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ABSTRACT

The role of property rights in resource allocation has been one of the central themes in development economics. There exists extensive theoretical arguments that property rights in land are closely associated with the productive efficiency of agricultural resources as well as investment decisions. However, empirical findings have not been conclusive. This has been complicated due to possible endogeneity of titles, unobserved hetrogeneities and the non-experimental nature of the data. To overcome these problems, the study employs an instrumental variable and fixed effects models. The inheritance status of a plot is used as an IV for the titling status of a plot. Using the 2010/2011 Tanzania National Survey data, it is shown that the effects of titling on investment is positive and sizable. Formal tests of endogeneity are presented to establish the claim that titles are endogenous.

1. Introduction

The role of property rights in resource allocation has been one of the central themes in development economics. There have existed extensive theoretical arguments that property rights in land are closely associated with the allocative efficiency of agricultural resources and investment decisions. Various arguments have been forwarded to support the strong linkages between well-defined formal land rights and investment decisions. Goldstein and Udry (2008) argue; it is apparent that investment incentives depend on expectations of rights over the returns to that investment and hence on the nature of property rights. Individuals do not invest if the fruits of their investments are seized by others (Besley, 1995). Fear of expropriation could discourage long term investments on land. Land titles induce investment through improved access to credit through collateralization of land (Feder et al. 1988). Improved rights through titling simplify land exchanges and transactions, hence enabling the efficiency gains from trade and hence investment (Besley, 1995). Gershon and David (1991) also discuss the particular aspect of efficiency loss due to asymmetric information associated with insecure land tenure. In his most influential work "The Mystery of Capital", De Soto (2000) explains

why capitalism triumphs in the west and fails everywhere else. In these countries, he argues,

> ... Because the rights to these possessions are not adequately documented, these assets cannot readily be turned into capital, cannot be traded outside of narrow local circles where people know and trust each other, cannot be used as collateral for a loan, and cannot be used as a share against an investment. In the west, by contrast, every parcel of land, ... is represented in a property document that is the visible sign of a vast hidden process that connects all these assets to the rest of the economy.

Following these arguments, land titling or registration emerged as a very popular policy prescription to enhance productivity and reduce poverty. With ownership officially documented and verified, the risk of challenges to ownership will be reduced, and the likelihood of having to incur high costs in defending one's possession of land will be lower, incentives to invest will be enhanced, and land productivity will be increased (Feder and Nishio, 1999). Despite all the theoretical arguments for land titling, empirical evidence has not been clear and definite. There has not been clarity and conformity of results on the precise outcomes of land titling. The explanations are both methodological and conceptual. The identification of land titling effects is a difficult task because it typically faces the problem that formal property rights are endogenous (Galiani and Schargrodsky, 2010). The allocation of property rights across households is usually not random but based on a set of distinguishing features including the existing investment level on land. Besides, there are conceptual issues that put into question the property rights paradigm. For example, the gains from trade could be realized only in an efficient and free market, an unusual characteristics of most land markets in developing countries. In addition, private property titling could fuel rent seeking (Loehr, 2010). Land registration can create rather than reduce uncertainty and conflict over land rights (Atwood, 1990). It might increase risks and transaction costs for certain numerically important groups, especially local people who rely on existing informal means to establish and safeguard their land claims (ibid).

The purpose in this study is to test the property right paradigm and adopt an empirical investigation of the validity of the claims made by the property rights advocates in developing economies. The particular interest is to analyze if land titling leads to the presumed outcomes based on the property rights paradigm. Various studies have documented the relationship between tenure security and investment in developing economies. There is a predominant consensus in empirical literature that well

defined property right structures enhance investment and hence increased agricultural production (Feder et al, 1988, Blarel, 1994; Gallinai and Schargodsky, 2010). Yet, whether formal land titling yields the expected results has been controversial in empirical studies. A group of studies discovered a positive association between titling of plots and agricultural investments (Alston et al, 1996). Others (e.g. Bellemare, 2012) found out that titles have no impact on investment and productivity. Another study (Place and Otuska, 2002) in Uganda, found that the direction of causality between formal title and fixed investment varies with the type of investment.

Empirical studies have been riddled with difficulties. Data on fixed investment were often binary, reducing the likelihood of relating titling to continuous investment data (Smith, 2006). Binary choice models are regression models with less information compared to their counterpart. Most importantly, the identification of land titling effects is a difficult task because it typically faces the problem that formal property rights are endogenous (Besley, 1995; Galiani and Schargrodsky, 2010). The allocation of property rights across households is not random but based on as set of distinguishing household and village level characteristics including the existing investment level on land, presence of legal instruments as well as other household unobservables. This study attempts to address these empirical issues by the use of instrumental variables method and village level fixed effects.

The rest of the paper is organized as follows. The next section presents the basic conceptual framework used in the study along with a brief review of related literature. Section three details the empirical framework applied in the study followed by a description of the data and variables. Section five presents the results. Section six concludes with possible policy implications and future research directions.

2. Conceptual Framework

In his book, "the Mysteries of Capital", De Soto (2010) argued the failure of developing economies to establish well defined system of land rights is responsible for their weak economic performance. Though interest on the significance of well defined land rights grew after De Soto's book, there has already been a significant discourse since the 1990's. Three arguments are presented to explain the positive implications of secure land tenure on investment. First, well defined rights endow the farmer with the freedom from possible expropriation (Demsetz, 1967; Alchian and Demsetz, 1973). Second, property rights on land provide for acceptable collateral asset, hence enhancing access to credit and easing the liquidity constraint

for investment (Feder et al. 1988). Finally, official land titles, by making transfer of land through sale easy, lead to a more efficient resource allocation by enabling the realization of the gains from trade (Besley, 1995). But the empirical evidence has not been compellingly supportive of these premises.

Besley (1995) provided the fundamental conceptual framework for analyzing the link between property rights and long term investment on land based on the three channels. This study follows Besley's (1995) framework. Consider an individual making an investment decision on how much capital (k_t) to invest at time t on a given plot. The return from investment function for time $t+1$: V_{t+1} depends on property rights, denoted by R_{t+1}:[1]

$$V_{t+1} = V(k_t(R_{t+1}),\ R_{t+1}) \tag{1}$$

Since tenure security could be driving investment on the land, land right is considered endogenous[2] and is given by the general equation where R_{t+1} is increasing in both k_t and R_t.

$$R_{t+1} = \psi(\lambda k_t,\ (R_t) \tag{2}$$

The return on investment is assumed to be increasing in both k_t and R_{t+1} and concave in k_t. The cost of investment, that is increasing in k_t and non-increasing in R_{t+1} is given by:

$$C(k_t(R_{t+1}),\ R_{t+1}) \tag{3}$$

The optimal investment choice satisfies the return (profit) maximizing condition of the farmer:

$$max\ W(k_t, \psi(\lambda k_t, R_t)) \equiv V(k_t, \psi(\lambda k_t, R_t)) - C(k_t, \psi(\lambda k_t, R_t)) \tag{4}$$

From the optimization problem, it follows that investment increases as rights are improved. Solving the optimization yields an investment function that provides the framework for the empirical model in this study:

$$k_t = \upsilon(R_t) \tag{5}$$

[1]Besley's (1995) original specification denotes investment as $V_{t+1} = V(k_t, R_{t+1})$. However; investment is determined by the property right regime. Hence, the original investment function is slightly modified to $V_{t+1} = V(k_t(R_{t+1}),\ R_{t+1})$ and hence the cost function.

[2]This is the popular endogeneity problem associated with land titling. However, endogeneity could as well be either due to selection or other omitted variables. It is challenging to confirm that the endogeneity is due to reverse causality as suggested by Besley (1995).

The claim that individual land titles through formalizing land rights drives investment has been found to be fragile. First, the expected efficiency gains from trade could be realized only in an efficient and free market, an unusual characteristics of most land markets in developing countries. Property titling could also fuel rent seeking (Loehr, 2010; Platteau, 1996). The success of property titling programs could be compromised by capture of these programs by local elites who are better informed about the processes and procedures. Still, this might not imply a reduction in investment on land, rather a possible rise due to an increase in investment capacity from the elites. Land registration can also create rather than reduce uncertainty and conflict over land rights (Atwood, 1990). It might increase risks and transaction costs for certain numerically important groups, especially local people who rely on existing informal means to establish and safeguard their land claims (ibid). Assuming that each of the three channels through which higher tenure security enhance investment is an oversimplification. Testing the efficacy of each of the three channels separately is a topic for future research. All said, the controversies on whether improved land rights and security through formalization of rights yields the expected rise in investment can only be substantiated using empirical analysis. This study attempts to address this empirical issue by the use of instrumental variables method and village level fixed effects. The principal argument that rights are endogenous since farmers tend to invest on land to protect their rights or claims on the land (Besley, 1995) has not been formally tested. It's largely based on ancillary evidence. With the use of simple comparison of the results from the fixed effects and IV models as well as statistical tests of identification, the study tests this widely held belief.

3. Empirical Framework

The basic empirical strategy, following Besley (1995), was described with the following fundamental regression equation.

$$y_{ijk} = f(R_{ij}, P_{ij}, X_{ij}, \varepsilon_{ij}) \tag{6}$$

Where y_{ijk} is the investment level k undertaken by household i on plot j ; R_{ij} is the property right status of the plot,P_{ij} is a set of plot specific characteristics, X_{ij} is a set of household characteristics and ε_{ij} is the stochastic element.

In the ideal setting of an experimental design, the treatment group comprises of plots of land that are randomly titled. Hence, simple testing

of the difference in investment behavior between titled and non-titled plots would yield the required results. This would however require repeated observations of randomly assigned titles and their counterpart plots across several villages and over a relatively longer time period. The data set used in this study is only cross-sectional.[3] And, it is hardly possible that land titles are randomly assigned. It is possible that the plots in a given village are more likely to be titled than in other villages (ibid.). Or, more importantly, households who seek titles could be systematically different from those who don't. To account for these systematic differences, various controls are used both at the household and plot level including soil quality, steepness of plot, wealth status of household, distance to market from the plot, and others. Controlling for these characteristics is critical in understanding their investment behavior. Hence the following basic model will be estimated.

$$y_{ijk} = \alpha_k X_i + \beta_k R_{ij} + \gamma_k P_{ij} + \varepsilon_{ij} \tag{7}$$

However, the inclusion of the controls provides only a limited solution leaving a concern that measured rights might also proxy for omitted variables such as the village political structure, farmers' investment ability or knowledge. The distribution of land titles runs across administrative procedures. The implementation of the titling program differs across various regions in a country. Land titles are applied in different periods of time in various regions. The extent of tenure security availed by the tiles also differs based on local administrative factors such as the extent of elite capture, recent history of tenure security and the level of trust/security a title provides. This would bias the estimates of (5) and one could only find a spurious link between land rights and investment. Without controlling for these village specific fixed effect, one would expect to see differential effects of land titles on investment. The village fixed effect may also represent other time invariant variables. In Tanzania, the survey identifies 26 administrative regions (villages). The following model is estimated with village level fixed effects (α_{ki}):.

$$y_{ijk} = \alpha_{ki} + \beta_k R_{ij} + \gamma_k P_{ij} + \varepsilon_{ij} \tag{8}$$

Though this method yields a better relationship between titling and investment, there are still concerns with establishing actual causality between land titling and investment. Because, the identification of land titling effects in this framework is difficult due to the fact that land titles

[3]Use of panel data won't also help the results since land titles are usually fixed and less likely to change within short to medium period of time.

might be endogenous. In fact, a reverse causation has commonly been suggested in which investments on a plot of land can possibly secure the owner's right to the land (Besley, 1995). For example, households could invest in infrastructure as well as tree boundaries to secure their tenure. To account for the endogeneity of land rights or titling, the following empirical model is estimated with instrumental variables method.

$$y_{ijk} = \alpha_i + \beta R_{ij} + \gamma_k P_{ij} + \psi X_i + \varepsilon_{ij} \tag{9}$$
$$R_{ij} = \sigma_{ij} + \varphi Z_{ij} + \eta_{ij}$$

Where, Z_{ij} is the instrumental variable for the ownership of a formal title of ownership for plot j by household i. Given the above specification, there is a need to employ an efficient instrument for property rights that is exogenous and relevant. The literature in the choice of instruments ranges from those that use no instruments at all (e.g. Smith, 2004) to those who suggested multiple instruments (Besley, 1995). Besley (1995) suggested four possible instruments of property rights: ($i.$) Whether there is a transfer deed, ($ii.$) Whether the household has ever litigated over its right to the field, ($iii.$) How the field was acquired, ($iv.$) How many years the field has been owned. Yet, the first instrument is endogenous itself since investment could be made to secure the transfer deed as it would to secure official land title. The fourth IV also fails to satisfy the externality/exogeneity assumption, since the number of years the plot has been owned determines the already existing level of investment on the land. Most other empirical work in the field employed community level indicators such as the legislative framework or some district level indicator. For example, Do and Iyer (2010) used the province-level proportion of households with land user titles as a measure of the probability that a given household would have a land use certificates. The challenge with these instruments, however is that they have different unit of analysis (province) than that of the original variable, title ownership, which is a plot level characteristic. Mullan et. al (2010) uses village fixed effects to capture the impact of village land rights manipulation on migration. This makes the instrument weak in terms of explaining within community variation in having title and the related investment implications. This is particularly problematic since the interest is in explaining differences in investment in plots with differing title after controlling for other variables for households and plots which would be preferably located close to each other than across villages.

This study exploits the fact that a predominant number of households (47%) own more than a single plot with different title structures. This allows for a close to experimental analysis of the distinction between titled

and non-titled plots within a single household. Hence, using a village or community level instrument would limit our understanding of the within village variations as well as the within household variations across plots. In cases when the difference is across villages and is difficult to control for unobservables, using household level fixed effects would be appropriate. The inheritance status of the plot is used to instrument for the titling status of the plot. The inheritance status variable provides an exogenous source of variation that determines the probability of seeking to have a land titled or not. The underlying assumption is that it is external to the investment decision on that specific plot. But how the plot is acquired would affect the likelihood of seeking to have a title. A simple regression of land title status on inheritance status indicates strong possible association between the two variables, hence satisfying the 'relevance' (Greene, 2012) assumption. 2SLS method will be employed to estimate the instrumental variable model (7). Since theoretical and Monte Carlo simulations indicate that the limited information maximum likelihood (LIML) estimator may yield less bias and confidence intervals with better coverage rates than the 2SLS estimator (Poi, 2006; Stock,et al, 2002), LIML results are presented and compared with 2SLS. Various permutations of control variables will be used to check robustness and sensitivity of the results. Finally, formal tests will be undertaken to establish the widely held claim that land titles are endogenous. Various tests of identification will be undertaken to check for the strength of the selected IV.

4. Data and Variables

The study uses the 2010/2011 Tanzania Living Standards Measurement Survey; a nationally representative household survey that collected information on a wide range of topics including agricultural production, non-farm income generating activities, and a wealth of other household characteristics. Information is collected at a plot level. Farmers were asked about the size and number of plots and titles they possessed and the usage of plots. Information on the main crop cultivated, decisions on which crop to cultivate, soil type and quality as well as the steepness of plot were also collected. Besides, there is information on the number of permanent crops and trees planted on each plot. Unlike many other surveys, there is information on the titling status of each plot. A list of the variables used in the study is presented in Table 1 below.

The dependent variable used to proxy for fixed investment is the number of trees or permanent crops per acre on each plot. Considering the per acre investment rather than the total investment helps account for variations due to size of plot. These include the planting of trees, either fruit or otherwise, and permanent crops that take relatively many

years to yield output. Tree planting has been the preferred proxy for fixed investment (Besley, 1995; Smith, 2004; Bandiera, 2007; Bellemare, 2010). However, unlike all these studies which employed a binary variable to determine whether investment has been undertaken, a continuous measure of number of trees planted will be used. Since planting of trees and permanent crops might not be the appropriate investment choice for households in urban areas, the study will only focus on rural households. The analysis identifies the effect of land titles on investment using plot level and household level characteristics. Household level characteristics include the demographic structure of the household, education of adults in the household, the main occupation of the head, as well as the wealth index as a proxy for the economic status of the household. Plot level characteristics used in the study are primarily the specific feature of the plot in terms of soil quality, steepness of plot, and proximity to markets. Table 2 presents a descriptive statistics of the variables used in the study.

Tabelle 1. Description of Variables

Variables
Dependent Variable
No. of permanent crops and trees per hectare on a plot
Independent Variables
Household Level Characteristics
Age of household head
Average education of adults
Male labor
Female labor
No. of children
Distance to the nearest market (KM.)
Non agricultural wealth index
Plot Level Characteristics
No. of plots
Area of plot (ha.)
Slope of Plot
Flat top
Slightly sloped
Very steep
Years of holding
Soil quality
Good
Average
Bad
District and Regional Variables
District (1 to 8)
Region (1 to 26)
Instrumental variable for land title on a plot
Inheritance status (=1 if plot is inherited, =0 otherwise)

Tabelle 2. Summary Statistics of Variables

	Plots Without Titles		Plots With Titles		Full Sample	
	Mean	Sd. Dev.	Mean	Sd. Dev.	Mean	Sd. Dev.
Title Status of Plot	0.00000		1.00000			
Inheritance status of plot	0.00000	0.00000	0.21725	0.41271	0.02729	0.16294
No. of trees crops per acre	56.10717	273.2968	161.917	691.8023	71.46666	366.733
Gender of household head	0.20686	0.40510	0.19677	0.39788	0.20558	0.40417
Age of household head	49.26842	14.91877	49.88548	14.56504	49.34637	14.87450
Average education of adults	5.24125	2.72781	5.96737	3.06262	5.33332	2.78265
Main occupation of head	0.87927	0.32585	0.72843	0.44512	0.86023	0.34679
Male labor	1.44939	1.15298	1.71452	1.57754	1.48289	1.21782
Female labor	1.49744	0.99544	1.70000	1.45487	1.52302	1.06641
No. of children	3.08909	2.11253	3.47903	3.38931	3.13835	2.31620
No. of plots	3.17607	1.69840	2.71936	1.38604	3.11838	1.66897
Years of holding	23.96145	26.96647	21.80192	24.68416	23.69021	26.69778
Distance to nearest market	1.33597	2.18905	1.52061	2.62491	1.35895	2.24838
Wealth index	-0.00283	0.87374	0.38048	1.33131	0.04297	0.94818

5. Results

Results corresponding to the main hypotheses suggest that, the titling status of a plot matters significantly in long term investment decisions. Providing land certification is found to have a strong positive economic impact in terms of increasing long term investment as shown in the results from variants of the models. Table 3 reports results of basic OLS estimates of model (7) and village specific fixed effects model (8). Results from the fixed effects models show that the title status of the plot did have significant positive effect on the number of trees and permanent crops planted on a plot. Plots with titles accrue higher investment per acre than plots without titles. After controlling for titles, households with female heads tend to undertake higher long term investment on their plots compared to their counterparts. Slopes of the plots and number of plots a household owns are other factors that explain differences in investment among plots and households. It might seem counter-intuitive that fewer number of trees are planted on flatter plots. However, it is more reasonable to presume that more suitable and flatter plots are used for the production of recurrent and staple crops. The effect of titling on the number of trees and permanent crops planted declines by about 50% when controlling for regional fixed factors. Hence, including household fixed effects suggests a strong but lower positive relationship between titling status and investment when controlling for unobserved village level characteristics. As indicated previously, this relationship between titling and investment might have been biased due to the endogeneity of titling. To address this, IV models are estimated and variants of the estimation results are presented in Table 4.

Variations of the instrumental variable model estimates also show that certification of land through titles matters significantly in investment decisions. Both 2SLS and LIML yield similar results. The last column in Table 4 reports estimates for LIML while the others were results based on 2SLS.Both the fixed effects and the IV models show that titling has a sizable effect on the number of permanent crops or trees planted. Both the fixed effects model and the IV model yield consistent and robust results with respect to the positive and sizable effect of secure land tenure in the form of formal title on investment. These findings are robust to various specifications.Inclusion and exclusion of various household and plot level characteristics did not change the results. However, the titling coefficients in the IV model are almost five times greater than that of the fixed effect. The impact of improved rights through land titles increases significantly with the use of instrumental variables compared to the fixed effects model. This might indicate that the fixed effects model estimates are biased due to endogeneity of titles. Tests of the weakness of the

instruments suggest the strength of the chosen instrument, hence a reasonable validation of the choice of the inheritance status as an appropriate IV. Various tests of endogeneity including the Durbin and Wu-Hausman statistics confirm the endogeneity of titles.

The findings reaffirm the property rights paradigm that improved tenure security through formal titles enhances fixed investments. This may also indicate the empirical challenge of understanding the relationship between property rights and investment is attributed largely to endogeneity of land titles. But, it fails to confirm the popular claim that land rights are endogenous because farmers undertake investment decisions in the effort to ensure greater tenure security. Though titles are endogenous, it is not clear if this is due to reverse causality, unobserved hetrogeneities, selection or omission of variables. Though the study confirms the expectation that land titles encourage long term investment on the land, it doesn't provide further information about the channels through which titles provide incentives for increased invesment. Further understanding the channels through which formal titles impact investment requires further investigation. Revealing if this relationship is working through enhanced assurance of future benefits, increased access to credit or greater efficiency gains from ease of exchange requires further investigation.

Tabelle 3. OLS and Fixed Effects Model Results

	Dependent Variable: Number of trees and permanent crops per acre on a plot				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Land Title	126.5***	154.3***	62.17**	89.60***	103.2***
	(27.41)	(34.64)	(27.00)	(29.37)	(33.70)
Female head		93.80***		46.80*	77.42**
		(32.49)		(27.30)	(31.48)
Age of household head		0.531		-0.0738	2.177
		(5.418)		(4.522)	(5.244)
Age of household head squared		-0.00424		-0.00126	-0.0214
		(0.0518)		(0.0431)	(0.0501)
Average education of adults		6.162		2.894	0.0179
		(4.890)		(4.006)	(4.892)
Main occupation of head is agri.		-0.308			-1.268
		(42.54)			(42.77)
Male labor		-3.788		3.984	4.674
		(11.62)		(9.878)	(11.61)
Female labor		-1.937		-4.651	-3.940
		(13.96)		(11.80)	(13.55)
No. of children		-7.872		-9.355*	-9.534
		(6.004)		(5.185)	(5.906)
No. of plots		-27.46***		-17.55**	-14.26*
		(7.578)		(6.984)	(8.016)
Flat bottom		-134.0***		-74.90*	-85.13*
		(45.35)		(42.01)	(46.19)
Flat top		-148.9**		-112.9**	-128.1**
		(62.13)		(52.95)	(59.97)
Slightly sloped		-111.4**		-79.77*	-98.39**
		(46.30)		(41.25)	(45.10)
Good soil quality		11.12		51.05	52.40
		(42.50)		(36.21)	(41.82)
Average soil quality		10.44		49.44	45.58
		(42.96)		(36.14)	(41.77)
Distance to the nearest market		-2.515			-4.585
		(4.862)			(4.732)
RURAL: non-agricultural wealth index		10.37			-4.470
		(14.03)			(13.82)
District = 2		-10.02			
		(34.13)			
District = 3		-74.76*			
		(38.29)			
District = 4		-22.99			
		(41.15)			
District = 5		-63.89			
		(43.29)			
District = 6		-82.48*			
		(48.18)			
District = 7		-110.0			
		(98.69)			
District = 8		-93.44			
		(133.9)			
Constant	58.87***	254.0*	67.55***	161.6	122.3
	(10.07)	(151.7)	(9.555)	(119.9)	(145.4)
Fixed effects	None	None (Districts dummy)	Region (Village)	Region (Village)	Region (Village)
Observations	1,683	1,126	1,683	1,390	1,126
R-squared	0.013	0.060	0.134	0.154	0.155

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tabelle 4. IV Model Results

	DV: No. of trees/permanent crops per acre			
VARIABLES	(1)	(2)	(3)	(4)
Land Title	481.1***	424.3***	489.9***	489.9***
	(73.41)	(65.68)	(73.29)	(73.29)
Female head	99.00***	77.95***	99.82***	99.82***
	(33.45)	(28.92)	(33.49)	(33.49)
Age of household head	1.084	-2.099	1.253	1.253
	(5.567)	(4.806)	(5.583)	(5.583)
Age of household head squared	-0.0110	0.0161	-0.0132	-0.0132
	(0.0532)	(0.0459)	(0.0534)	(0.0534)
Average education of adults	5.092	6.255	4.925	4.925
	(5.036)	(4.025)	(5.043)	(5.043)
hh_b11==AGRICULTURE/ LIVESTOCK	50.93		48.47	48.47
	(44.81)		(44.80)	(44.80)
Male labor	-6.527	-4.336	-7.657	-7.657
	(11.99)	(10.29)	(11.99)	(11.99)
Female labor	0.350	0.541	-0.711	-0.711
	(14.38)	(12.57)	(14.39)	(14.39)
No. of children	-10.75*	-9.235*	-10.91*	-10.91*
	(6.210)	(5.467)	(6.212)	(6.212)
RURAL: non-agricultural wealth index	0.664		2.829	2.829
	(14.50)		(14.52)	(14.52)
No. of plots	-19.81**	-22.57***	-20.87***	-20.87***
	(7.900)	(6.919)	(7.907)	(7.907)
Flat bottom	-44.38*	-132.0***	-142.2***	-142.2***
	(25.30)	(42.53)	(46.74)	(46.74)
Flat top	-97.22*	-173.7***	-197.4***	-197.4***
	(50.70)	(56.63)	(64.66)	(64.66)
Distance to the nearest market	-4.993		-4.344	-4.344
	(5.012)		(5.020)	(5.020)
District = 2	20.30	14.10	17.65	17.65
	(35.48)	(30.90)	(35.55)	(35.55)
District = 3	-81.34**	-34.04	-81.42**	-81.42**
	(39.49)	(34.49)	(39.47)	(39.47)
District = 4	2.607	6.766	2.029	2.029
	(42.68)	(36.56)	(42.66)	(42.66)
District = 5	-32.24	-25.56	-31.77	-31.77
	(44.94)	(38.71)	(45.01)	(45.01)
District = 6	-72.73	-29.71	-68.23	-68.23
	(49.67)	(42.65)	(49.71)	(49.71)
District = 7	-167.0	-117.8	-157.1	-157.1
	(101.9)	(84.69)	(102.1)	(102.1)
District = 8	13.96	-14.97	-6.294	-6.294
	(138.7)	(126.4)	(139.0)	(139.0)
Slightly sloped		-107.1**	-118.6**	-118.6**
		(43.41)	(47.71)	(47.71)
Good soil quality		4.682	5.021	5.021
		(37.93)	(43.80)	(43.80)
Average soil quality		11.60	10.19	10.19
		(38.15)	(44.25)	(44.25)
Constant	54.97	254.2**	151.7	151.7
	(149.8)	(129.4)	(157.4)	(157.4)
Durbin (Score) Chi2(1)	28.2373	24.7922	29.8135	
Wu-Hausman F(1, N-K) (Score) Chi2(1)	28.372	24.8248	29.9172	
Minimum Eigenvalue Statistic	341.668	385.935	341.942	341.942
Observations	1,126	1,390	1,126	1,126

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6. Conclusion

Previous studies find conflicting results on the effect of titling on fixed investment. This study adopts econometric tools to control for the endogeneity of land titles and unobserved heterogeneity to find the impacts of land titling on investment. Using the 2010/2011 Tanzania National Survey data, the results indicate a robust and positive relationship between titling and long term investment as measured by the number of trees and permanent crops planted on a plot. Due to the richness of the data set, it was possible to control for a host of plot level and household level characteristics, hence providing robust outcomes. Households tend to increase the level of fixed investment on titled plots. This confirms the general hypothesis that titling encourages long term investment.

This study is an improvement from previous literature in two ways. First, it takes advantage of the continuous measure of fixed investment: number of permanent crops and trees planted on a plot. Almost all Previous studies (Besley, 1995; Smith, 2004; Bellemare, 2010; Galiani and Schargrodsky, 2010) used discrete measures of whether there was investment in trees, infrastructure or land improvements on a plot, hence limiting the range of relationship between investment and titling status. Second and most importantly, it introduces a more reliable instrument for titling that yields consistent estimates with the fixed effects model. The results also suggest that the empirical challenge in identifying the effects of property rights on investment is attributed largely to endogeneity of titles. However, the source of endogeneity is not clear from the study.

The results provide evidence on the positive impacts of formal land titling schemes to encourage investment. It should, however, be emphasized that further policy actions should rely on the precise channels through which formal titles enhance investment. Further tests of each of the presumed channels including improved access to credit, increased security, ease of exchange or other possible links is critical in better understanding the benefits and costs of titling programs. The study suggests that government actions in similar African countries that improve tenure security through titles can significantly enhance investment and further economic activity. But, a closer look at the process of titling and possibilities of rent seeking and elite capture should also be countered.

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