2009 survey year, 89.5% of PA allocated plots and 83.6% of inherited plots have transfer rights, while the figures are only 74.5% and 57.1%, respectively in 2004 (Table 2A). It is clear that there is a marked change in the perception of plot transfer rights between 2004 and 2009. This implies that measurement error could be one potential explanation because there were no major policy changes concerning plot transfer rights in Ethiopia since 1995. In order to minimize the noise in the plot transfer right variable, we use a variable that indicates plot transfer rights at household level, while excluding plots that were leased in from other households. For reported variations in transfer rights that are not related to the presence of leased plots in a household (which are <2%), a household is considered to have a plot transfer right if the respondent in that household reported that at least one of the household plots can be transferred.[9] In this way, we examine whether farmers who perceive that they have the right to transfer their land (not rented land) invests more compared to those who perceive that they have no transfer rights.

The household level transfer rights variable indicates that 71.7% of the households in 2004 and 88.1% of them in 2009 reported that they have transfer rights. Significant change in the perception of transfer rights between 2004 and 2009 remained high. However, as the discussion above

[8] For instance, in the 1999 survey round, among households who reported that they have transfer rights for plots that they had leased from others, 44% of them responded that the original landowner have the right to transfer the plots.

[9] After excluding the leased plots, the observed variations in most cases are most likely due to coding error.

indicates, the 'transfer right' variable in the questionnaire is not specific and we can get different results across time.[10] Thus, care is required in interpreting the coefficients on the transfer right variable. We include the perceived plot transfer rights variable in our analysis in order to compare results from other studies that have used this variable as tenure security indicator (e.g. Ali et al., 2011; Deininger & Jin, 2006).

5. Estimation Strategies

In theory, security assurance, collateralization and benefits from trade are the three main channels through which secure property rights are expected to impact investment positively. As noted above, we argue that it is mainly the assurance aspect of tenure security that is important in the context of Ethiopia. Our main tenure insecurity variable is the one that indicates whether a household have expected to lose land due to land redistribution during 1999–2004 and 2004–2009, which was collected in 1999 and 2004 survey years, respectively.We use tree planting and soil conservation practices to indicate farmers' medium to long-term land-related investment decisions. However, our focus is mainly on tree growing decisions, which indicates farmers' decisions to plant trees (eucalyptus trees or all type of trees) within 5-years (during 1999-2004) and (2004-2009). In effect, a household's decision to plant trees in the periods 1999–2004 and 2004–2009 would have taken into consideration expected tenure security status as reported in 1999 and in 2004, respectively.[11] Unlike the tree planting decisions, the information on soil conservation practices do not have a time-frame.

The dependent variable in our model indicates whether a farmer participated in a particular land-related investment. Therefore, a decision to invest in either tree planting or soil conservation is modelled as an investment in a binary choice model. Following Wooldridge (2010), we incorporate unobserved time-invariant household heterogeneity (e.g. farming ability, farmer's attitude towards risk, and time preferences) and specify an investment model as:

$$I_{it} = 1[\alpha_{iI} + \beta S_{it} + X_{it}\phi_I + \varepsilon_{it1} \geq 0] \qquad [5] \qquad \varepsilon_{it1} \mid X_i \sim Normal(0,1)$$

Where I_{it} is a dummy variable equal to one if household i has undertaken land-related investments at time t, α_{iI} indicates time-invariant unobserved household heterogeneity, S_{it} indicates expected tenure security status , which was collected at time t, β and ϕ are parameters to be estimated, X_{it} indicates other socio-economic household characteristics that are expected to affect land-

[10] However, we expect that the perceived transfer rights variable mainly indicates farmers' rights to rent or sharecrop their land, which is legal in all regions. Using nationally representative data, Deininger and Jin (2006; p.1260) showed that about 91% of farmers in Ethiopia indicate to have right to rent and sharecrop, while "only 23% indicate that they would be able to temporarily mortgage their land and only 4% indicate that they would be able to permanently transfer the rights to their land through sale."

[11]The plot transfer right variable in 2004 and 2009 might indicate transfer rights with reference to about one year before each survey was conducted, while the investment decisions could be made at any time between 1999 and 2004 or 2004 and 2009.

related investment decisions at time t, and ε_{it1} is a random error term which is assumed to be independent of (X_i , α_i). Conditional on α_i , variables in X_{it} are assumed strictly exogenous.

As mentioned earlier, endogeneity of tenure security is a potential problem when estimating the impact of tenure security on land-related investment decisions. Although we assume that there is no reverse causality between investment and tenure security status, time-varying omitted variables can still bias our estimates. This allows us to specify a reduced form equation for the perception of tenure security status as follows:

$$S_{it} = 1[\alpha_{is} + X_{it}\phi_s + \varepsilon_{it2} \geq 0] \qquad [6]$$

$$\varepsilon_{it2} \mid X_i \sim Normal(0,1)$$

To deal with the heterogeneity problem, Wooldridge (2010, 2013) suggests the use of correlated random effects model, an approach first proposed by Mundlak (1978) and extended by Chamberlain (1984). The correlated random effects approach (CRE) allows unobserved household heterogeneity α_i to be correlated with exogenous variables, X_{it} , for all t in a linear way. This method specifies that unobserved factors captured by α_i are partially dependent on a function of other exogenous covariates in the model. Thus, α_i in each equation can be presented as:

$$\alpha_i = \tau + \overline{X}_i\theta + a_i \qquad [7]$$

$$a_i \mid X_i \sim Normal(0, \sigma_a^2)$$

Where a_i is a new unobserved individual effect, $\overline{X}_i$ are time averages of strictly exogenous covariates in the model (5). After substituting equation (7) into equations (5) and (6), we can write the resulting models as:

$$I_{it} = 1[\psi_{aI} + \beta_{aI}S_{it} + X_{it}\phi_{aI} + \overline{X}_{it}\gamma_{aI} + \upsilon_{it1} \geq 0] \qquad [8]$$

$$S_{it} = 1[\psi_{as} + X_{it}\phi_{as} + \overline{X}_i\gamma_{as} + \upsilon_{it2} \geq 0] \qquad [9]$$

In each equation $\upsilon_{it} = (a_i + \varepsilon_{it})/(1+\delta_a^2)^{1/2}$ has a standard normal distribution conditional on X_i . The subscript "a" in the parameters indicates division by $(1+\delta_a^2)^{1/2}$. With the presence of both heterogeneity and binary endogenous variables in non-linear panel data, Wooldridge (2010) suggests the use of a pooled bivariate probit model with correlated random effects. In this case, the error terms in equations 8 and 9 are assumed identically distributed as bivariate normal with zero mean, unit variance, and correlation coefficient (ρ_{jm}). In this way, we can estimate the scaled coefficients and we can identify both the parameters of the model and average partial effects (Wooldridge, 2010). According to Wooldridge (2013), in using this approach we are averaging out

both time-invariant and time-variant unobservables. To correct for error correlations over time for a given household we use clustered robust standard errors (Carmeron & Triveda, 2010).

The vector of exogenous variables in equations 8 and 9 are not necessarily identical. Indeed, according to Wooldridge (2010), some instruments should be omitted from equation (8) for identification purpose. However, according to Wilde (2000) the existence of one exogenous regressor is sufficient to avoid identification problems. In our case, a variable indicating whether households had lost land due to redistribution in the past is excluded from the investment equation.[12] We argue that this variable while directly affecting the perception of tenure security has no direct effect on land-related investment decisions once we control for land holding sizes and household wealth(e.g. livestock). The introduction of this variable in the investment equation provides a nonsignificant coefficient, which enables us to use it to identify our mode.

The vector X_{it} includes age, education, and gender of the head of a household, plot size (excludes land obtained via land rental markets), number of working age male and female family members in a house and livestock holdings, which we assume are exogenous in our model (at least in the short-run). The term $\overline{X}_i$ includes average values for time-varying exogenous variables. Village (district) dummies were also include in the estimation model to control for the differences in agro-ecological conditions, cropping practices, population pressure, access to markets, prices, and variations in land rights.

Recent studies suggest that social networks and access to extension services are important factors in farmers' decisions in land-related investments (Conley & Udry, 2010; Krishnan & Patnam, 2014). Access to extension services can provide farmers with more information on the benefits of land-improvements and improves their access to inputs such as fertiliser or seeds. Likewise, participation in local labour-sharing arrangements is expected to solve labour shortage problems in rural areas. To account for such institutional factors, we include variables indicating whether a household had participated in local labour sharing arrangements and whether a household had access to extension services.

6. Results and discussions

6.1. Descriptive Evidence

In the 1999 survey year, farmers were asked to provide information on the main factors that had affected their investment decisions in tree planting and soil conservation practices. The same information was collected in the 2004 and 2009 survey years for soil conservation practices only. Of those households that did not grow any type of tree crops, 41.6% reported that land shortage is the main constraint; however, there are marked regional variations (Table 2). The figure is relatively

[12] According to Monfardini and Radice (2008), using the exclusion restriction in a bivariate probit model improves the validity of tests of exogeneity of the potentially endogenous explanatory dummy variables when the distributional assumptions are misspecified.

higher in Tigray (75%) and SNNP (68%) regional states, while it is lower in the Oromia region (19%). This result is in line with the fact that per capita land size is relatively smaller in the Tigray and SNNP regional states. Other constraints, such as water shortage, labour shortage, and lack of funds are reported by 17.8%, 13.2%, and 10.4% of the respondents, respectively. A lack of security of tenure is reported as a major constraint by only 1.2% of the respondents with the figure being higher in Tigray (3.6%) and Amhara (1.9%) regions where land redistributions were widespread during the current regime.

Regarding households that did not practised any soil conservation on their plots; a large number reported absence of erosion as a major reason (75.9%), followed by labour shortage (16.2%). These figures are more or less the same in the 2004 and 2009 survey years. None of the households in the sample areas reported lack of security of tenure as a reason for not practising soil conservation on their land. The evidence from the descriptive data analysis is informative about that land tenure security status plays a limited role in explaining the existing variations in land-related investment activities in rural Ethiopia. However, it neglects the effect of other sources of household heterogeneity that might affect both farmers perception of tenure insecurity and decisions to participate in land-related investments. Thus, we provide results from econometric analysis in the next section.

Table 2: Major investment binding constraints by region (1999)

Reasons	Regions				
	Tigray	Amhara	Oromia	SNNPR	Total
Reasons for not growing trees (% households)					
Land shortage	75	47.6	19.1	68.1	41.6
Shortage of labour	3.6	16.5	10.5	12.8	13.2
Lack of fund	7.1	9.7	12.5	8.5	10.4
Shortage of water	0.0	1.0	49.3	0.0	17.8
Less profitable	0.0	2.4	3.3	8.5	3.2
Tenure insecurity	3.6	1.9	0.0	0.0	1.2
Other reasons	10.7	20.9	5.3	2.1	12.7
Reasons for not practising soil conservation (% households)					
No erosion	68.2	63.6	74.2	86.6	75.9
Labour shortage	31.8	27.1	16.3	7.1	16.2
Other reasons*	0.0	9.3	9.5	6.3	7.9

Source: Own calculations using data from the 1999 ERHS round. Note: * tenure insecurity is not reported here.

6.2. Estimation results

In this section, we present model estimates for several specifications regarding farmers' tree planting and soil conservation practices. Table 3 provides coefficient estimates from the pooled bivariate probit model with CRE in which we control for both household heterogeneity and possible endogeneity of the tenure insecurity variable in the investment equation. We find that the

estimated correlation coefficient (ρ_{jm}) between the investment equation and the tenure security equation is not statistically significant at conventional levels in all specifications. This suggests that the tenure security variables are not endogenous in the investment model. Hence, we provide estimated marginal effects based on pooled probit and panel CRE probit model estimates in Table 4 (for tree planting decisions), and Table 5 (for soil conservation practices). In the case of panel CRE probit model estimates, we report average partial effects along with bootstrapped standard errors (200 replicates).

Table 3: Pooled bivariate probit estimates of the determinants of land-related investment decisions

	Eucalyptus tree		All type of trees		Soil conservation	
	1	2	3	4	5	6
Expected land loss	0.48		0.50		0.65	
	(0.57)		(0.61)		(0.78)	
Perceived land transfer rights		-0.34		0.28		-0.22
		(0.48)		(1.55)		(0.32)
Male family labour (num)	0.00	0.00	0.04	0.05	0.13**	0.13**
	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)
Female family labour (num)	-0.05	-0.06	0.00	-0.01	0.11*	0.09
	(0.06)	(0.06)	(0.05)	(0.05)	(0.06)	(0.06)
Head can read and write	0.07	0.05	0.00	-0.00	0.10	0.06
	(0.11)	(0.11)	(0.11)	(0.13)	(0.12)	(0.12)
Head sex	-0.13	-0.13*	-0.09	-0.09	-0.16**	-0.17**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Land size (hectares)						
Land size (>0.5 and <=1)	0.18*	0.18*	0.22**	0.21**	0.20*	0.20*
	(0.11)	(0.10)	(0.10)	(0.10)	(0.12)	(0.12)
Land size (>1 and <=3)	0.21**	0.22**	0.20**	0.19*	0.26**	0.27**
	(0.10)	(0.10)	(0.10)	(0.12)	(0.12)	(0.12)
Land size (>3)	0.50***	0.51***	0.37***	0.35**	0.13	0.15
	(0.15)	(0.15)	(0.14)	(0.18)	(0.15)	(0.15)
Livestock holdings (log)	0.02**	0.02***	0.01	0.01	0.01	0.01*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Access to extension services	0.24***	0.24***	0.29***	0.30***	0.26***	0.25***
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Labour sharing	0.23***	0.23***	0.15**	0.14**	0.16**	0.16**
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Observations	2,359	2,359	2,359	2,359	2,359	2,359
Rho	-0.37	0.24	-0.29	-0.19	-0.42	0.27
	(0.31)	(0.27)	(0.33)	(0.92)	(0.48)	(0.18)

Source: Own calculations using data from ERHS (2004 & 2009). Note: Regression includes, head age and age square, time averages of time-varying exogenous covariates, time and village dummies, and a constant. Cluster-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

The estimated coefficient on our main variable of interest, farmers' perception of losing land, is not significant in our pooled bivariate probit model estimates regarding farmers' tree planting decisions (Table 3). In contrast, results from the pooled probit model estimates suggest that households with tenure insecurity have 5% lower probability (at a 10% significant level) of planting eucalyptus trees when compared to households that had reported more tenure security (Table 4). However, the estimated marginal effect on this variable becomes insignificant once we control for unobserved household heterogeneity in our panel CRE probit model. The variable remains insignificant when we use all type of trees as a dependent variable (results not shown here). Likewise, the estimated marginal effect on the plot transfer rights variable is not significant in all model estimates for tree planting decisions. These results suggest that, *ceteris paribus*, improvement in tenure security does not stimulate investment in trees.

Our findings are in line with results found by other studies in Ethiopia (Holden & Yohannes, 2002; Ali et al., 2011). Using the same data set used in this study, Ali et al. (2011) also found that perceived plot transfer rights were not significantly related with planting eucalyptus trees, but were positive and significant in the decisions to plant other trees (coffee and *chat*).[13]However, our results contrast with those of Mekonnen (2009) and Deininger and Jin (2006). Mekonnen (2009) found that farmers' perception of losing land was positively associated with more likelihood of planting of eucalyptus trees in Amhara region of Ethiopia. Likewise, Deininger and Jin (2006) found that past redistribution experiences at village level encouraged tree planting in rural Ethiopia. These findings suggest that tree planting may be used as a means of strengthening tenure security implying that tenure insecurity increases investment. However, these results could also reflect the fact that areas with past land redistributions are also had extensive public-led afforestation and soil conservation interventions (Benin & Pender, 2001; Hagos & Holden, 2006). Therefore, their results could be due to omitted variable bias.

The estimated marginal effects on village dummies reflect the importance of public-led afforestation and soil conservation practices in Ethiopia. Village (district) dummies seem to explain more than 75% of the variations in farmers' tree planting and soil conservation practices. Table 4A presents estimated marginal effects on village dummies based on the pooled probit model estimates (Table 4 and Table 5, column 1). Compared to the base category village in Tigray, *Harresaw*, the probability of planting eucalyptus tree is lower by about 10-44% in other villages, while the probability of tree planting is higher by about 18% for households residing in *Cheha* and *Kembata* districts. These results are in line with what was found in village studies. According to these studies, in *Harresaw*, both government extension agents and local NGOs were heavily involved in facilitating afforestation works and soil and water conservation practices. For instance, after 1991 more than 26,625 eucalyptus seedlings and about 11,000 other tree seedlings were grown in the

[13] Unlike this study, Ali et al. (2011) included leased plots in their analysis. However, our data show that average holding period and the percentage of plots with transfer rights are systematically lower for plots that were leased from other households (Table 2B).Given this, farmers are expected to have less incentives to plant trees on leased plots, irrespective the tree species (Eucalyptus, chat or coffee, which take several years to pay off). Thus, it is not clear why they got different impacts of transfer rights variable on eucalyptus tree and coffee.

area through food-for-work projects (Bevan & Pankhurst, 1996; p. 28). Regarding *Cheha* and *Kembata* districts, though there is relatively limited public-led afforestation interventions; eucalyptus has become a cash crop in these areas since it introduced in 1960's (Bevan & Pankhurst, 1996).

Likewise, the probability of practicing soil conservation is lower by about 20-90% for those households residing in villages other than *Harresaw*. The only exception is for those residing in *Geblen* (another village in Tigray). Other studies also found strong government intervention to facilitate community-led soil conservation practices in Tigray region (e.g. Gebremedhin & Swinton, 2003; Hagos & Holden, 2006). According to Hagos and Holden (2006:189), close to 70% of plots conserved in their sample from Tigray regional state were conserved through puplic-led conservation measures.

Table 4: Marginal effects on the marginal probability of investment (Eucalyptus tree)

	Pooled probit			Panel CRE probit	
	1	2	3	4	5
Expected land loss	-0.06*		-0.05*	-0.05	
	(0.03)		(0.03)	(0.03)	
Perceived land transfer right		0.02			0.02
		(0.02)			(0.02)
Male family labour (num)	0.01	0.01	0.01	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.013	(0.02)
Female family labour (num)	-0.00	-0.00	-0.00	-0.02	-0.02
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Head can read and write	0.05**	0.05**	0.05**	0.01	0.02
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Head sex	-0.04*	-0.04*	-0.03	-0.04	-0.04*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Land size(hectares)					
Land size (>0.5 and <=1)	0.04	0.04	0.03	0.04	0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Land size (>1 and <=3)	0.05**	0.05**	0.04*	0.05*	0.05*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)
Land size (>3)	0.13***	0.12***	0.11***	0.12***	0.12***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)
Livestock holdings (log)	0.01***	0.01***	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Access to extension services	0.06***	0.06***	0.06***	0.06***	0.06***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Labour sharing	0.06***	0.06***	0.06***	0.06***	0.06***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Previous tree planting			0.11***		
			(0.02)		
Planted trees in 1994			0.04*		
			(0.02)		
Observations	2,373	2,374	2,372	2,373	2,374

Source: Own calculations using data from ERHS (2004 and 2009). Notes: Regression includes, head age and age

square, time averages of time-varying exogenous covariates, time and village dummies, and a constant. Standard errors of the estimated marginal effects are presented in parentheses. Bootstrap standard errors (200 replicates) used in the case of CRE model estimates. *** p<0.01, ** p<0.05, * p<0.1

The importance of village dummies in our results is consistent with what was found by Hagos and Holden (2006) that public intervention significantly increased households' decision to invest in land conservation (stone terraces). Indeed, our results suggest that variations in agro-ecological conditions and other village factors (e.g. public-led conservation interventions) that could be captured by village dummies are significantly important in explaining the variations in farmers' land-related investment decisions.

As with tree planting decisions, farmers' perception of losing land is not a significant factor in their decisions to practice soil conservation on their land (any type of soil conservation) (Table 3 and Table 5). [14] In contrast, the marginal effect on the perceived plot transfer rights variable is positive (0.07) and significant (at a 1% significant level) for the case of soil conservation practices suggesting that improvement in plot transfer rights is associated with increased likelihood of soil conservation. Separate analysis of stone terraces and soil bunds (Table 5,column 3 and 4) suggest that improved plot transfer right is not significantly related with soil conservation in the form of stone terraces, while it is significantly related with land improvements in the form of soil bunds. The result contrasts with what was found by Gebremedhin and Swinton (2003; p.80) that "tenure security favours long-term soil conservation investments such as stone terraces, whereas insecurity favours short-term investments, such as soil bunds." As we discussed earlier, measurement error in the transfer rights variable could be responsible for the significant land rights coefficients obtained for soil conservation. In addition, the information on soil conservation practices do not have a time-frame.

[14] We present here (Table 5) only estimated marginal effects from pooled probit model for all soil conservation types because these results are the same from the panel CRE probit model. Likewise, we present only estimated marginal effects from panel CRE probit model for stone terracing decisions because we got similar results from pooled probit model estimates.

Table 5: Marginal effects on the marginal probability of investment (soil conservations)

	All types (pooled probit)			Stone terraces (panel CRE probit)	
	1	2	3	3	4
Expected land loss	-0.03	-0.03		-0.03	
	(0.03)	(0.03)		(0.02)	
Perceived land transfer right			0.07***		0.00
			(0.02)		(0.02)
Male family labour (num)	0.02**	0.03**	0.03**	0.02	0.02
	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)
Female family labour (num)	0.02**	0.03	0.03*	-0.03*	-0.03*
	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)
Head can read and write	0.06***	0.02	0.02	0.01	0.01
	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)
Head sex	-0.04**	-0.04**	-0.04**	-0.01	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Land size(hectares)					
Land size (>0.5 and <=1)	0.06*	0.05*	0.05*	0.01	0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Land size (>1 and <=3)	0.07**	0.07**	0.07**	-0.01	-0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Land size (>3)	0.04	0.03	0.03	-0.01	-0.01
	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)
Livestock holdings (log)	0.00	0.00*	0.00	0.00	0.00
	(0.00)	(0.002)	(0.002)	(0.00)	(0.00)
Access to Extension services	0.07***	0.07***	0.07***	0.06***	0.06***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Labour sharing	0.04**	0.04**	0.04**	0.04**	0.04***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	2,373	2,372	2,373	2,372	2,373

Source: Own calculations using data from ERHS (2004 and 2009). Notes: Regression includes, head age and age square, time averages of time-varying exogenous covariates, time and village dummies, and a constant. Standard errors of the estimated marginal effects are presented in parentheses. Bootstrap standard errors (200 replicates) used in the case of CRE model estimates. *** p<0.01, ** p<0.05, * p<0.1

Looking at other variables, we find that households that had planted trees (eucalyptus) in the previous period have 11.0% more likelihood of planting trees in the next periods (Table 4, column 3).[15] Having invested in the past could allow farmers to learn about the benefits associated with land-related investments and thus they would be more likely to invest again. The probability of investing in tree corps and soil conservation is marginally (at a 10% level of significance) lower for female-headed households suggesting that compared to their male counter parts female-headed

[15] We could not estimate this model for soil conservations because time-frame is not available for soil conservation practices.

households are less likely (4%) to invest on their land. However, gender is not significantly associated with investment in stone terracing and becomes insignificant in the case of tree planting decisions once we control for past investment (Table 4, column 3).

The estimated coefficients (Table 3) and marginal effects (Table 4 and Table 5) on variables indicating access to extension services and participation in local labour sharing arrangements are positive and significant in all our estimates. Having access to extension services and participation in local labour sharing arrangements increases the likelihood of tree planting by 6%, while these probabilities are 7% and 4% for soil conservation practices, respectively. In the face of poorly developed factor and credit marks, farmers' decisions to invest on land may depend largely upon their preferences and endowments (Pender & Kerr, 1998; Sadoulet, Janvry & Benjamin, 1998). In such case, participation in labour sharing arrangements increases farmers' access to labour and then land related investments.Likewise, access to extension services can improve farmers' awareness about the benefits of land-improvements and improves their access to inputs such as fertiliser or seeds. Thus, the results suggest that, *ceteris paribus*, by compensating for market imperfections (e.g. information, labour and other inputs) access to these institutions might improve farmers' ability to invest on their land.

In all our estimates, land holding size is found to be statistically significant in explaining households' decisions to invest in tree crops (all type of trees and eucalyptus). Compared to households with land holding size of less than 0.5 hectares, those households with land size between one and three hectares have 4-5% more likelihood of planting eucalyptus trees, and this probability increases to 11-13% for those households with greater than three hectares. The result remains more or less the same when we use all types of trees as a depended variable with the probability being 6-9% and 11-17%, respectively (results not shown here). This result confirms our previous findings derived from Table 2 that land shortage is the key constraint in farmers' decisions to plant trees on their land. These results suggest that farmers plant trees on their land if the opportunity cost of forgone benefits on the land used is lower than the benefits they get from planting trees. In particular, given most farmers in rural Ethiopia are subsistence farmers with very small land holdings, we expect planting of non-food trees such as eucalyptus could be easier for farmers with more land holdings compared to land-poor farmers.

In the case of soil conservation, we find that compared to households with land holding size of less than 0.5 hectares, those households with land size between one and three hectares have 7% more probability of practicing soil conservations. However, the marginal effect on land size becomes insignificant for the case of stone terrace. These results may suggest that an increase in land holding size is not necessarily associated with more soil conservations because soil conservation practices are largely driven by presence of soil erosion (see Table 2).

So far, we assume that farmers tree planting and soil conservation practices are independent. However, recent studies suggest that there could be complementarity or substitutability between farmers' various land-related investment decisions (Abdulai, Owusu, & Goetz, 2011). This means that the error terms in tree planting and soil conservation practices could be correlated. Therefore, as a robustness check, we estimate a multivariate probit model for tree planting and soil conservation

practices (results are not shown here). Following the method of Cappellari and Jenkins (2003, 2006), model parameters are estimated using the simulation maximum likelihood (SML) estimation procedure.The likelihood ratio test shows that the estimated correlation coefficient between tree planting and soil conservation is though very small (0.098) it is marginally significant (at a 10% level of significance) suggesting that those who planted trees also have unobserved factors which make them more likely to practice soil conservations. Our main findings do not change: tenure insecurity is not significantly associated with farmers' decision to either plant tree crops or practice soil conservation. Our findings indicate that because of other investment constraints, (e.g. land shortage) farmers with secure tenure may not invest on land-improvements.

7. Conclusion

Although the theory is clear about why secure land rights are expected to enhance investment incentives, the empirical evidence linking land tenure security and investment is less clear in Ethiopia and elsewhere in Africa (Fenske, 2011). The land tenure system in Ethiopia has long historical roots. Following the 1975 land reform, all land in Ethiopia is under state ownership, and farmers have usufruct rights only. They are not allowed to sell or mortgage their land. Alongside this, government sponsored land redistributions have been widely used in order to reduce landlessness and equalize land holdings. Such regular land redistributions undermine farmers' tenure security. Since 1997, the frequency of such land redistributions has reduced and the government has begun providing forms of land title to individual farmers in order to improve tenure security. However, fear of land expropriation by the government remains high in rural areas.

In this study, we use a good panel data set to examine whether, in this contemporary context, there is a relationship between farmers' perception of tenure insecurity and their long-term land-related investment decisions in the form of tree planting and soil conservation. The data show that participation in soil conservation and tree planting has increased in rural areas over the study period. However, our findings suggest that although the reduced incidence of land redistribution might have affected farmers' perception of tenure security positively, reduced insecurity does not seem to be significant in these investment decisions of farmers. These findings are robust to changes in model specifications. The results suggest that it is other basic rights and asset holdings that induced farmers to make these land-related investments.

Our argument is not that the existing land tenure system in Ethiopia is satisfactory for farmers' intensification efforts. It is widely argued that past and current land polices in the country have led to decreased and fragmented land holdings in rural areas (Rahmato, 1993; Teklue & Lemi, 2004). As a result, for many there is limited room for farm intensification or fallowing. Fallowing is particularly problematic in that the right to use land in Ethiopia is contingent on continuous cultivation of the land. Thus, leaving land fallow for longer periods could be is a source of insecurity faced by farmers in rural Ethiopia. Other studies in Africa found that plots with more security were more likely to left fallow (Fenske, 2011; Goldstein & Udry, 2008).

Clearly, then the tenure security system is not satisfactory and it is not hard to see why advisors have given emphasis to the need for tenure reform in Ethiopia and why there have been some tenure reforms. However, when we use a panel data set to model the livelihoods of rural farmers in Ethiopia and the constraints that they face in their decision-making, these reforms are not yet having notable impacts. It seems that the history of state redistribution and the fact that legislation remains on the books exercises a lingering impact on farmers' thinking. Also though, further tenure reform will remain conditional on all of the other prevailing realities of rural life. We find that land size, access to labour and extension services, and location are important factors in farmers' investment decisions. Without policy initiatives to circumvent barriers to credit and other market imperfections, land titling programmes may fail to realise their theoretical benefits in Ethiopia. Strategies that will increase access to more land and that will improve market performance should be implemented side by side with any land administration polices aiming at improving agricultural production.

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Appendix A: Tables

Table 1A: Households that experienced and expected land redistribution reforms (1994-2009)

	Tigray	Amhara	Oromia	SNNP	Total (%)	Total households
Lost land due to redistributions (%)						
Lost land before 1994	38.1	44.5	34.7	19.1	33.5	1,455
Lost land 1983-1994	20.9	17.1	6.3	1.1	9.8	1,455
Lost land 1994-1999	0.8	22.7	1.6	2.3	8.6	1,358
Lost land 1999-2004	0.0	2.6	0.9	2.1	1.7	1,353
Lost land 2004-2009	0.0	1.3	0.3	2.7	1.3	1,345
Expected land redistributions (%)						
Expected redistribution in 1999-2004*	14.0	21.0	33.0	10.6	20.4	1,403
Expected land loss	11.6	14.4	13.2	6.4	11.4	1,403
Expected redistribution in 2004-2009	12.7	11.1	12.8	4.0	9.6	1,348
Expected land loss	9.7	6.2	7.0	3.2	5.9	1,348

Source: Own calculations using data from ERHS.
Note:* 'Expected redistributions' includes both those expected land losses and gains due to land redistributions.

Table 2A: Mode of plot acquisitions and plot transfer rights (2004 and 2009)

	2004			2009		
Mode of plot acquisitions	Plots with transfer right (%)	Average holding period (years)	Total plots	Plots with transfer right (%)	Average holding period (years)	Total plots
From PA officials	74.5	17.8	3 604	89.5	23	4 002
Purchased	52	24	173	73.1	26	167
Inherited	57.1	25.1	1 710	83.6	23.8	1 776
Mortgaged[a]	35.7	4.5	14	66.7	13	3
Cash rental	4.9	4.2	143	2.7	4.1	148
Sharecropped-in	7.8	5.1	397	1.2	5.5	435
Borrowed free	33.3	22.1	36	0.0	7.4	12
Others	30.8	17.2	13	0.0	*	1

Source: Own calculations using data from ERHS.
Note: [a] Mortgaged refers to informal form of mortgage between farmers. * indicates information is not available. Farmers asked the following question for each plot they cultivate: "Does anyone in the house have the right to transfer the plot?"

Table 3A: Reasons for within household variations in plot transfer rights (2004 and 2009)

Plot transfer rights	2004	2009
Percentage of households that reported		
No within household variations in plot transfer rights	84.1	78.9
Within household variation in plot transfer rights due to the presence of leased-in plots	14.0	19.3
Within household variations in plot transfer rights for reasons not related with the presence of leased-in plots	1.9	1.8
Household level transfer rights excluding leased-in plots		
Households with transfer rights at least for one plot (%)	71.7	88.1
Total sample households	1360	1355

Source: Own calculations using data from ERHS.

Table 4A: Marginal effects for village dummies (pooled probit model)

District (village) names	Eucalyptus planting	Soil conservation
Base category = Atsib(Harresaw) in Tigray		
Subhsaesie *(Geblen)*	-0.10	0.02
	(0.06)	(0.01)
Ankober	-0.43***	-0.20***
	(0.05)	(0.04)
Baso-worana	-0.06	-0.30***
	(0.06)	(0.03)
Enemay	-0.27***	-0.68***
	(0.06)	(0.05)
Bugena	-0.44***	-0.16***
	(0.05)	(0.03)
Adaa	-0.20***	-0.69***
	(0.06)	(0.04)
Kersa	-0.20***	-0.19***
	(0.06)	(0.03)
Dodota	-0.44***	-0.43***
	(0.05)	(0.05)
Shashemene	-0.03	-0.53***
	(0.06)	(0.04)
Cheha(Imdibir)	0.18***	-0.93***
	(0.06)	(0.02)
Kembata	0.17***	-0.74***
	(0.06)	(0.04)
Bule	-0.10*	-0.79***
	(0.06)	(0.03)
Bolosso	0.08	-0.79***
	(0.06)	(0.03)
Dera-Malo	-0.29***	-0.87***
	(0.06)	(0.03)

Source: Own calculations using data from ERHS. *** p<0.01, ** p<0.05, * p<0.1

southern africa labour and development research unit

The Southern Africa Labour and Development Research Unit (SALDRU) conducts research directed at improving the well-being of South Africa's poor. It was established in 1975. Over the next two decades the unit's research played a central role in documenting the human costs of apartheid. Key projects from this period included the Farm Labour Conference (1976), the Economics of Health Care Conference (1978), and the Second Carnegie Enquiry into Poverty and Development in South Africa (1983-86). At the urging of the African National Congress, from 1992-1994 SALDRU and the World Bank coordinated the Project for Statistics on Living Standards and Development (PSLSD). This project provide baseline data for the implementation of post-apartheid socio-economic policies through South Africa's first non-racial national sample survey.

In the post-apartheid period, SALDRU has continued to gather data and conduct research directed at informing and assessing anti-poverty policy. In line with its historical contribution, SALDRU's researchers continue to conduct research detailing changing patterns of well-being in South Africa and assessing the impact of government policy on the poor. Current research work falls into the following research themes: post-apartheid poverty; employment and migration dynamics; family support structures in an era of rapid social change; public works and public infrastructure programmes, financial strategies of the poor; common property resources and the poor. Key survey projects include the Langeberg Integrated Family Survey (1999), the Khayelitsha/Mitchell's Plain Survey (2000), the ongoing Cape Area Panel Study (2001-) and the Financial Diaries Project.

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