School of Business, Economics and Law
UNIVERSITY OF GOTHENBURG

WORKING PAPERS IN ECONOMICS

No 321

Tenure Security and Investments: Micro-evidence from Zimbabwe's Fast Track Land Reform Programme

Precious Zikhali

October 2008

ISSN 1403-2473 (print)
ISSN 1403-2465 (online)

SCHOOL OF BUSINESS, ECONOMICS AND LAW, UNIVERSITY OF GOTHENBURG

Department of Economics
Visiting adress Vasagatan 1,
Postal adress P.O.Box 640, SE 405 30 Göteborg, Sweden
Phone + 46 (0)31 786 0000

Tenure Security and Investments: Micro-evidence from Zimbabwe's Fast Track Land Reform Programme

Precious Zikhali[1]

Abstract

The government of Zimbabwe launched the Fast Track Land Reform Programme (FTLRP) in 2000 as part of its ongoing land reform and resettlement programme aimed at addressing a racially skewed land distribution. Its goal has been to accelerate both land acquisition and redistribution, targeting at least five million hectares of land for resettlement. This paper investigates the impact of the FTLRP on its beneficiaries' perceptions of land tenure security, and how these subsequently impacted soil conservation investments. Evidence suggests that the programme created some tenure insecurity, which adversely affected soil conservation investments among its beneficiaries. We find support for the contention that households invest in land-related investments to enhance security of tenure. The results underscore the need for the government of Zimbabwe to clarify and formalise land tenure arrangements within the programme.

Key words: Land reform, Tenure security, Investments, Zimbabwe.
JEL Classification: O12, O13, Q15, Q24.

[1] Department of Economics, University of Gothenburg, Box 640, SE405 30, Gothenburg, Sweden.
Email: Precious.Zikhali@economics.gu.se The author gratefully acknowledges comments from Afaf Rahim, Gunnar Köhlin, Håkan Eggert, Jesper Stage, Klaus Deininger, Menale Kassie, Måns Söderbom, Prosper Matondi, Sven Tengstam, Wilfred Nyangena, seminar participants at the University of Gothenburg, participants at the Economic Development in Africa conference, Oxford, United Kingdom as well as participants at the First Annual Meeting for Environment for Development (EfD) initiative, Cape Town, South Africa. Many thanks to the Centre for Rural Development in Zimbabwe for help with data collection. Finally, financial support from Sida is gratefully acknowledged.

1. Introduction

In an attempt to address a racially skewed land distribution, Zimbabwe has, since independence in 1980, pursued a land reform and resettlement programme premised on land acquisition and redistribution. The most recent phase of this programme, the Fast Track Land Reform Programme (FTLRP), on which this analysis is based, was officially launched in July 2000 with a goal to attain extensive, compulsory land acquisition and redistribution, targeting at least five million hectares of land for resettlement (Zimbabwe, 2000). While, in principle, the land tenure system under the FTLRP ranges from a permit system to a 99-year lease with an option to purchase the land, the reality is that the FTLRP beneficiaries have been issued many different types of temporary licenses that the government intends to convert, in time, to permanent leases. This has been argued to be a source of tenure insecurity among the beneficiaries (Munyuki-Hungwe and Matondi, 2006).

Macro-evidence indicates that the FTLRP had been accompanied by a 30% drop in agricultural production by 2004 (Richardson, 2004). Given that land-related investments such as soil conservation investments have been found to enhance productivity in Zimbabwe (Zikhali, 2008), it can be argued that the rapid decline in production is partly due to low levels of land-related investments conditioned by the reform process.[2] Moreover, a survey in 2003 concluded that about one-quarter of all land in Zimbabwe is severely eroded (Richardson, 2004), implying that comparatively large benefits could be derived from land-related investments. Thus, using Zimbabwe as a case study makes an interesting contribution to the existing literature that assesses empirically the link between tenure security and investment incentives in the context of land reforms.

Economic theory postulates three links between land tenure security and agricultural investment incentives:[3] The first is what Besley (1995) refers to as a 'security argument', which captures the direct and positive link between tenure security and investment incentives. The logic is that insecure tenure leads to market imperfections and increases the risk associated with farming through the threat of dispossession. The second link is referred to as a 'collateral-based view' due to its premise that when land

[2] Of course there are other explanations as well, such as the loss of economic scale and replacement of experienced farmers with less experienced ones who are more geared towards subsistence production.

[3] See Besley (1995) for a comprehensive summary.

tenure is secure and thus easier to collateralise, it can reduce the price of capital and subsequently increase the value of investments. The third and final link is referred to as a 'gains-from-trade perspective' and is based on the fact that secure land rights increase investment incentives by lowering transaction costs if land is to be either rented out or sold, thereby expanding trading opportunities and the ability to take advantage of gains from trade. Tenure security is more important when one considers medium- to long-term investments; hence the justification of investigating the impact of tenure security on long-term investments such as tree planting and construction of soil conservation structures (Besley, 1995; Hayes et al., 1997; Holden and Yohannes, 2002).

The main econometric challenge in most studies analysing the link between tenure security and investments arises from the fact that most African countries have a causality problem where land rights may depend on past investments and vice versa (Besley, 1995; Brasselle et al., 2002). Consistent with this, tree planting has been identified as a way of establishing and/or enhancing tenure security (Besley, 1995; Sjaastad and Bromley, 1997). This endogeneity of tenure security with investments could partly explain the mixed results found in the existing literature on the empirical analysis of the link between land tenure and investments.[4] For instance Besley (1995), Holden and Yohannes (2002), and Ayalew et al. (2005) underscore the significance of tenure security in promoting land-related investments while Gavian and Fafchamps (1996) found little impact of property rights on land-related investments. This paper employs an estimation methodology that allows for the possible endogeneity of land tenure security and investment decisions.

Few studies have explored the link between tenure security and land-related investments in Zimbabwe, especially within a land reform framework. Fortmann (1998) suggested that lack of tenure security discourages female farmers from making long-term, ecologically beneficial investments on their land. With regards to the impact of land reforms in Zimbabwe, Moor (1996) found that perceived tenure security in the form of land titling and registration had a significant and positive effect on long-term on-farm investments among beneficiaries of pre-2000 land reform programmes.

No study, as can best be determined, has conducted an empirical analysis of the impact of Zimbabwe's FTLRP on tenure security and land-related investments. Hence, we set out to do this by investigating the impact of Zimbabwe's FTLRP on its

[4] See Brasselle et al. (2002) for a survey of empirical studies on land tenure and investments in Africa.

beneficiaries' perceptions of tenure security and subsequently investments in soil conservation. We pursue an estimation strategy that employs both semi-parametric and parametric econometric methods, permitting us to (1) explore how household characteristics condition households for selection into the FTLRP, (2) assess the differences in perceptions of land tenure security between beneficiaries of the FTLRP and communal farmers and (3) explore how these differences, if any, affect investments in soil conservation. In addition, our strategy allows us to overcome the problems arising from the potential endogeneity of perceived tenure security with soil conservation investments. Specifically, it makes it possible for us to deal with the causality problem between security and investment by using modes of acquiring land as instruments for perceived tenure security, with acquisition through the FTLRP being one of them. Using data from Mashonaland Central province in Zimbabwe, the results provide evidence that the programme has created some tenure insecurity among its beneficiaries, which has impacted investments in soil conservation adversely. Endogeneity of perceived tenure security is confirmed, suggesting that households invest to establish and/or enhance security of land tenure.

The credibility of this analysis could be questioned in light of the current economic crisis in Zimbabwe (especially the hyperinflationary environment). However, since the analysis is based on quantities and not prices, this problem is minimised. In particular, the fact that the analysis focuses on soil conservation, which is labour-intensive and has family labour as the default labour available to the household, implies that liquidity or financial constraints that could be associated with the economic crisis might not be a limiting factor in soil conservation investments. This increases the chances of isolating the effect of the FTLRP on soil conservation investments. Thus, we believe the analysis gives a fairly reasonable reflection of the direction of the FTLRP's impact on perceived tenure security and soil conservation investments.

The following section gives a brief background on the FTLRP. Section 3 presents the underlying conceptual framework, while our econometric framework and estimation strategy are discussed in Section 4. Section 5 discusses the data used in the empirical estimation and the results. Section 6 concludes the paper with policy implications.

2. Fast Track Land Reform in Zimbabwe

Zimbabwe inherited a racially skewed agricultural land-ownership pattern at independence in 1980. White large-scale commercial farmers – less than 1% of the population – occupied 45% of all agricultural land, of which 75% was found in the most agriculturally productive areas (Shaw, 2003).[5] Consequently, the Zimbabwean government adopted a land reform and resettlement programme aimed at land acquisition and redistribution. The primary, long-standing objectives of this programme have been to for example (1) address the imbalances in land access while alleviating population pressure in communal areas, (2) improve the base for productive agriculture in the smallholder farming sector, (3) improve the living standards of the majority of the population, and (4) bring idle or under-utilised land into full production (Kinsey, 1999). Indigenous Africans constitute the small-scale communal agricultural sector with communal land ownership vested in the state, with rights of usufruct being allocated to an individual (usually a male) by a chief. These rights can, in principle, be passed on as an inheritance along the lines of primogeniture, following the death of the original owner.

The land reform and resettlement programme can be classified into two broad phases, the first of which began in 1980 with the primary objectives of addressing inequitable land ownership, insecurity of tenure, and unsustainable and sub-optimal land use (Moyo, 2006). Given its policy of national reconciliation as well as the restrictive Lancaster House Constitution,[6] the government pursued a land resettlement programme based on a willing-seller/willing-buyer approach. However, in 1997 the government of Zimbabwe initiated a process of radical land reform based on extensive, compulsory land acquisition and redistribution that targeted at least 5 million hectares of land for resettlement (Moyo, 2004). This heralded the start of the second phase of the programme. The FTLRP, on which this analysis is based, was officially launched in July 2000 as part of the second phase.

The main objectives of the FTLRP are to speed up the identification of not less than five million hectares of land for compulsory acquisition and resettlement, to accelerate

[5] It is also worth noting that commercial farms were crucial for employment and total agricultural production, as well as export earnings. For example, in the 1990s, commercial farms accounted for 68% of gross agricultural output and 40% of export earnings (Addison and Laakson, 2003).

[6] The Lancaster House Constitution obligated the government to acquire land on a willing-seller/willing-buyer basis during the first 10 years of independence.

the planning and demarcation of the acquired land and placement of settlers, and to provide basic infrastructure and farmer support services (Zimbabwe, 2000; Moyo, 2006). The programme has two models: Model A1 is intended to decongest communal areas and generally help land-constrained subsistence farmers. It is based on the existing communal-area organisation, where peasants produce mainly for subsistence with small surpluses for the market in good seasons. Model A2, on the other hand, is a commercial settlement scheme for small-, medium- and large-scale farming based on the concept of full-cost recovery from the beneficiary, and is intended to create a cadre of black commercial farmers. This is, in principle, targeted at any Zimbabwean who can prove their farming experience and/or resource availability (Zimbabwe, 2000). The bulk of the programme centres on Model A1.

In principle, the tenure arrangements within the FTLRP entail permits for Model A1 beneficiaries and a 99-year lease with an option to purchase the land for Model A2 beneficiaries. In reality, however, FTLRP settlers have been issued many different types of temporary licenses. Moreover, the duration of contract under the lease is relative despite it stating that the lease is for 99 years, and its conditions for subletting are not clear (Moyo, 2004). Munyuki-Hungwe and Matondi (2006) claim this to be a source of tenure insecurity among FTLRP beneficiaries. This paper attempts to assess empirically how the FTLRP has affected perceived tenure security among farming communities, and then goes a step further by analysing how these perceptions have affected land-related investments. We base the analysis on a sample of communal farmers as well as farmers who have benefited from the FTLRP under Model A1. Communal farmers acquire land either through inheritance, allocation by a traditional leader, buying or renting.

3. The conceptual framework

The conceptual framework models households' perceptions of tenure security and investments in soil conservation, conditioned by the FTLRP. The theoretical literature on the link between land tenure security and farm investments suggests that tenure security affects investments especially when considering medium- to long-term investments such as tree planting and soil conservation (Besley, 1995; Sjaastad and Bromley, 1997). Accordingly, we model investments in soil conservation as:

$$I = I(S, \Lambda, \mathrm{P}) \ , \tag{1}$$

where I is the level of soil conservation investments, measured as the total parcel area under soil conservation structures constructed in the last five years, normalised by the total parcel size. A parcel is defined as a contiguous piece of land on which one or more different crops can be cultivated. S is an indicator of perceived tenure security and Λ is a vector that captures households' socioeconomic characteristics, e.g. gender, age, education of household head, household composition, access to agricultural extension workers, social capital indicators and involvement in off-farm activities. P is a vector of parcel characteristics and these include size, subjective measures of steepness, soil depth and fertility of parcel as well as the initial endowment of soil conservation structures.[7] Our choice of variables is informed by previous studies that analyse determinants of investments in soil conservation (see for example Shiferaw and Holden, 1998; Deininger and Jin, 2006).

Consistent with theoretical postulations, the study hypothesises that $\frac{\partial I}{\partial S} > 0$. Furthermore, in many African countries, long-term investments are a means of attaining and/or enhancing tenure security (Besley, 1995; Sjaastad and Bromley, 1997), implying that households with physical long-term investments such as soil conservation structures on their plots might feel more tenure secure. This is supported by the fact that about 58% of the households in the sample believe land investments reduce the probability of losing land through evictions or expropriation, for example. Accordingly, our empirical strategy corrects for the possibility of this kind of endogeneity, thereby minimising the upward-biased inferences on the impact of perceived tenure security on investment decisions.

Given the background of the FTLRP in Zimbabwe, we postulate that perceived tenure security has indeed been affected by the programme. This implies:

$$S = S(R) \ , \tag{2}$$

where R is a dummy indicating whether or not a household got the parcel through the FTLRP. We maximise the information at hand by including dummies that capture

[7] Ideally the level of investment will be a function of the difference between a household's desired stock of soil conservation structures and the current stock. However, data limitations made it unworkable to model this.

different modes of acquiring the parcel (i.e. whether the parcel was bought, inherited, allocated to the household by a traditional leader or acquired via the FTLRP). We hypothesise that farmers feel less tenure secure about parcels received via the FTLRP.

4. The econometric framework and estimation strategy

Equation (1) implies the estimation of equation (3) below for investment levels:

$$I = \alpha_0 + \alpha_1 S + \alpha_2 \Lambda + \alpha_3 \mathrm{P} + \nu \ , \tag{3}$$

where $\alpha_0, \alpha_1, \alpha_2$ and α_3 are parameters or vectors of parameters to be estimated, and ν is the error term. It is assumed that the error term is independently, identically and normally distributed with zero mean (Wooldridge, 2002). To ensure robustness, both semi-parametric and parametric approaches are employed to estimate equation (3). Specifically, we start by using a semi-parametric method, the Propensity Score Matching (PSM) method. This is followed by an estimation of two-stage Probit and Tobit models with endogenous regressors, i.e. Instrumental Variable Probit (IV-Probit) and Instrumental Variable Tobit (IV-Tobit), both parametric methods. A detailed discussion of the estimation strategy follows below.

4.1. The Propensity Score Matching method

The idea underlying the PSM is that one group of people participates in a programme while another group does not, and the objective is to assess the effectiveness of the programme (or treatment) by comparing the average outcomes. Given observational rather than experimental data, there is non-random selection into the programme. Thus, a matching process based on observed characteristics is used to compare participants and non-participants. Here, we use the PSM method to address the problem that FTLRP beneficiaries might not form a randomly selected sub-group of all farmers in the sample. If so, there is a risk that the non-random selection process may lead to differences between FTLRP beneficiaries and communal farmers that can be mistaken for effects of the FTLRP. The PSM method is a semi-parametric method used to estimate the average treatment effect of a binary treatment on a continuous scalar outcome (Rosenbaum and Rubin, 1983). We take FTLRP as the treatment variable, while investments in soil conservation and perceived tenure security are the outcomes of interest. The group that

has benefited from the reform is the treatment group, while those in the communal areas form the control group.

In order to estimate the average treatment effect of the FTLRP on soil conservation investments in the resettlement areas, we would ideally want to estimate the following:

$$ATT = E[I_1 \mid R = 1] - E[I_0 \mid R = 1] \quad , \tag{4}$$

where ATT is the average effect of the treatment on the treated households or parcels, $I_0 \mid R = 1$ is the level of soil conservation investments that would have been observed had the parcel *not* been acquired through the FTLRP, while $I_1 \mid R = 1$ is the level of investments actually observed in the land reform sub-sample. The challenge is that $I_0 \mid R = 1$ cannot be observed, necessitating the creation of a counterfactual of what can be observed by matching treatment and control groups.

Given that matching on covariates is not always practical, particularly with many covariates, propensity scores ($p(X)$) – the conditional probabilities of being in the land reform group conditional on X – are used to reduce this dimensionality problem. Here X is the set of covariates that influence selection into the FTLRP. The model matches treated units to control units with similar values of X . The equation to be estimated then becomes:

$$ATT = E[I_1 \mid R = 1, p(X)] - E[I_0 \mid R = 0, p(X)] \ . \tag{5}$$

The PSM relies on the key assumption that conditional on X , the outcomes must be independent of the targeting dummy R (the conditional independence assumption, or CIA). While the CIA cannot be directly tested since PSM uses non-experimental data, we make use of the 'Rosenbaum bounds' (Rosenbaum, 2002) to investigate how strong the effect of unobservable characteristics has to be to in order to change the treatment outcomes. This sensitivity analysis makes use of the odds ratio of participating in the FTLRP between two matched households. Let the probability of participation by an household *i* be:

$$p(X) = p[R = 1 \mid X] = F(\theta X + \gamma \omega] \quad , \tag{6}$$

where ω is the unobserved variable and γ is its effect on selection into the FTLRP. If there is no hidden bias, γ will be zero and the chances of selection into FTLRP will be

the same for matched households. It will, however, be different in the presence of a hidden bias. The odds ratio for selection into the FTLRP is given by $\exp[\gamma(\omega_i - \omega_j)]$ for matched households *i* and *j*. If the ratio departs from the value of 1, it is due to hidden bias, i.e. because $\omega_i \neq \omega_j$ or $\gamma \neq 0$. Sensitivity analysis evaluates how much the effect of the FTLRP is changed by changing the values of γ and $(\omega_i - \omega_j)$, i.e. examining the bounds on $1/\exp(\gamma)$ and $\exp(\gamma)$.

The matching process used here uses the kernel matching method which matches a treated unit to all control units weighted in proportion to the closeness between the treated and the control unit. We also estimate equation (5) for perceived tenure security instead of I, to investigate how the FTLRP has affected households' perceptions of tenure security.[8]

4.2. Instrumental Variable models

As the next section describes, not all surveyed parcels experienced soil conservation investments in the last five years. Hence, we need econometric models that correct for this censoring of the dependent variable, since the use of Ordinary Least Squares (OLS) on the whole sample will give inconsistent estimates (Wooldridge, 2002). Accordingly, a censored regression model is used to estimate equation (3). Specifically we estimate a two-stage Tobit model with endogenous regressors. The Tobit model, originally developed by Tobin (1958), is defined by equations (7) and (8) below:

$$I = \begin{cases} I^* \text{ if } I^* > 0 \\ 0 \text{ otherwise} \end{cases} , \tag{7}$$

$$I^* = \alpha_0 + \alpha_1 S + \alpha_2 \Lambda + \alpha_3 \mathrm{P} + \nu = \varphi Z + \nu \ , \tag{8}$$

where I^* is a latent variable that is observed only when $I > 0$. The Tobit model assumes that the error term in equation (8) is independently, identically and normally distributed with zero mean and constant variance (Wooldridge, 2002). S is the potentially endogenous perceived tenure security variable and $Z = [S, \Lambda, \mathrm{P}]$, $\varphi' = [\alpha_0', \alpha_1', \alpha_2', \alpha_3']$. A test proposed by Smith and Blundell (1986) is used to test the exogeneity of perceived tenure security. The test works in the same way as a Hausman test for OLS regression whereby in the first stage the endogenous variable is estimated

[8] More details on this method can be found in Becker and Ichino (2002). The estimation here uses the STATA 10's psmatch2 routine developed by Leuven and Sianesi (2003).

with OLS over a set of instruments and exogenous variables of the Tobit model and then in the second stage the residuals from the first stage are included as an additional explanatory variable in equation (8). The null hypothesis here is that the residuals have no explanatory power. Failure to reject the null implies that the standard Tobit model is appropriate, while rejection suggests the need to use an alternative model.

Efficient estimation of φ' for endogenous S

To estimate the parameters in φ' in case of a rejection of exogeneity of perceived tenure security, we use an estimator proposed by Amemiya (1978, 1979) and shown by Newey (1987) to be efficient. The method applies the generalised least squares in the relationship between the Tobit model's structural parameters, φ, given by equation (8) and its reduced-form parameters:

$$I^* = \mu_0 + \mu_1 \hat{S} + \mu_2 \Lambda + \mu_3 \mathrm{P} + \eta \quad , \tag{9}$$

where $\hat{S}$ is a residual from the first stage regression of perceived tenure security on a set of instruments and exogenous variables; $\mu_0, \mu_1, \mu_2, \mu_3$ are parameters to be estimated; and η is an error term. The exogeneity test is performed using Baum's (1999) procedure while $\mu_0, \mu_1, \mu_2, \mu_3$ are estimated using Harkness' (2000) procedure in STATA. Following the preceding discussion, the mode of acquisition of the parcel (i.e. whether the parcel was bought, inherited, allocated to the household by a traditional leader, or acquired through the FTLRP) is used as an instrument for perceived tenure security. The IV-Tobit model is estimated using the two-stage procedure in STATA 10. We also estimate an IV-Probit model to examine factors affecting the decision to invest in soil conservation. Estimating both IV-Probit and IV-Tobit models allows for the possibility that the decision to invest and the intensity of investments are determined by different factors. We chose this over a Heckman selection model due to a lack of strong theoretical arguments to guide the selection of exclusion variables able to determine the decision to invest but not the intensity of the investments.

5. The data, empirical results and discussion

5.1. The data

The primary aim of the empirical analysis is to test the hypotheses that the FTLRP has been accompanied by tenure insecurity and subsequently an adverse impact on soil conservation investments among its beneficiaries. It is based on primary data collected from Mazowe District, one of the seven districts in the Mashonaland Central province in Zimbabwe. Mazowe District lies in Natural Regions 2 and 3 and is divided into 29 wards.[9]

The data was collected in May 2007 for 592 parcels of 383 randomly selected households falling under three different chieftainships. The sample includes 222 communal households (operating 431 parcels) and 161 households in resettlement areas (operating 161 parcels). It is in resettlement areas that we find beneficiaries of the FTLRP. The questionnaire asked detailed questions about the households' perceptions of tenure security, investments made in the last five years, parcel and socioeconomic characteristics.

Descriptive statistics

Summary statistics for parcel level variables are reported in Table 1, while Table 2 reports statistics for household level variables. We also perform two-sample *t*-tests to test for differences between the FTLRP and the communal groups, and these reveal significant differences. Around 27% of the surveyed parcels were acquired through the FTLRP, 27% were inherited, 32% allocated to the household by a traditional leader, 6% rented and 7% bought. The data reveals thin land rental and sales markets.

The data includes three indicators of perceptions of parcel-level tenure security: (1) the perceived right to bequeath the parcel, (2) the perceived ease of renting out the parcel and (3) the perceived ease of using the parcel as collateral against a financial loan. These are all dummy variables with a value of one if the answer is in the affirmative, and zero otherwise. To utilise all the information gathered without losing too many degrees of freedom, we use Principal Components Analysis (PCA) to construct an overall indicator of tenure security: *Tenure security*. PCA is used here to

[9] On the basis of its climatic pattern, altitude and soil type, the country is classified into five agro-ecological regions with agricultural potential declining from Region 1 to Region 5.

statistically weigh the three indicators in order to calculate an aggregate index of perceived tenure security (Jolliffe, 1986). Generally, the communal group exhibits higher levels of perceived tenure security than the FTLRP group.

This study focuses on a specific type of soil conservation structures – contour ridges. The decision to focus on contour ridges was guided not only by availability of data but also by their popularity as soil conservation technology in the study area. Initially, similar to the experiences in Kenya and Niger, the construction of contour ridges in Zimbabwe was promoted by projects and government bodies. Contour ridges are earthen ridges which continue to be widely used in southern Africa as a means of controlling soil erosion (Critchley et al., 1992). Just over 29% of the surveyed parcels had soil conservation investments in the last five years. The average area of contour ridges investments is 79.5 square metres per hectare, with significantly more investments undertaken in communal relative to resettlement areas. This is in spite of the fact that communal farmers have higher contour ridges endowments than FTLRP farmers. These descriptive statistics are in line with the hypotheses that the FTLRP has been accompanied by tenure insecurity and a reduction in soil conservation investments among its beneficiaries.

We also use Principal Components Analysis (PCA) to aggregate the original off-farm activities variables (*Small scale, Natural Resource, Employment* and *Trade*), resulting in the variable *Off-farm*; social capital indicators (*Cash assistance, Oxen assistance, Maize assistance* and *Labour assistance*), resulting in *Social Capital*. Similarly, *Media* is from a PCA of variables on access to media (TV, radio and newspapers). In all PCA constructions we retained components with an eigenvalue greater than one.

Table 1: Descriptive statistics of parcel level variables

Variable	Description	Communal (n=431)	FTLRP (n=161)	*t*-tests	Pooled (N=592)
Mode of acquisition					
FTLRP	Acquired the parcel under the FTLRP (1=yes, 0=no)				0.27
Inherited	Inherited the parcel (1=yes, 0=no). The reference mode of acquisition variable	0.38			0.28
Allocation	Allocated the parcel by a traditional leader (1=yes, 0=no)	0.44			0.32
Bought	Bought the parcel (1=yes, 0=no)	0.09			0.07
Rented	Renting the parcel (1=yes, 0=no)	0.09			0.06
Tenure security indicators					
Bequeath	Can easily bequeath the parcel (1=yes, 0=no)	0.80	0.57	***	0.74
Rent	Can easily rent out the parcel (1=yes, 0=no)	0.26	0.22		0.25
Collateral	Can easily use the parcel as collateral (1=yes, 0=no)	0.37	0.22	***	0.33
Tenure security	Aggregate indicator of tenure security from Principal Components Analysis	0.79	0.56	***	0.72
Soil conservation investments					
Investment decision	Decision to construct contour ridges on the parcel in the last 5 years (1=yes, 0=no)	0.28	0.33		0.29
Investment level	Total length of contour ridges constructed in the last 5 years, in square metres per ha	91.05	48.63	***	79.51
Soil conservation endowment	Total length of contour ridges constructed more than 5 years ago, in square metres per ha	217.02	125.71	***	192.19
Parcel characteristics					
Parcel size	Size of the parcel, in hectares	3.56	6.38	***	4.33
Steep slope	Steep slope (1=yes, 0=no)	0.12	0.10		0.11
Moderate slope	Moderate slope (1=yes, 0=no)	0.44	0.73	***	0.52
Flat	Light slope (1=yes, 0=no). The reference slope variable	0.44	0.17	***	0.37
Deep soils	Very deep soils (1=yes, 0=no)	0.27	0.27		0.27
Moderately deep soils	Fairly deep soils (1=yes, 0=no)	0.44	0.67	***	0.50
Shallow	Shallow soils (1=yes, 0=no). The reference soil depth variable	0.29	0.06	***	0.23
High Fertility	High fertile (1=yes, 0=no)	0.14	0.06	***	0.12
Moderate fertility	Fairly fertile (1=yes, 0=no)	0.43	0.45		0.44
Infertile	Infertile (1=yes, 0=no). The reference soil fertility variable	0.43	0.49		0.44

*Source: Own survey data, 2007. *Difference significant at 10%; ** significant at 5%; *** significant at 1%.*

Table 2: Descriptive statistics of household level variables

Variable	Description	Communal (n=222)	FTLRP (n=161)	*t*-tests	Pooled (N=383)
Male	Gender of the household head (1=male, 0=female)	0.71	0.78		0.74
Age	Age of the household head	52.57	46.25	***	49.91
Education	Number of years of formal schooling of the household head	8.01	9.17	***	8.50
Male adults	Number of male household members older than 15 years	1.83	1.95		1.88
Female adults	Number of female household members older than 15 years	2.38	2.06		2.25
Children	Number of household members younger than 15 years	2.48	2.58		2.52
Livestock	Livestock holdings (in Tropical Livestock Units)	3.43	3.32		3.39
Livestock2000	Livestock holdings in the year 2000 (in Tropical Livestock Units)	2.84	1.99	**	2.49
Communal farmer2000	Household head a communal farmer before FTLRP (1=yes, 0=no). The reference occupation of household head before FTLRP	0.96	0.40	***	0.72
Farm worker2000	Household head farm worker before FTLRP (1=yes, 0=no)	0.01	0.09	***	0.05
Non-farmer2000	Household head engaged in non-farming before FTLRP (1=yes, 0=no)	0.03	0.51	***	0.23
Extension	Whether the household has access to an extension worker (1=yes, 0=no)	0.72	0.89	***	0.79
Farming Certificate	Household has at least one member with a farming qualification (1=yes, 0=no)	0.23	0.22		0.23
Remittances	Receipt of remittances (1=yes, 0=no)	0.41	0.25	***	0.34
Small-Scale	Number of household members involved in small-scale artisanship	1.05	0.60	***	0.86
Natural Resource	Number of household members involved in natural resource utilisation	1.18	0.62	***	0.95
Employment	Number of household members in employment	0.53	0.35	***	0.45
Trade	Number of household members involved in trade e.g. buying and reselling of goods	0.49	0.14	***	0.35
Off-farm	Principal components scores on involvement in small-scale artisanship, natural resource utilization and cross-border trade	1.67	0.86	***	1.33
TV	Access to TV (1=yes, 0=no)	0.30	0.57	***	0.41
Radio	Access to Radio (1=yes, 0=no)	0.58	0.78	***	0.67
Newspapers	Access to Newspapers (1=yes, 0=no)	0.23	0.44	***	0.32
Media	Principal components score on access TV, radio and newspapers	0.64	1.03	***	0.80
Cash assistance	Household has people in the village to borrow at least 20000ZW$ (equivalent to 1 USD at the time of the survey) from (1=yes, 0=no)	0.52	0.38	***	0.46
Oxen assistance	Household has people in the village to borrow oxen from (1=yes, 0=no)	0.60	0.52		0.57
Maize assistance	Household has people in the village to borrow 25kg of maize from (1=yes, 0=no)	0.51	0.50		0.50
Labor assistance	Household has people in the village to ask for extra agricultural labor from (1=yes, 0=no)	0.53	0.41	**	0.48
Social capital	Principal components scores of whether or not household can get assistance from neighbours	1.08	0.91	**	1.01
Makope	Chief Makope (1=chief Makope). The reference chieftainship variable	0.30	0.12	***	0.22
Chiweshe	Chief Chiweshe (1=Chief Chiweshe)	0.14	0.47	***	0.28
Negomo	Chief Negomo (1=chief Negomo)	0.57	0.40	***	0.50

*Source: Own survey data, 2007. * Difference significant at 10%; ** significant at 5%; *** significant at 1%.*

5.2. Results from the Propensity Score Matching method

As the foregoing discussion on the econometric strategy we pursue shows, the use of the PSM method allows us an opportunity to explore how the households' characteristics predispose them for selection into the FTLRP as well as how the programme has impacted their perceived tenure security and investments in soil conservation.

We begin by investigating how the households' characteristics predispose them for selection into the programme. We do this by estimating a probit model of selection into the FTLRP on households' socioeconomic characteristics. A particular challenge given the cross-sectional nature of our data is obtaining variables that capture the situation before the start of the FTLRP. Fortunately the questionnaire had questions on livestock holdings and occupation of the household head in the year 2000. We also include education of household head, number of male and female adults, number of children, whether the household has at least one household member with a farming qualification, access to remittances and media, as well as involvement in off-farm activities. There could be concerns that the last five variables might have changed between the start of the programme and the time the data was collected. To deal with this problem, two probit models are estimated: the first includes only those variables that existed for sure at the beginning of the FTLRP, while the second model also includes variables that might have changed over the years. The ensuing discussion of the results is based on the second model, which we consider the full model.

Another concern could be the controversy regarding the selection process under the FTLRP. This might imply that we may not have been able to control for some factors such as political inclination, which has been argued to have played a role in the selection process. However, we believe that by focusing on Model A1 beneficiaries, who are fairly comparable to communal farmers, we minimise the bias especially given that the controversy surrounding the allocation of land under the FTLRP is more of a concern when it comes to commercial settlement under Model A2.

Table 3 below reports the probit results of participation, or the likelihood of being selected into the FTLRP.

Table 3: Probit estimates for selection into the FTLRP

	Restricted Model		Full Model	
Variable	Coefficient	Robust Std. Error	Coefficient	Robust Std. Error
Male	0.13	0.19	-0.24	0.24
Age in year 2000	-0.02***	0.01	-0.02**	0.01
Education	0.02	0.03	0.01	0.03
Male adults	0.03	0.04	0.15***	0.04
Female adults	-0.01	0.03	0.01	0.04
Livestock in year 2000	-0.01	0.03	-0.04	0.03
Farm worker2000	1.69***	0.38	2.12***	0.39
Non-farmer2000	2.21***	0.23	2.67***	0.32
Children			0.04	0.05
Farming certificate			0.17	0.22
Remittances			-0.85***	0.21
Off-farm			-0.64***	0.12
Media			0.76***	0.16
Constant	-0.30	-0.40	0.14	-0.48
Observations		383		383
Log-likelihood		-172.55		-129.12
Overall correct predictions (%)		81		85

*Note: * significant at 10%; ** significant at 5%; *** significant at 1%.*

The broad objectives of the FTLRP's Model A1 scheme are to for example decongest overcrowded communal areas, alleviate poverty within rural communities by giving them enough land for agricultural land use, and promote sustainable land use. This implies that selection into the FTLRP should favour poor households. Although the coefficient for livestock holdings is negative, it is insignificant. With livestock holdings as a proxy for wealth in this study, our results thus do not point to a systematic attempt by the government to prioritise poor households as beneficiaries of the programme.

Furthermore, the decongestion objective implies that we would expect priority to be given to communal households when it comes to selection into the FTLRP. However, contradictory to the programme's goal of decongesting communal areas, the results indicate that households in which the household head was either a commercial farm worker or engaged in non-farm activities prior to the commencement of the FTLRP were more likely to have benefited from the programme than households in which the household head was a communal farmer. While we would expect commercial farm workers to have had an advantage in taking over commercial farms given that they were already in the system, caution is called for in interpreting this finding since the data is not able to reveal whether they had any land of their own prior to the reform. The

positive effect of having a household head who was engaged in non-farm activities before the programme could be indicative of corrupt tendencies that could frustrate the programme's decongestion goal. Again there is need for caution in interpreting this finding as it is possible that those engaged in non-farm activities prior to the FTLRP were forced to do so due to landlessness.

The FTLRP's Model A1 scheme is intended to reach out to households whose livelihoods are based mainly on agriculture. Accordingly, the negative impact of involvement in off-farm activities may be evidence of some screening within the FTLRP in favour of people who depend mainly on farming for a living. This is also true for the negative coefficient for remittances. The results might also reflect the fact that households involved in off-farm activities are less likely to apply for land under the FTLRP.

Our findings suggest that efforts to increase women's access to land within the FTLRP may have been ineffective, in line with concerns posed by Goebel (2005); the more male adults in a household, the more likely it is to benefit from the FTLRP. Customarily in Zimbabwe, rights to land have been reserved for men and, thus, the more men a household has, the greater the comparative advantage with regards to land access. In addition we find that the FTLRP has tended to favour younger household heads. The significance of access to media indicates that media plays a significant role in providing detailed information on programme eligibility and the application process.

The reform has two complementary selection processes: selection of beneficiaries and selection or identification of farms or parcels to be redistributed. Both beneficiary and parcel characteristics affect observed productivity. Consequently, the propensity scores used in the matching process are based on a probit model that includes both households' socioeconomic characteristics and parcel characteristics (not reported here). These parcel characteristics include steepness of parcel, soil depth and fertility indicators and whether the parcel had soil conservation structures at the start of the programme. We also control for whether the parcel is in an area with access to extension services, distance from parcel to nearest trading town, and regional dummies. Sensitivity analysis is then used to examine how robust the treatment effects are to unobservables.

The estimated propensity scores are used to generate samples of matched FTLRP and communal areas groups using the kernel matching method. First, the results are used to calculate the impact of the programme on perceptions of tenure security. Second, as when estimating equation (3), we calculate the direct impact of the programme on the

intensity of soil conservation investments. PSM results are presented in Table 4 below. Only observations within common support are used, i.e. observations for which matches were found. ATT is the average treatment effect on the treated. The standard errors for the ATT are calculated using bootstrapping with 200 replications.

Table 4: Perceived tenure security and investment levels estimated by PSM

	Tenure Security	Investment Levels
FTLRP	0.52	54.80
Communal	0.78	83.01
Difference, ATT	-0.26**	-28.22
(Std. Error)	(0.13)	(50.38)
Total number of observations		
FTLRP	161	161
Communal	431	431
Number of observations within common support		
FTLRP	73	73
Communal	431	431

*Note: * significant at 10%; ** significant at 5%; *** significant at 1%.*

The results indicate that, based on household characteristics of the FTLRP beneficiaries and on parcel characteristics, a randomly chosen farmer among the programme beneficiaries perceives tenure security to be weaker by a score of about 0.26, compared to if s/he were a communal farmer. However, although the ATT for investment levels is negative, the results do not reveal a significant direct effect of the FTLRP on soil conservation investments. This does not, however, lead to the conclusion that the FTLRP has not had an impact on soil conservation investments; it could suggest that the programme has impacted soil conservation behaviour via its impact on households' perceived parcel-level tenure security. In the following section we use parametric methods to investigate this possibility.

Assessing the quality of the matching process

The PSM method conditions only on the propensity score. This necessitates the need to check whether the matching procedure is able to balance the distribution of the covariates in both the FTLRP and the communal areas groups. If differences persist even after matching, then matching on the propensity score was not totally successful. We thus perform balancing tests that examine the standardised bias for all covariates

used in the matching process. The standardised bias is defined as the difference between the sample means in the FTLRP and the matched control group subsamples as a percentage of the square root of the average of the sample variances in both groups. We also use two-sample *t*-tests to investigate the significance of the differences in the covariate means for the two groups. We do this only for perceived tenure security for which the treatment effect is significant. The results are reported in Table 5.

Table 5: Balancing tests for all matching covariates

	Mean		Standardised Bias		T-test
Variable	FTLRP	Communal	% bias	% reduction in bias	p-values
Socioeconomic characteristics					
Male	0.77	0.7	15.3	18.2	0.36
Age	40.84	37.57	22.6	44.8	0.11
Education	8.33	9.24	-27.2	14	0.13
Male adults	1.82	1.86	-2.3	76.9	0.86
Female adults	2.36	1.86	19.6	-43.8	0.11
Children	2.71	3.01	-16.3	-294.8	0.30
Livestock	2.57	3.04	-14.4	61	0.39
Farming certificate	0.19	0.11	20.2	-75.3	0.14
Remittances	0.25	0.23	3.3	92.5	0.83
Off-farm	1.12	1.23	-10.9	86.2	0.41
Media	0.92	0.91	1.1	98.1	0.95
Extension	0.88	0.83	12.6	65.3	0.43
Social capital	0.88	0.96	-10.2	65.9	0.55
Farm worker2000	0.03	0.004	10.5	69.4	0.26
Non-farmer2000	0.19	0.14	14	89.1	0.40
Parcel characteristics					
Size	6.70	8.18	-40.2	47.6	0.11
Size squared	74.17	99.13	-16.1	14.3	0.53
Steep slope	0.14	0.07	22	-310.3	0.18
Moderate slope	0.69	0.77	-17.9	71.1	0.25
Deep soils	0.25	0.20	11.3	-1109.1	0.47
Moderately deep soils	0.66	0.75	-18.5	61	0.24
High fertility	0.06	0.03	8.4	69.5	0.46
Moderate fertility	0.48	0.59	-23.1	-426	0.17
Soil conservation endowment	138.55	168.9	-12.6	66.8	0.33
Chiweshe	0.26	0.33	-15.6	80.3	0.38
Negomo	0.56	0.49	14.4	58.7	0.39

As the results indicate, the reduction in the standardised bias is substantially reduced after matching. Moreover, the test of the null hypothesis of *no* significant differences after matching cannot be rejected at 10% for any of the variables. This suggests that the propensity score is balanced for each covariate between the two subsamples.

Sensitivity analysis

Given that the PSM method we use is based on observable characteristics, it could be the case that there are unobservable characteristics affecting assignment into the FTLRP and the outcome variable simultaneously, i.e. there could be a hidden bias to which matching estimators are not robust. As discussed earlier, we address this problem by using the bounding approach proposed by Rosenbaum (2002) with the help of an ado-file provided by DiPrete and Gangl (2004), which allows us to test sensitivity for continuous-outcome variables. Using the Rosenbaum bounds, by selecting a number of values of the odds that matched pairs may differ in their probability of treatment due to differences in unobservables (i.e. $\exp(\gamma)$ values), we can tell at what point the treatment effect becomes insignificant. Table 6 presents the results of this analysis.

Table 6: Rosenbaum bounds

$\exp(\gamma)$ values	Upper bound significance level	Lower bound significance level	Upper bound Hodges-Lehman point estimate	Lower bound Hodges-Lehman point estimate	Upper bound confidence interval	Lower bound confidence interval
1	0.000	0.0001	-0.30	-0.30	-0.43	-0.16
1.5	2.7e-08	0.008	-0.40	-0.20	-0.53	-0.04
2	1.1e-11	0.07	-0.46	-0.12	-0.60	0.06
2.25	2.1e-13	0.14	-0.49	-0.09	-0.63	0.1
3	0	0.43	-0.56	-0.01	-0.70	0.19

The results reported in Table 6 suggest that the unobserved effect would have to increase the odds of benefiting from the FTLRP by at least 100% before it would change the conclusion that the FTLRP leads to a 0.262 reduction in the perceived tenure security score. Using the Hodges-Lehman point estimates, the results indicate that at $\exp(\gamma) = 2$, the estimated treatment effect may be as high as 0.458 or as low as 0.12, and the upper bound estimated treatment effect is significant at 10%. While there is no definitive answer to what constitutes a small or large odds ratio, an odds ratio of 2 implies that the postulated unobservable effects would have to be considerably large to cast doubt on the treatment results.

5.3. Results from the Instrumental Variable estimations

This section presents the results from the Instrumental Variable estimation of the FTLRP's impact on perceived tenure security and subsequently on households' investments in soil conservation. Instrumental variable estimations are employed to deal with the causality problem between tenure security and investment decisions. Perceived tenure security is assumed to be endogenous, i.e. tenure security may depend on soil conservation investments and vice versa. The modes of acquisition are used as instruments for perceived tenure security, with acquisition via the FTLRP as one of them. Table 7 reports the results from (1) the first stage OLS estimation of perceived tenure security; (2) the second stage IV-Probit estimation of the households' decision to invest in soil conservation; and (3) the second stage IV-Tobit estimation of the intensity of investments.

The main finding is that perceived tenure security is endogenous both in the decision to invest and in the intensity of the investments. However, it has a positive and significant impact only on the intensity of investments while it has no significant effect on the decision to undertake investments. We also perform a Wald test of exogeneity of perceived tenure security and find it to be rejected at 10% and 5% levels of significance in the IV-Probit and IV-Tobit estimations, respectively, justifying the use of IV-Probit and IV-Tobit instead of the standard Probit and Tobit estimators. This suggests that households invest in land-related investments to enhance security of tenure, consistent with Besley (1995) and Deininger and Jin (2006). Hence it is implied that tenure security should be understood as something that farmers believe they can affect and that is not exogenously given, emphasising the need to understand the determinants of perceived tenure security instead of focusing solely on its consequences. Our findings indicate that the impact of improved tenure security on farm investments can be enhanced by coordinating policies that aim at improving property rights systems with complementary policies that support well-functioning capital and asset markets. Such policies would allow households to focus primarily on productivity-enhancing investments.

We investigate the validity of the instruments using the Amemiya-Lee-Newey test of over-identifying restrictions (Baum et al., 2006). The test fails to reject the null hypothesis of validity of dummies for different modes of acquiring the parcel as instruments for perceived tenure security, making their use as instruments acceptable.

Table 7: Two-stage Least Squares Probit and Tobit models with endogenous regressors

	First Stage: Tenure Security		Probit: Decision to Invest		Tobit: Investment Levels	
Variable	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
Mode of acquisition and tenure security						
Tenure Security			0.51	0.36	286.92**	129.55
FTLRP	-0.38***	0.07				
Allocation	0.003	0.05				
Bought	-0.06	0.08				
Rented	-0.62***	0.08				
Socioeconomic characteristics						
Male	0.02	0.05	0.23	0.16	104.72*	58.18
Age	-0.001	0.001	0.004	0.01	1.65	1.61
Education	0.01	0.01	0.01	0.02	-3.13	8.08
Male adults	-0.02*	0.01	0.02	0.04	-2.10	16.10
Female adults	0.02*	0.01	0.01	0.03	2.37	9.28
Children	-0.03***	0.01	-0.01	0.04	5.44	13.57
Livestock	-0.0002	0.01	0.03	0.02	8.05	6.04
Farming certificate	0.13***	0.04	0.03	0.15	-27.13	53.47
Remittances	-0.06	0.04	-0.16	0.13	-47.71	47.43
Off-farm	-0.01	0.02	-0.04	0.06	-11.52	21.30
Media	-0.07**	0.03	-0.01	0.11	7.15	40.43
Extension	0.12**	0.05	0.02	0.16	15.06	58.94
Social capital	0.06**	0.03	0.02	0.09	-8.82	31.58
Farm worker2000	0.07	0.10	0.39	0.32	129.55	111.06
Non-farmer2000	0.10	0.06	-0.24	0.19	-97.92	69.05
Chiweshe	-0.05	0.06	-0.50**	0.20	-172.03**	73.99
Negomo	-0.07	0.05	-0.24	0.16	-83.12	57.62
Parcel characteristics						
Parcel size	0.02**	0.01	0.22***	0.05	45.17***	17.19
Parcel size squared	-0.001**	0.0003	-0.01***	0.003	-2.14**	0.96
Steep slope	0.09	0.06	0.24	0.21	66.83	77.39
Moderate slope	-0.05	0.04	0.46***	0.15	171.19***	52.31
Deep soils	0.11*	0.06	-0.68***	0.19	-241.41***	69.97
Moderately deep soils	0.08	0.05	-0.30*	0.17	-94.98	59.66
High fertility	0.05	0.06	0.14	0.20	35.16	70.10
Moderate fertility	-0.02	0.04	0.07	0.13	27.13	46.74
Soil conservation endowment	-0.00004	0.0001	-0.0003	0.0003	-0.23**	0.11
Constant	0.72***	0.13	-1.79***	0.53	-571.80***	194.96
Observations	592		592		592	
Uncensored Observations					174	
R-squared	0.22					
Model Wald Chi2 (27)			70.42		51.47	
Exogeneity test (p-value)			0.086		0.016	
Amemiya-Lee-Newey Over-identification test (p-value)			0.684		0.725	

*Note: * significant at 10%; ** significant at 5%; *** significant at 1%.*

Fast Track Land Reform and tenure security

The results reveal a highly significant and negative impact of the FTLRP on perceptions of tenure security, consistent with the *a priori* hypothesis. This could be due to the fact that the FTLRP has been carried out at an accelerated pace which has overridden legal procedures, thereby raising tenure insecurity among its beneficiaries. Moreover, since the introduction of the FTLRP, the government's policy and stated aims in relation to redistribution and land occupations have repeatedly changed, further fuelling tenure insecurity. In addition, the use of different laws, inauguration of different administrations, and institution of different policies – creating multiple tenure systems – has spawned grounds for conflict which has further contributed to tenure insecurity (Munyuki-Hungwe and Matondi, 2006). Farmers also feel less secure about parcels they rent compared to parcels acquired through inheritance. This reflects the uncertainty of tenure that apparently accompanies rented parcels. These results are worrisome, as tenure insecurity might have adverse implications on planning horizons and consequently agricultural productivity.

In Zimbabwe, as in most patriarchal societies in Africa where limited resources makes society prioritise the education of men rather than women, men are more connected to the wider events of the country, hence more informed and thus more concerned with the general instability in the agricultural and political scenes. The finding that perceived tenure security declines with the number of male adults in a household indicates that this apparently translates into lower perceived tenure security. Conversely, the more female household members a household has, the higher the levels of perceived tenure security. The labour constraints imposed by an extra child in the household are reflected by the finding that the more children a household has, the lower the perceived tenure security. Having many children is demanding in terms of labour hours spent child rearing, which obviously implies less time spent monitoring parcels.

Given that one of the criteria the government uses in selecting people for resettlement within the FTLRP is farming experience or knowledge, we would expect households with at least one household member with a farming qualification to feel more secure. So, the results here are as expected. Access to media is associated with lower levels of tenure security. This could reflect the fact that access to media makes the household more aware of the manner of the reform process and the ongoing debates on the

government's ever-changing policies that might make households uncertain about their security of tenure.

Access to extension workers improves perceived tenure security. A possible explanation for this result is that extension workers in Zimbabwe are sometimes seen as an institution that not only disseminates information to farmers but also helps resolve agriculture-related disputes if the need arises. Hence, the presence of agricultural extension workers could in principle make households feel more protected and thus more tenure secure. Social capital strengthens tenure security. Having more community ties assures the household of support from neighbours in case there is a need to defend land rights. Thus, a household with strong ties with the neighbours generally feels more secure.

Interestingly, equity considerations might make households feel that excessive or large parcels relative to others make them a likely target of acquisition of land for redistribution. This is supported by the finding that perceived tenure security increases with size but only up to a certain threshold; i.e. parcel size is concavely associated with perceived tenure security. However, since the threshold is around 21 hectares and 99% of all parcels are below this size, we can argue that perceived tenure security increases with parcel size. This together with the finding that tenure security increases with soil depth, one of the indicators of good parcel quality, implies that having high quality parcels could also be confounded with other qualities that capture the unobserved relative social power of the household. Socially powerful households obtain higher quality parcels and naturally have higher perceived tenure security than less socially powerful households.

Fast Track Land Reform and the decision to invest in soil conservation

The results reveal no significant impact of perceived tenure security on the likelihood to invest in soil conservation technology.

The significance of regional dummies points to the importance of location-specific determinants or deterrents of adoption of soil conservation technology. In particular, the results suggest that households under the chieftainship of Chiweshe are less likely to have invested in soil conservation than households under Chief Makope.

As expected, households are more likely to build contour ridges on larger parcels, consistent with Holden and Yohannes (2002) and Hayes et al. (1997). Contour ridges compete for space with regular crops; thus, the bigger the parcel the easier it is for the household to have contours and still have some space left for regular crops. However, the marginal effect declines with size. Steepness of a parcel affects the decision to construct conservation structures positively, with moderately steep parcels being more likely to have investments compared to those with a low slope, consistent with Gebremedhin and Swinton (2003). Soil depth impacts the likelihood of investing negatively. This is intuitive given that one main objective of soil conservation structures is to conserve soils, which is of less concern when soils are perceived to be deep.

Fast Track Land Reform and the intensity of soil conservation investments

The objective of the empirical analysis has been to investigate whether the FTLRP has had, via its impact on perceived tenure security among its beneficiaries, any impact on soil conservation investments. We find evidence that perceived tenure security has had a positive impact on the intensity of investments among its beneficiaries, consistent with Besley (1995) and Holden and Yohannes (2002) who found a positive and significant role of tenure security in promoting land-related investments. This, together with the first stage results which suggest that FTLRP program beneficiaries feel less tenure secure than communal farmers who inherited their parcels, lends support to the *a priori* hypothesis that the FTLRP impacts soil conservation investments negatively via its negative impact on perceived tenure security. This adverse effect could partly explain the decline in agricultural production following the launch of the programme.

Our results help shed light on the implications of gender on soil conservation investments. In particular, we find that male-headed households undertake more investments than female-headed households, consistent with Holden and Yohannes (2002). Construction of contour ridges requires manual labour and having a male household head makes it easier for households to commit to such projects. It is also relatively easier for male heads to organise more male labour to help with construction of contours. This implies that policies that seek to encourage investments in soil conservation should be gender-sensitive.

With regards to parcel characteristics, we find, consistent with Gebremedhin and Swinton (2003), a convex association between parcel size and investment levels. This could be indicative of possible diminishing marginal returns to contour ridges. The result also suggests that households with smaller parcels might be more likely to practice agricultural intensification and, therefore, construct more contour ridges to increase agricultural productivity. Households tend to invest more on moderately steep parcels compared to those with a low slope. This is intuitive since steeper slopes are more prone to erosion. In the same vein, parcels with deep soils indicate that soil erosion is of less concern, and subsequently less soil conservation structures are needed on them than on parcels with shallow soils. Intensity of investments decreases with level of initial endowments of conservation structures, reflecting possibly declining marginal returns to contour ridges.

The significance of regional dummies points to the importance of location-specific determinants of investments, with households under the chieftainship of Chiweshe investing less than households under Chief Makope.

In sum, the results suggest that parcel characteristics, along with perceived parcel-level tenure security, are more important than socioeconomic characteristics in determining both the decision to invest as well as the intensity of the investments.

6. Conclusions and policy implications

This paper seeks to contribute to the literature that assesses empirically the impact of land reforms. It does this by providing micro-evidence of the impact of the most recent phase of Zimbabwe's land reform programme, the Fast Track Land Reform Programme (FTLRP), on its beneficiaries' perceived tenure security and subsequent decisions to invest in soil conservation. In so doing we employ both semi-parametric and parametric econometric methods, permitting us to: (1) explore how household characteristics predispose households for selection into the FTLRP, (2) assess the difference in perceptions of land tenure security between beneficiaries of the FTLRP and communal farmers and (3) explore how these differences affect investments in soil conservation. In addition, our strategy allows us to overcome the problems arising from the potential endogeneity of perceived tenure security with soil conservation investments.

The results provide evidence that the programme has created some tenure insecurity among its beneficiaries, and this in turn has had an adverse impact on investments in soil conservation. The analysis suggests that the programme might have failed to offer security of tenure necessary for the long-term planning horizons of its beneficiaries. The results, thus, underscore the need for the government of Zimbabwe to restore confidence and credibility in the agricultural property rights system. As a start, the government is recommended to clarify and formalise tenure arrangements within the FTLRP. This, together with a commitment towards respecting property rights in general, might go a long way in enhancing perceived tenure security and encouraging on-farm investments.

In addition, our results indicate that households undertake investments in soil conservation not only to enhance productivity but also to establish and/or enhance security of land tenure. This implies that policies that seek to improve the positive impact of tenure security on farm investments should be formulated from analyses that consider tenure security as endogenous. Furthermore, as Antle et al. (2003) argue, such policies should be accompanied by complementary policies such as improved legal institutions and other policies needed to support well-functioning capital and asset markets. This would allow households to focus primarily on productivity-enhancing investments. This further reinforces the need for the government of Zimbabwe to prioritise the formulation and implementation of policies that clarify and formalise tenure arrangements within the FTLRP.

It is important to emphasise that formalisation of tenure arrangements without a commitment to respect property rights in general or without polices that guarantee the government's preparedness to respect tenure arrangements, will amount to what Bromley (2000, p.2) likens to 'governments issuing counterfeit currency', i.e. tenure arrangements are meaningless without the full support of the issuing entity – the government. Furthermore, for tenure arrangements to affect outcomes such as on-farm investments effectively, they should be connected to wider policies that for example increase access to credit.

Future research investigating whether soil conservation technology enhances productivity in the study area is needed, as this plays an important role in investments decisions. Furthermore, the positive impact of perceived tenure security on soil conservation investments suggests that there are still policy gains to be made from revisiting the issue of land tenure security and investments in Africa.

References

Addison, T., and L. Laakson. 2003. The political economy of Zimbabwe's descent into conflict. *Journal of International Development* 15: 457-470.

Amemiya, T. 1978. The Estimation of a Simultaneous Equation Generalized Probit Model. *Econometrica* 46: 1193-1205.

Amemiya, T. 1979. The Estimation of a Simultaneous Equation Tobit Model. *International Economic Review 20:169-181*.

Antle, J. M., D. Yanggen, R. Valdivia, and C. C. Crissman. 2003. Endogeneity of Land Titling and Farm Investments: Evidence from the Peruvian Andes. Working Paper Series (08-2004). Bozeman, MT: Department of Agricultural Economics and Economics, Montana State University.

Ayalew, D., S. Dercon, and M. Gautan. 2005. Property Rights in a Very Poor Country: Tenure Insecurity and Investment in Ethiopia. Global Poverty Research Group Working Paper, GPRG-WPS-021.

Baum, C. 1999. Probexog-Tobexog: Stata Modules to Test Exogeneity in Probit/Tobit. http://ideas.repec.org/c/boc/bocode/s401102.html.

Baum, C. F., M. E. Schaffer, S. Stillman, and V. Wiggins. 2006. Overid: Stata module to calculate tests of overidentifying restrictions after ivreg,ivreg2, ivprobit, reg3. *http://ideas.repec.org/c/boc/bocode/s396802.html*.

Becker, S.O. and A. Ichino. 2002. Estimation of average treatment effects based on propensity scores. *The Stata Journal* 2: 358-377.

Besley, T. 1995. Property Rights and Investment Incentives: Theory and Evidence from Ghana. *Journal of Political Economy* 103(5): 903-937.

Brasselle, A., F. Gaspart, and J. Platteau. 2002. Land tenure security and investment incentives: puzzling evidence from Burkina Faso. *Journal of Development Economics* 67: 373-418.

Bromley, D.W. 2008. Formalising property relations in the developing world: The wrong prescription for the wrong malady. *Land Use Policy*, doi:10.1016/j.landusepol.2008.02.003

Critchley, W., C. Reij, and A. Seznec. 1992. Water Harvesting for Plant Production. Volume II: Case Studies and Conclusions for Sub-Saharan Africa. World Bank Technical Paper No. 157.

Deininger, K., and S. Jin. 2006. Tenure security and land-related investment: Evidence from Ethiopia. *European Economic Review* 50: 1245-1277.

DiPrete, T., and M. Gangl. 2004. Assessing Bias in the Estimation of Causal Effects: Rosenbaum Bounds on Matching Estimators and Instrumental Variables Estimation with Imperfect Instruments. *Sociological Methodology* 34:271-310.

Fortmann, L. 1998. Why Woman's Property Rights Matter. In Proceeding of the International Conference on Land Tenure in the Developing World. University of Cape Town.

Gavian, S., and M. Fafchamps. 1996. Land Tenure and Allocative Efficiency in Niger. *American Journal of Agricultural Economics* 78(2): 460-71.

Gebremedhin, B. and S.M. Swinton. 2003. Investment in soil conservation in northern Ethiopia: the role of land tenure security and public programs. *Agricultural Economics* 29: 69-84.

Goebel, A. 2005. Zimbabwe's 'Fast Track' Land Reform: What about Women? *Gender, Place and Culture* 12(2): 145–72.

Harkness, J. 2000. IVProbit and IVTobit: Stata module to estimate instrumental variables probit and tobit. http://ideas.repec.org/c/boc/bocode/s415801.html.

Hayes, J., M. Roth, and L. Zepeda. 1997. Tenure Security, Investment and Productivity in Gambian Agriculture: A Generalized Probit Analysis. *American Journal of Agricultural Economics* 79: 369-382.

Holden, S., and H. Yohannes. 2002. Land Redistribution, Tenure Insecurity, and Intensity of Production: A Study of Farm Households in Southern Ethiopia. *Land Economics* 78(4): 573-590.

Jolliffe, I. T. 1986. *Principal component analysis.* Springer-Verlag KG, Germany.

Kinsey, B.H. 1999. Land Reform, Growth and Equity: Emerging Evidence from Zimbabwe's Resettlement Programme. *Journal of Southern African Studies* 25(2): 173-196.

Leuven, E., and B. Sianesi. 2003. PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing. http://ideas.repec.org/c/boc/bocode/s432001.html., version 3.0.0.

Moor, G.M. 1996. *Tenure Security and Productivity in the Zimbabwean Small Farm Sector: Implications for South Africa*. University of Natal, Pietermaritzburg.

Moyo, S. 2004. Overall Impacts of the Fast Track Land Reform Programme. Prepared for the Review of the Zimbabwean Agricultural Sector following the Implementation of the Land Reform Project Funded by the European Union, AIAS, Harare.

Moyo, S. 2006. The evolution of Zimbabwe's land acquisition. In *Zimbabwe's Agricultural Revolution Revisited* edited by Mandivamba, R., P. Tawonezvi, C. Eicher, M. Munyuki-Hungwe, and P. Matondi. University of Zimbabwe Publications.

Munyuki-Hungwe, M., and P. Matondi. 2006. The evolution of agricultural policy: 1990-2004. In *Zimbabwe's Agricultural Revolution Revisited* edited by Mandivamba, R., P. Tawonezvi, C. Eicher, M. Munyuki-Hungwe, and P. Matondi. University of Zimbabwe Publications.

Newey, W. K. 1987. Efficient Estimation of Limited Dependent Variable Models with Endogenous Explanatory Variables. *Journal of Econometrics* 36:231-250.

Richardson, C. 2004. *The Collapse of Zimbabwe in the Wake of the 2000-2003 Land Reforms*. Lewiston: Edwin Mellen Press.

Rosenbaum, P.R., and D.B. Rubin. 1983. The central role of the propensity score in observational studies for causal effects. *Bometrika* 70: 42-55.

Rosenbaum, P.R. 2002. *Observational Studies*. New York: Springer.

Shaw, W. 2003. 'They Stole Our Land': debating the expropriation of white farms in Zimbabwe. *J. of Modern African Studies* 42(1): 75-89.

Shiferaw, B., and S. Holden. 1998. Resource degradation and adoption of land conservation technologies in the Ethiopian highlands: a case study in Andit Tid, North Shewa. *Agricultural Economics* 18:233–247.

Sjaastad, E., and D.W.Bromley. 1997. Indigenous Land Rights in Sub-Saharan Africa: Appropriation, Security and Investment Demand. *World Development* 25(4): 549-62.

Smith, R. J., and R. W. Blundell. 1986 An Exogeneity Test for a Simultaneous Equation Tobit Model with an Application to Labor Supply. *Econometrica* 54 (3):679-686.

Tobin, J. 1958. Estimation of Relationships for Limited Dependent Variables. *Econometrica* 26(1)**:** 24-36.

Wooldridge, J. M. 2002. *Econometric Analysis of Cross Section and Panel Data.* Cambridge:MIT Press.

Zikhali, P. 2008. Fast Track Land Reform and Agricultural Productivity in Zimbabwe. *Work in Progress.*

Zimbabwe. 2000. The Accelerated Land Reform and Resettlement Implementation Plan (Fast Track). Harare, Ministry of Lands, Agriculture and Rural Resettlement.