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Impacts of Land Certification on Tenure Security, Investment, and Land Markets

Evidence from Ethiopia

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Abstract

While early attempts at land titling in Africa were often unsuccessful, the need to secure land rights has kindled renewed interest, in view of increased demand for land, a range of individual and communal rights available under new laws, and reduced costs from combining information technology with participatory methods. We used a difference-in-difference approach to assess the effects of a low-cost land registration program in Ethiopia, which covered some 20 million plots over five years, on investment. Despite policy constraints, the program increased land-related investment and yielded benefits significantly above the cost of implementation.

Key Words: land certification, land rights, tenure security, investment, Ethiopia

JEL Classification: O13, O17, Q15

Contents

Impacts of Land Certification on Tenure Security, Investment, and Land Markets: Evidence from Ethiopia

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Introduction

Two factors have led to the recent increase in interest in land registration and formalization of property rights to land in Africa. First, since the 1990s, most African countries have passed new land legislation to remedy some of the perceived shortcomings of existing systems, particularly by strengthening customary land rights, recognizing occupancy short of full title, improving female land ownership, and decentralizing land administration. Advances in information technology and remote sensing have revolutionized the way land is administered in other regions and reduced the cost by providing tools for implementation that were not available before. Second, higher prices for food, fuel, and fiber are capitalized in land values and, together with emerging demand for land by investors, add to pre-existing pressures on land from urban expansion all over Africa. Clearly defined property rights (at the individual or group level) and a well-governed system of land administration are essential to avoid socially undesirable outcomes and conflicts.

Although the importance of formalizing property rights has been emphasized by a number of scholars (de Soto 2000), surprisingly little seems to have happened on the ground. Progress via implementation of new laws has often been slowed by institutional wrangles. This may even have led respected scholars to view interventions to register land as classic examples of a long discredited top-down approach to development rather than ways to empower land users (Easterly 2008). Although it is recognized that the "title–no title" dichotomy may be "the wrong

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answer to the wrong question" (Bromley 2008), it tends to encourage the empirical debate in the literature.

Against this backdrop, our paper aims to quantify the economic impacts of recent land certification in Ethiopia, arguably the largest land administration program in the last decade in Africa, and possibly the world. The program departs from traditional titling interventions in a number of ways, in particular by 1) issuing non-alienable use-right certificates, rather than full titles; 2) promoting gender equity with joint land ownership by spouses (certificates have photos of both spouses on them); 3) using a participatory and highly decentralized process of field adjudication; and 4) minimizing use of spatial information to reduce costs. This could be the basis for a rapid and large-scale approach that avoids the shortcomings in the past, which reduced the sustainability and poverty impact of past land registration programs, and that can respond to the emerging challenges.

To assess Ethiopia's experience—and possible lessons for others—we investigated the impact of the program in the Amhara region on perceived tenure security, land-related investment, and land market participation. Due to limited capacity at the *wereda*[1] level, the program was phased in through several stages. This, together with a four-round panel household survey, allowed us to implement a difference-in-difference strategy to identify early program impacts. Evidence pointed not only to significant positive program effects on the outcomes of interest but also to a very positive cost-benefit ratio. Our study suggests a number of steps to ensure or even increase sustainability of benefits and highlights the need for further study of differentiated impacts, as well as channels through which they materialize. At the same time, there are clear lessons that could help other countries in confronting some of the material challenges they face in land policy and administration.

The paper is structured as follows. Section 1 reviews evidence of the impacts of land-related programs, as well as characteristics of the Ethiopian effort that are used to formulate hypotheses on program impact. Section 2 presents descriptive data for the entire sample, with both "treated" and control groups, and discusses program implementation and the implications for the estimation strategy. Section 3 provides estimates of certification impacts on the key

[1] A *wereda* (or *woreda*) is an administrative district of local government in Ethiopia. Weredas, which are made up of *kebeles*, or neighborhood associations, are typically collected together (usually contiguous weredas) into zones.

variables, and section 4 concludes with implications for Ethiopia and other countries in the region.

1. Background and Approach

To set the stage, we discuss how and why measures to strengthen land rights or improve the way in which they can be enforced will affect owners' incentives to make land-related investments, transfer land to more efficient uses through market transactions, and use it as collateral for credit. These predictions are contrasted with empirical evidence from different settings, especially in Africa. We used characteristics of Ethiopia's program and policy environment to review expected impacts, identify proxies to measure them empirically, and formulate hypotheses that can be subjected to statistical tests.

1.1 Evidence from the Literature and Implications for Africa

The literature identifies three channels through which higher security and better enforcement of property rights can, in principle, affect economic outcomes. First, clearly defined property rights to land and the ability to draw on the state's enforcement capacity will lower the risks of squatters and eviction, increase incentives for land-related investment (Bresley 1995), and reduce the need for land owners to expend resources to stake out or defend their claims. The latter can be especially important to groups, e.g., women and the traditional discrimination against them owning land (Joireman 2008).

The positive impacts of more secure land tenure on investment and land values in rural areas have been demonstrated in China (Jacoby et al. 2002), Thailand (Feder et al. 1998), Latin America (Deininger and Chamorro 2004; Field et al. 2006; Bandiera 2007; Fort 2007), Eastern Europe (Rozelle and Swinnen 2004), and Africa (Deininger and Jin 2006; Goldstein and Udry 2006). In urban areas, efforts to enhance tenure security have led to increased levels of self-assessed land values (Lanjouw and Levy 2002), greater investment in housing (Galiani and Schargrodsky 2005), and more female empowerment (Field 2005). Receipt of titles has allowed former squatters, especially women, to join formal labor markets instead of staying home to guard their land, which increased their income and reduced child labor (Field 2007). Joint titles have helped reduce fertility (Field 2003), increased investment in children's human capital (Galiani and Schargrodsky 2004), and improved educational outcomes (Galiani and Schargrodsky 2005). How property rights to land are exercised has affected governance and corruption (Lobo and Balakrishnan 2002) and performance of local institutions (Deininger and Jin 2008).

The strength and size of the effect of tenure-security on investment depends on the attractiveness of investment opportunities and the efficacy of enforcement, i.e., it will be greater where tenure has been very insecure or the level of conflict high. A key policy issue, especially in Africa, is not only whether expected benefits justify the cost but also whether a process can be implemented equitably and its institutions sustained over time. The emphasis on individual titles has often been associated with failure to take advantage of the wide spectrum of joint and communal rights or to recognize that local institutions may be more effective than a distant state agency. As a result, efforts to improve tenure security may weaken or extinguish some rights, displace institutions without providing alternatives (thus disempowering certain groups), and increase rather than reduce conflict.

Adoption of a sporadic rather than systematic approach and a lack of safeguards (such as wide dissemination of information and transparent public adjudication with an appeals process) have often set off a speculative clamor for land, where the interventions reinforced or exacerbated pre-existing inequalities and had little positive impact on growth. If the costs of first-time registration and up-to-date registry records are not commensurate with the benefits of land registration, it can be difficult to carry out either of these steps. A combination of these issues has often limited the effectiveness and reach of land registration in many African contexts (Pinckney and Kimuyu 1994; Bruce and Migot-Adholla 1994; Jacoby and Minten 2007), so it is important to determine how Ethiopia managed these problems.

Affordable access to reliable information about an individual's land ownership via a public registry will also reduce the cost of renting or selling land. Renting allows land owners to tap new sources of income, but still retain their land for insurance or old-age protection, or to consolidate it and cultivate larger farm areas. A certificate of land ownership can allay fears that rental land can be taken away, either by the government through redistribution or by a tenant who does not vacate it at the end of the lease period. Certificates can help when migration requires land owners to be absent temporarily or if the number of registration transactions increases beyond the capacity of informal, local mechanisms to handle them transparently. In China, rental land contributed to occupational diversification and was estimated to have increased productivity by about 60 percent (Deininger and Jin 2008). In Vietnam, awarding certificates seemed to prompt investment in perennial crops (by 7.5 percent, compared to no

certificates) and expanded the amount of time (11–12 weeks) households spent in non-agricultural activity—particularly by the poor (Do and Iver 2008).

The key benefits of formal land titles are the ability to sell or rent land to strangers and the associated ability to use land as collateral for credit (de Soto 2000).[2] Land is ideal collateral if a reliable land registry provides a formal and low-cost way to identify land ownership without physical inspection or inquiry with neighbors. At the same time, to take advantage of credit that formal land ownership can make possible, households need to have other bankable projects, be credit-worthy, and be willing to take the associated risk (Boucher et al. 2008). Moreover, land markets must be sufficiently liquid to make sales feasible within a given time, implying that land rights are fully transferable and neither legal provisions nor social conventions limit foreclosure. While credit advantages of land titling have been reported in the literature (Feder et al. 1998), positive impacts have often been limited to larger land owners (Mushinski 1999; Carter and Olinto 2003), and some studies failed to find credit effects even where they were expected (Field et al. 2006; Fort 2007). Even if profitable projects exist, legal restrictions on land sales (Sundet 2004), limited commercial value of the land (Galiani and Schargrodsky 2005; Payne et al. 2008), and social or political considerations that limit foreclosure (Field and Torero 2006) may jeopardize realization of credit effects. This implies that such credit may be realized less readily than is sometimes suggested.

1.2 Hypotheses for Program Impact and Outcome Variables

The extent to which the positive effects of land certification materialize depends on the policy environment, features of the land registration program, and the owners' confidence that certificates will be respected and change behavior. Before formulating our hypotheses, we discuss these three elements in turn.

Three factors contributed to low levels of tenure security in Ethiopia (in Amhara) and the considerable potential for certification. First, Amhara's 1997 redistribution of land was largely politically motivated and generated considerable conflict (Ege 1997). Second, because land in Ethiopia remains state owned and the constitution affirms the right of every adult to access to land, the government must resort to land redistribution to achieve this goal, using heavy-handed

[2] The large differences in the ratio of credit to gross domestic product across countries are a key argument for justifying interventions to formalize land rights that would allow greater use of land as a collateral to access credit (de Soto 2000; Besley and Ghatak 2008).

bureaucratic discretion as necessary.[3] Discussion of this topic recently intensified when Tigray region passed and began enforcing a proclamation (law) that took away the land of rural residents who had left their villages for more than two years. Third, urban expansion and land grants to investors by the government are proceeding apace. In both cases, possession of a certificate provides at least a basis to demand and determine the level of compensation. Also, because land in Ethiopia is state property that can neither be sold nor mortgaged, we would expect no credit effects from land certification. Moreover, with the exception of Amhara, all regions restrict the amount of land that can be leased to 50 percent of any holding, suggesting that—beyond Amhara—the impact of certification on land rental markets may be limited.

The literature has many examples where differential access to information about and during land registration programs resulted in such interventions exacerbating rather than reducing pre-existing biases toward wealth or gender. In Ethiopia, the tendency of land certification to encourage encroachment on communal lands by the powerful was particularly strong. The only way to avoid this situation is to identify communal lands in a public and participatory process before individual plots are demarcated (Gebre and Keneaa 2008). Both a process perceived as unjust and the failure of officials to honor certificates can undermine the credibility of the whole program, as well as any expected positive impact. Indeed, case studies have reported great skepticism among farmers who initially believed that certification was merely another politically motivated campaign and only changed their views as they participated in the process and realized the potential usefulness of the certificates (Adal 2008).

Qualitative data on the characteristics of a program can provide an initial assessment of the economic impacts from certification. Our quantitative outcome variables focused on three areas, namely perceived tenure security, land-related investment, and rental market participation. First, the high level of tenure insecurity prior to the program, and the fact that certification was expected to affect this variable quickly, implied that the perceived level of land tenure security could be a useful indicator. We used the response to the question of whether the household expected a change (increase or decrease) in land holdings via administrative action over the next

[3] The proclamation, or law, in Amhara calls for land redistribution, but makes it the responsibility of local communities and requires that it be supported by research to eliminate potentially adverse effects on land fragmentation and productivity. Tigray has recently started redistributing the land of anybody who has been absent from the village for more than two years and who earned more than a certain amount (US$ 100 per month).

five years and noted that (the question format was identical in all the four survey rounds) concerns about potential halo effects were unfounded.

Second, our theory suggested that higher levels of tenure security would lead to greater voluntary land-related investment, possibly with some lag. We used a dummy for whether households constructed new soil conservation structures (e.g., terraces, soil or rock bunds, and hedgerows) or repaired existing ones at the plot level, as well as for the number of hours spent on conservation, to measure such investment. Unfortunately, this variable was only included in the last two survey rounds.

Third, at least in the case of Amhara, possession of a certificate should have made it easier to rent land, but—except for general equilibrium effects at the village level—it did not affect the extent of renting in. We used a dummy for the type or net rental market participation and the amount of land transacted through such markets as the relevant indicator to ascertain impacts of land certification on participation. Other impacts (e.g., those on allocative efficiency and overall productivity) transcended the scope of this paper and should be the subject of a separate investigation.

1.3 Program Characteristics and Qualitative Evidence on Impact

In one of the largest land registration programs in the world, three of Ethiopia's four main regions have, over the last five years, registered more than 20 million parcels of rural land to some 6 million households.[4] Despite the speed of the program, the quality of the certification process—measured by the share of cases where conflict could not be resolved and precluded issuance of a certificate—was high; certificates could not be issued in only 5 percent of cases, compared to 20 percent in other titling projects. Moreover, at less than US$ 1 per parcel (Deininger et al. 2008), the cost of Ethiopia's certification program is an order of magnitude lower than the $20–$60 per parcel for traditional titling reported in the literature (Burns 2007). In fact, even low-tech approaches that only issued certificates in West Africa were estimated to cost $ 7–10 per parcel (Lavigne-Delville 2006).

[4] Tigray implemented a similar program in 1998. The size of its program is similar to Vietnam's program (1993–2000), which awarded 11 million certificates, and Thailand's issuance of 8.7 million titles in 1980–2005. Tigray's program also compares favorably to other land administration programs, such as the 2.7 million titles (1.2 million urban and 1.5 million rural) issued in Peru in 1992–2005, and the 1.8 million titles issued in Indonesia since 1996.

Under the general process adhered to (with some regional variations), certification is initiated by a team of experts from the wereda that guides the process from a village meeting to the election of an independent village land use and administration committee (LAC).[5] The LAC then assumes responsibility for systematic adjudication of rights—physically, in the field—as a public process with the presence of neighbors. Although LAC members repeatedly emphasized the demanding nature of their task, this feature is critical to ensure transparency, e.g., in identifying communal areas and reducing the scope of errors that could arise from using land records that may not be up to date. The field adjudication process, which may rely on the assistance of village elders to resolve conflicts, concludes with the issuance of a preliminary registration certificate that identifies the size and the adjoining neighbors for each holder's plot(s). Results are then displayed in public and entered into registry books; copies are also kept at both the kebele and wereda levels. Then, certificates with pictures of the land holders (husband *and* wife where the couple has joint ownership), are issued. The certificates include space for maps, but spatial information is not included, except in pilot locations, to keep costs down; it is expected to be added in a second stage.

Qualitative evidence suggests that decentralized, participatory, and transparent implementation; issuance of certificates rather than titles; and a focus on gender equality helped the program avoid some of the problems described in the literature on land titling in Africa. A nationwide survey highlighted evidence that access to information or certificates was not biased against women or the poor. Moreover, the process was generally implemented as planned. In particular, public meetings were held before and during the certification process, land use committees were elected and represented most of the sub-kebeles, and adjudication relied on village elders to resolve disputes and included demarcation in the field with neighbors present. The time allowed for the field process was long enough to sort out conflicts locally, so the program was able to adapt to local conditions and still make rapid overall progress.

An overwhelming majority of households in Ethiopia pointed out the positive impacts of certification on gender relations, land-related investment, rental market participation, and the perceived ability to receive compensation if land was taken away. More than 80 percent were willing to pay for a replacement certificate (if lost), as well as the addition of a map (Deininger et

[5] The fact that the LAC is directly elected in a democratic fashion, rather than being part of the (often politicized) administrative structure, was mentioned repeatedly as an important merit in interviews with groups as well as individual villagers.

al. 2008). Case study evidence pointed in a similar direction: when registration involved identification of borders and systematic conflict resolution, it led to a significant drop in land conflict which, according to local government reports, accounts for 80 percent of rural crime. In one site, the volume of court cases is reported to have been reduced from 20 to at most 2 per week (Adal 2008). In some cases, widows were able to win court cases to hold on to their land, rather than, as dictated by local tradition, have it revert to the husband's family at his death. In polygamous households, the requirement to have separate certificates for all spouses is linked to a reduction in (reported) polygamy. Even male farmers acknowledged that joint titling increased their wives' willingness to work and invest as official co-owners. Households in areas threatened by urban expansion are reported to be particularly eager to get certificates that could help them substantiate their claims for compensation, if their land is taken for urban expansion. In fact, observers linked the ability to use certificates to insist on compensation to the emergence of innovative, in-kind compensation arrangements in a number of peri-urban areas.

2. Data, Descriptive Evidence, and Econometric Approach

This section describes the data underlying our empirical evidence and the sequence of program implementation in treated and control villages as a basis for tracking key indicators for hypothesized program impacts. These comparison groups and a phased-in implementation allowed us to apply a difference-in-difference method to estimate the impact of land certification on the outcome variables of interest.

2.1 Data Sources and Program Implementation

To test program impacts, we used data from four rounds of a panel survey of rural households conducted in 1999, 2001, 2004, and 2007 in the East Gojjam zone of Amhara region, in villages which were aided by a SIDA-supported rural development project.[6] In each round, the survey[7] included information on some 900 randomly selected households and more than 4,000

[6] The East Gojjam zone was selected on purpose to represent surplus-producing areas of the region. The districts and the villages in each district were also selected based on similar criteria, while the households in each village were selected randomly.

[7] The survey was undertaken by the Department of Economics of Addis Ababa University, in collaboration with University of Gothenburg (Sweden), Ethiopian Development Research Institute (EDRI), and the World Bank.

plots cultivated by them.[8] The fact that the first three rounds of the survey covered the period before certification started, and that some of the villages had been certified at the time of the fourth round, allowed us to use a difference-in-difference strategy together with a phased-in implementation. This was possible because, in some villages, certification had been completed 12 months or more before the fourth round of the survey, thus affecting investment and land market participation decisions. As other project components were available in all villages, we were not concerned that time-varying factors might affect villages differently and thus bias our estimates. This was supported by the fact that, before the program, outcome variables moved in parallel in the villages.

Our strategy was conservative in two ways. First, at the time of the fourth round of our survey, all of the villages had received information about the certification program. Households in villages, which we classified as "non-certified" (some of them had already received a certificate at the time of the survey), may well have adjusted their behavior in anticipation of future program participation. This implied that estimates of program impacts from these villages would be a lower bound of the true effect. Second, we defined the intervention at the village rather than the household level, so our "treated" category included households which, for a number of reasons (mainly conflict that could not be resolved or certificates issued late due to delays or lack of photos), did not receive a certificate. This again exerted a downward bias on the estimated effects of certification under reasonable assumptions.

Table 1 illustrates patterns of program implementation for the seven villages (kebeles) in three districts (weredas) in our survey. First, we noted that the program was distinctly phased in by the wereda administration at their discretion. With the exception of one control village (Telma), the program was introduced in February 2003–2004 in our treated villages, compared to May 2005–September 2006 in the control villages. It then took an average of 11 months to complete registration and another five months for certificates to be issued. By comparison, three of the control villages had completed registration and two had started issuing certificates at the time of the survey. In the control villages that had started certification, the process commenced some 15 months later than the treated ones. This delay in program introduction provided an identification strategy for our empirical analysis. Apart from the later start, the process was

[8] Information from one of the sampled villages is available only in the last two rounds because it was added to the sample during the third round. For production information, the reference period was the main agricultural season (*meher*, i.e., from June–February) of 1998–99, 2000–2001, 2003–2004, and 2006–2007.

identical, with the same number of LAC members and village meetings, and did not show any significant differences between the two groups of villages.

Table 1. Program Characteristics by Village

	Certificates issued 12 months before survey?						
	No				Yes		
District (wereda) name	Gozamin		Enemay		Machakel		Gozamin
Village (kebele) name	Kebi	Wolkie	Telma	S. Debir	Amanuel	D. Elias	A. Gulit
Size of kebele, in hectares	630	2670	1964	2560	4373	1790	2172
Number of households	1094	1050	1464	1275	1151	906	890
Date program introduced	May 2005	Sep 2006	Oct 2003	Jun 2005	Feb 2004	Feb 2004	Feb 2003
Date registration competed	Dec 2005	NC	Aug 2006	Dec 2006	Jun 2004	Jul 2004	May 2005
Start of certificate distribution	Aug 2006	NS	Sep 2006	NS	Feb 2005	Feb 2005	Jun 2005
Number of LAC members	15	20	21	35	14	14	18
Training days for LAC members	3	5	8	8	9	4	6
Number of village meetings	4	4	6	2	5	3	3

Notes: NC = Not completed at the time of the survey. NS = Not started at the time of the survey.

Source: Authors' computation from AAU/Gothenburg/WB survey, 1999–2007.

The household-level data on program characteristics in Table 2 reinforces this: 85 percent of households in villages issuing certifications, and 78 percent in the control villages, attended an average of 3.5 public information meetings; and 85 percent and 68 percent, respectively, thought they were well informed about the program. At the time of the survey, 87 percent of households in treated villages had received a certificate, which they held for an average of 17 months, compared to 36 percent and 8 months, respectively, in the control villages; 77.5 percent in treated villages and 2.3 percent in control villages held their certificates longer than 12 months.

Plot-level data in Table 2 show some difference in implementation across villages. Almost all of the plots (92 percent) in treated villages were measured (95 percent with rope) in the field with more than half of the neighbors present. However, in 60 percent—and between one-third and one-half in 20 percent of cases—the field was measured in less than two-thirds of

the registered plots in the control villages. Some 35 percent of these cases involved eye estimation only, and more than half or more than one-third of neighbors were present in 35 percent and 11 percent of the control villages.

Table 2. Program Characteristics at Household and Plot Levels

	Certificates issued?	
	No	**Yes**
Household-level data		
A member of the household attended public information meetings	0.78	0.85
Number of meetings attended	3.50	3.60
Felt well informed about the program	0.68	0.85
Had landholding certificate	35.55	87.47
Number of months since ownership certified	8.07	17.15
Plot-level data		
Plot area determined in the field	0.64	0.92
Plot area determined at kebele office, referring to previous records	0.35	0.05
Plot measured using tape and rope, if determined in the field	0.65	0.95
Plot measured using eye estimation, if determined in the field	0.35	0.00
More than half of the neighbors present when measured	0.35	0.59
Half or less than half of the neighbors present when measured	0.11	0.20
Plot has a certificate	0.30	0.75
Number of months since plot certified	8.19	16.93
Plot jointly certified by household head and spouse	0.83	0.77
Number of households	481	359
Number of plots	2369	2143

Source: Authors' computation from AAU/Gothenburg/WB survey, 1999–2007.

Table 3. Household Characteristics by Treatment Category over Time

	No certificate				With certificate			
	1999	**2002**	**2004**	**2007**	**1999**	**2002**	**2004**	**2007**
Total owned plot(s), in hectares	1.34	1.35	1.61	1.47	1.57	1.59	1.89	2.06
Owned land per adult equivalent units, in hectares	0.36	0.34	0.36	0.32	0.37	0.34	0.36	0.38
Percent of good quality plot(s)	0.36	0.32	0.31	0.44	0.36	0.33	0.28	0.39
Number of dependents	2.50	2.59	2.70	2.68	2.83	2.97	2.84	2.83
Number of adult males	1.24	1.41	1.65	1.79	1.41	1.54	1.71	1.95
Number of adult females	1.21	1.33	1.58	1.68	1.36	1.53	1.71	1.93
Number of oxen	1.20	1.20	1.17	1.29	2.22	1.98	1.99	2.06
Value of livestock (ETB)	1,628	1,670	1,771	1,962	2,883	2,839	2,888	3,081
Value of other animals (ETB)	857	924	1,026	1,124	1,432	1,309	1,591	1,737
Corrugated iron roof	0.55	0.60	0.71	0.79	0.61	0.70	0.86	0.91
Age of household head (years)	44.17	45.66	48.08	49.81	44.87	46.67	48.72	50.46
Female-headed household	0.13	0.12	0.15	0.17	0.10	0.07	0.17	0.19
Household head can read and write	0.39	0.38	0.35	0.27	0.48	0.48	0.42	0.43
Value of crop output per hectare (ETB)	1,926	634	2,596	3,283	2,564	880	2,187	2,804
Number of households	462	463	475	477	229	233	347	356

ETB = Ethiopian birr

Source: Authors' computation from AAU/Gothenburg/WB survey, 1999–2007.

To illustrate the evolution of key dependent variables, Table 3 displays key household characteristics by participation status and year for the 356 and 477 households in treated and control villages, respectively. While there are few differences in the age or sex of household heads, systematic differences at the household-level point to the importance of controlling for household heterogeneity. For example, the treated villages had somewhat higher endowments of land per household (but not per capita), higher levels of human capital as proxied by literacy of the household head, and more livestock and other animals, and used greater amounts of fertilizer per hectare. Although the villages are some distance from each other, some time-varying factors (e.g., a drought in 2002) appeared to have affected both villages in similar ways.

Attributes for the 3,972 and 4,699 plots in treated and control villages, respectively, averaged over all periods as reported in Table 4, suggested that the mean plot size was about 0.3

hectares and had been in the possession of its current owner for about 21 years. For 4 percent, irrigation was rare in both villages and, even though there were small differences in the subjective land attributes (land quality and slope), there were no statistically significant differences between villages with flat and gently sloped plots or with good and medium quality plot soil.

Table 4. Plot Level Characteristics by Treatment Category

	No certificate	With certificate
	2004–2007	2004–2007
Plot size, in hectares	0.31	0.34
Number of years plot possessed	20.84	21.44
Good soil quality	0.38	0.35
Medium soil quality	0.37	0.43
Flat plot	0.57	0.72
Gently sloped plot	0.34	0.23
Irrigated plot	0.04	0.04
Number of observations (plots)	4699	3972

Source: Authors' computations from AAU/Gothenburg/WB survey, 1999–2007.

2.2 Outcome Variables

Levels and changes over time in the outcome variables of interest, as displayed in Table 5, were the first check of our hypotheses. We noted that in both treated and control villages perceptions of tenure insecurity in 1999 were, indeed, very high. Three-fourths or more of land holders (78 percent in treated villages and 75 percent in control villages) expected their land holdings to change due to administrative intervention, possibly because the 1997 redistribution was still fresh in their minds. Over the next five years, i.e., before the certification program, this percentage declined to 38 percent in both treated and control villages. Between 2004 and 2007, i.e., during the period of program implementation, the perception in tenure insecurity diverged—a drop to 24 percent in treated villages versus a slight increase to 39 percent in control villages. Disaggregation revealed that the share expecting to increase their holdings dropped from 19 percent to 4 percent in treated villages and to 11 percent in control villages, whereas those expecting a decrease in their holdings remained unchanged in treated villages, but increased from 19 percent to 28 percent in control villages. Because a generalized expectation of an increase in

holding size could exert considerable pressure on policy makers, both of these outcomes may be relevant for tenure security. While less robust, a plot-level variable asking land owners whether they were concerned about land conflict (introduced only in the last round) also pointed to significantly higher levels of tenure insecurity in the control villages (20 percent), as compared to the treated villages (14 percent) in a simple cross-section.

Table 5. Outcome Variables by Treatment Category

	None				With certificate			
	1999	**2002**	**2004**	**2007**	**1999**	**2002**	**2004**	**2007**
Expectations of land redistribution and conflict in the next five years (household level)								
Expect change in holdings	0.75	0.62	0.38	0.39	0.78	0.64	0.38	0.24
Expect an increase in holdings	0.55	0.45	0.19	0.11	0.55	0.36	0.18	0.04
Expect a decrease in holdings	0.20	0.17	0.19	0.28	0.23	0.27	0.19	0.19
Concerned about land conflict				0.20				0.14
Land-related investment over the last 12 months (plot level)								
Repaired conservation structure or built new one			0.36	0.24			0.12	0.25
Number of hours spent on conservation			8.22	5.51			2.26	4.38
Built new conservation structure			0.10	0.08			0.07	0.10
Plot has conservation structure			0.44	0.34			0.22	0.32
Participation in land rental market (household level)								
Rented-out plot(s)	0.24	0.21	0.29	0.34	0.17	0.15	0.26	0.33
Area rented out, in hectares	0.20	0.21	0.28	0.34	0.14	0.16	0.32	0.45
Rented-in plot(s)	0.37	0.26	0.20	0.36	0.49	0.31	0.36	0.45
Area rented in, in hectares	0.25	0.19	0.15	0.29	0.29	0.19	0.27	0.44
Number of households	462	463	475	477	229	233	347	356
Number of plots			2284	2415			1886	2086

Notes: Empty cells imply that no data was available.

Source: Authors' computations from AAU/Gothenburg/WB survey, 1999–2007.

Although the pre-program share of plots that had investment or repairs and the amount of time spent on such investments were significantly higher in control villages, compared to treated villages, the difference in both narrowed significantly and the construction of new conservation structures even reversed, consistent with the hypothesis that certification did affect investment

incentives in the expected direction. For example, a significant decline in the share of households which voluntarily constructed new conservation structures or repaired existing ones (from 36 to 24 percent), and the number of hours spent (from 8.2 to 5.5 hours) in control villages contrasted with an equally large increase (from 12 to 25 percent, and from 2.3 to 4.4 hours, respectively) of this variable in treated villages. We observed similar narrowing or reversal in the share of plots with any type of conservation structure (from 44 to 34 percent in control villages, and from 22 to 32 percent in treated villages), and in the share of households which constructed new conservation structures during the last 12 months (from 10 to 8 percent and from 7 to 10 percent in control and treated villages, respectively).

The share of landlords and mean area rented out was consistently higher in treated villages, compared to control villages, before land use certificates were distributed, a difference that narrowed after 2004. After certification, we noted a clear increase in rental market participation in both areas. While the increase in renting out (7 percent versus 5 percent) was marginally higher in the treated group as compared to the control group, the opposite was true for renting in, implying that more rigorous evidence is needed to assess whether certification had a significant impact on land market participation or whether, possibly as a result of the rather restrictive policy regime, no such impact materialized.

2.3 Econometric Approach

To identify possible impacts of the certification program, we applied a difference-in-difference approach that compared the difference between pre- and post-program household- and plot-level outcome variables in certified and non-certified villages. This could provide us with an unbiased estimate of program effects if unobserved differences between treated and control villages did not affect changes in outcome variables over time. This seemed reasonable—given that treated and control villages were located in the same zone and were exposed to the same set of interventions from a SIDA-financed rural development program but entered the certification program at different times—due to capacity limitations of the weredas (which implied the need to phase in program start-up). The fact that other characteristics, as well as outcome variables before the program, evolved in a similar fashion in both sets of villages added credence to this.

To estimate program impacts on perceived tenure security, we used data from all four rounds to estimate:

$$y_{it} = \lambda_t + \tau w_{it} + \mathbf{x}_{it}\boldsymbol{\gamma} + c_i + u_{it}, \qquad (1)$$

where y_{it} is a dummy variable that takes a value of 1 if household *i* expects an increase (or decrease) of its landholdings due to administrative intervention in the five years following the survey; w_{it} is the policy variable of interest (1 for post-treatment period if household *i* resides in treated village, and 0 otherwise); $\mathbf{x}_{it}$ is a vector of household controls that include the household head's age, gender, education, and assets (number of oxen, value of other livestock, roof material) and relative land size (defined as the amount of owned land per adult equivalent relative to the median of this variable in the village); c_i captures household-specific unobserved effects; λ_t is a full set of time dummies; and u_{it} is an IID (independently and identically distributed) error term. The null hypothesis that certification increases tenure security would imply that τ is negative and significant. A random effects probit model is appropriate if c_i is normally distributed with mean zero and variance σ_u^2 and independent from all right-hand side variables. As this may be unrealistic, we also used Chamberlain's random effects probit (Chamberlain 1980; Wooldridge 2001), which relaxes this by allowing correlation between c_i and the means of time-varying covariates at the household level, according to:

$$c_i = \psi + \bar{\mathbf{x}}_i \boldsymbol{\xi} + a_i,$$

where $\bar{\mathbf{x}}_i$ is the vector of average of time-varying household covariates for household *i* over all periods and a_i is an error term. All that is required is that $\mathbf{x}_{it}$ and a_i are independently and normally distributed with mean zero and variance σ_a^2. Adding $\bar{\mathbf{x}}_i$ as an explanatory variable to equation (1) in each time period allows estimation of the parameters λ, τ, $\boldsymbol{\gamma}$, ψ, $\boldsymbol{\xi}$, and σ_a^2 in a standard random effects probit model.

In contrast to the household-level analysis in equation (1), impacts of certification on land-related investment were assessed at the plot level. Dependent variables for land-related investment take the value of 1 if the plot received soil or water conservation investment or if the household spent some number of hours working on such investment during the past 12 months. Using the notation introduced above, the random effects probit or Tobit (depending on the choice of the dependent variable) model for land-related investment on plot *j* by household *i* is specified as:

$$y_{jit} = \psi + \lambda_t + \tau w_{it} + \mathbf{x}_{it}\boldsymbol{\gamma} + \mathbf{p}_{jit}\boldsymbol{\delta} + \bar{\mathbf{x}}_i\boldsymbol{\xi} + a_i + u_{jit}, \qquad (2)$$

where the only difference is the inclusion of $\mathbf{p}_{jit}$, a vector of plot-level characteristics that includes size, soil quality, slope, and length of possession plus a plot-specific error term u_{jit}. The hypothesis that certification increases incentives for land-related investment translates into $\tau >$

0. As earlier rounds did not include comparable information, our analysis was limited to the last two rounds.

Similar random effects probit and Tobit specifications for participation on either side of the rental market and the amount of land transferred, respectively, are estimated for our rental market outcomes. Because, for example, due to non-convex transaction costs, rental market participation may be persistent over time (Holden et al. 2008). We also estimated a specification that allowed for state dependence of rental market participation. The implied need to include the lagged dependent variable on the right-hand side of equation (1) gives rise to a nonlinear dynamic model that may suffer from the initial condition problem, i.e., the correlation between the unobserved effect and the initial observation of the dependent variable. To account for this, the distribution of the unobserved effect was modeled conditional on the initial observation, in addition to the time-varying household-level covariates (Wooldridge 2005). The reduced form equation to be estimated is:

$$y_{it} = \psi + \lambda_t + \tau w_{it} + \mathbf{x}_{it}\boldsymbol{\gamma} + \rho y_{i,t-1} + \xi_0 y_{i0} + \bar{\mathbf{x}}_i\boldsymbol{\xi} + a_i + u_{it}, \quad (3)$$

where y_{it-1} is the lagged dependent variable and y_{i0} is the first realization of the dependent variable. The parameters in equation (3) are estimated using standard random effects probit or Tobit, depending on the type of dependent variable. As this procedure requires data from at least four periods, we were forced to drop one of the villages (A. Gulit), which was added to the survey during the third round. The hypothesis of a positive impact of certification on the propensity to rent out land translates into $\tau > 0$ in the probit and Tobit equations for renting out or the area rented out.

3. Key Results

Results corresponding to the three main hypotheses suggest that, despite the limited time elapsed since its completion, certification had a positive economic impact and improved tenure security, investment, and supply of land to the rental market. Even conservative estimates and a rough calculation of monetary benefits point to a positive and large and positive cost-benefit ratio.

3.1 Tenure Security

Results from probit estimation of equation (1) to identify determinants of higher perceived risk of land loss or gain through administrative redistribution in the next five years are

reported in Table 6 for the simple (columns 1 and 3) and Chamberlain specifications (columns 2 and 4). In all cases, the results suggest that households in the treated villages had higher levels of tenure security, i.e., expected significantly less administrative intervention. Marginal effects suggest that, consistent across the two specifications, certification led to a decrease of about 14 percentage points in the share of those expecting to gain and about 9 percentage points in the share of those expecting to lose from land redistribution. Certification did not eliminate fears of land redistribution, but helped reduce it from levels that were very high even by global standards.

Table 6. Impact of Certification on Perceived Land Tenure Security: Marginal Effects from the Probit Model

	Expect an increase		Expect a decrease	
	Simple	**Chamberlain**	**Simple**	**Chamberlain**
Land use certificates issued	-0.135***	-0.135***	-0.093***	-0.095***
	(-4.12)	(-4.13)	(-4.34)	(-4.43)
Relative plot size	-0.106***	-0.106***	0.040***	0.041***
	(-7.33)	(-7.31)	(4.11)	(4.26)
Share of good quality land	0.066**	0.070***	-0.055**	-0.055**
	(2.52)	(2.66)	(-2.33)	(-2.35)
Number of dependents in household	-0.011	-0.001	0.014**	0.019
	(-1.59)	(-0.05)	(2.38)	(1.57)
Number of adult males in household	-0.026**	0.008	0.018**	0.027
	(-2.47)	(0.38)	(2.15)	(1.51)
Number of adult females in household	-0.019*	-0.033	0.013	0.025
	(-1.70)	(-1.54)	(1.39)	(1.43)
Number of oxen	-0.004	0.001	0.011	-0.005
	(-0.49)	(0.08)	(1.63)	(-0.52)
Value of other animals x 10^{-3} (ETB)	0.006	0.008	-0.002	0.002
	(1.21)	(1.45)	(-0.72)	(0.52)
Corrugated iron roof on house	-0.066***	-0.019	0.052***	0.031
	(-3.01)	(-0.56)	(2.90)	(1.04)
Age of household head (years)	-0.015***	-0.016***	0.006*	0.010***
	(-3.73)	(-3.70)	(1.77)	(2.62)
Age of household head squared	0.000***	0.000***	-0.000	-0.000
	(2.76)	(2.75)	(-1.30)	(-1.39)

	Expect an increase		Expect a decrease	
	Simple	**Chamberlain**	**Simple**	**Chamberlain**
Female-headed household	-0.032	0.021	-0.049**	-0.062
	(-1.16)	(0.35)	(-2.13)	(-1.44)
Household head can read and write	-0.023	0.013	0.032*	0.019
	(-1.22)	(0.41)	(1.84)	(0.66)
Year 2002	-0.093***	-0.098***	-0.012	-0.021
	(-4.85)	(-4.96)	(-0.57)	(-0.96)
Year 2004	-0.243***	-0.253***	-0.049**	-0.070***
	(-14.70)	(-13.34)	(-2.38)	(-3.04)
Year 2007	-0.320***	-0.333***	0.052*	0.012
	(-17.17)	(-15.53)	(1.92)	(0.38)
Number of observations	3042	3042	3042	3042
Number of households	882	882	882	882
Log likelihood	-1467.109	-1461.588	-1510.578	-1502.232
Chi-squared	518.218	517.908	111.531	126.756
Rho	0.070	0.070	0.049	0.046
Sigma u	0.274	0.274	0.227	0.220
Likelihood-ratio test of rho = 0	-1469.227	-1463.689	-1511.736	-1503.235
Chibar2	4.237	4.204	2.315	2.006

Notes: The dependent variable is whether the household expects an increase or decrease in landholdings over the coming 5 years due to land redistribution and reallocation.

The Chamberlain specification includes the mean value of the time-varying household-level variables (Chamberlain 1980), coefficients for which are not reported. A constant term is included in all the regressions.

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

ETB = Ethiopian birr

Coefficients on the time trend were highly significant and of large magnitude for gains, but were less significant for land losses. This is in line with descriptive evidence that pointed to a reduction over time in the share of households that expected their holdings to increase rather than those that expected to lose land. Signs for coefficients on other variables were largely as expected. Older household heads were more likely to expect land loss, consistent with the notion that administrative measures aim to redistribute productive assets among generations. A higher per-capita land endowment, relative to the village median, increased the perceived likelihood of

land loss and reduced the likelihood of gain, as expected in a system that aims to distribute a limited amount of communal land as equitably as possible among rural residents.

The opposite was true for larger shares of good quality land, which could suggest that officials were either not good at assessing land quality or did not take it into account in making their decisions. Higher endowments of non-land assets, oxen, education, or possession of an iron roof had—with the possible exception of the roof—little impact on the perceived threat of land loss or gain, suggesting that the officials' objective was neither a general redistribution of assets nor a maximization of productivity (e.g., a desire to substitute for land markets by giving land to better-endowed households). The significance of coefficients on gender-related variables, such as the sex of the household head and the number of adult males in the simple specification, disappeared when the Chamberlain method was used. This suggested that once we controlled for households' history, these variables no longer affected tenure security. Interactions between the treated dummy and variables, such as the amount of land owned, total assets, and gender of household head, were consistently insignificant. While this may have been a result of the limited number of observations, it provided little support to the notion that certification-induced tenure security effects were differentiated by wealth or gender.

3.2 Land-Related Investment

Table 7 reports coefficient estimates as marginal effects from probit and Tobit models for new investment in, or repairs to, conservation structures during the last 12 months for the simple (columns 1, 2, 4 and 5) and Chamberlain specifications (columns 3 and 6). Results consistently pointed to a statistically significant and economically meaningful certification impact with an estimated average treatment effect of some 30 percentage points on the propensity to invest in soil and water conservation measures and more than double the number of hours spent on such activities.

Although the initial levels were low, Table 7 shows a large impact of certification on plot conservation investment, compared to other studies in the literature. Given that certification was only concluded recently, such investment will not yet have affected the agricultural production reported in the survey.

To obtain a proximate measure of the size of the investment impact, we estimated a household fixed-effect production function with a dummy for the presence of a functioning conservation structure. (See Table 1 in the appendix for results.) The results suggested that such a structure increased output by about 9 percentage points, implying that, with a mean annual

Table 7. Impact of Certification on Propensity and Magnitude of Investment in Soil and Water Conservation: Marginal Effects

	Repairs and new investment last 12 months: Probit models			Hours spent on repairs and new investment in last 12 months: Tobit models[a]		
	I	II	Chamberlain	I	II	Chamberlain
Land use certificates issued	0.268***	0.302***	0.291***	1.279***	1.439***	1.347***
	(9.92)	(10.70)	(10.32)	(9.90)	(10.79)	(10.11)
Plot size, in hectares	0.019	0.057***	0.061***	0.205*	0.496***	0.523***
	(1.26)	(3.58)	(3.80)	(1.84)	(4.05)	(4.32)
Number of years possessed	-0.000	0.001	0.000	0.007*	0.011***	0.009**
	(-0.08)	(1.14)	(0.61)	(1.88)	(2.94)	(2.38)
Good soil quality	-0.014	-0.013	-0.013	-0.073	-0.051	-0.056
	(-1.18)	(-1.14)	(-1.15)	(-0.82)	(-0.58)	(-0.64)
Medium soil quality	-0.013	-0.012	-0.013	-0.090	-0.085	-0.098
	(-1.18)	(-1.17)	(-1.23)	(-1.06)	(-1.01)	(-1.19)
Flat plot	-0.129***	-0.121***	-0.121***	-1.075***	-1.023***	-1.002***
	(-6.02)	(-5.92)	(-5.89)	(-8.44)	(-8.14)	(-8.09)
Gently sloped plot	-0.025	-0.025*	-0.023	-0.261**	-0.245**	-0.213*
	(-1.54)	(-1.69)	(-1.57)	(-2.20)	(-2.09)	(-1.84)
Irrigated plot	0.017	0.019	0.019	0.101	0.091	0.087
	(0.72)	(0.86)	(0.83)	(0.60)	(0.55)	(0.53)
Total owned plot(s), in hectares		-0.058***	-0.062***		-0.335***	-0.357***
		(-6.81)	(-7.24)		(-6.53)	(-7.06)
Value of livestock x 10^{-3} (ETB)		-0.003*	-0.003*		-0.017*	-0.012
		(-1.91)	(-1.86)		(-1.86)	(-1.01)
Corrugated iron roof on house		0.017	-0.035		0.122	-0.355*
		(0.92)	(-1.21)		(0.98)	(-1.91)
Number of dependents in household		0.009	0.024***		0.089***	0.248***
		(1.41)	(2.59)		(2.61)	(3.78)
Number of adult males in household		0.013	0.015		0.080*	0.038
		(1.62)	(1.26)		(1.76)	(0.42)
Number of adult females in household		0.001	0.018*		-0.032	0.093
		(0.17)	(1.66)		(-0.68)	(1.16)

Age of household head (years)		0.006	0.007		0.055**	0.038
		(1.38)	(1.50)		(2.32)	(1.54)
Age of household head squared		-0.000*	-0.000***		-0.001***	-0.001***
		(-1.65)	(-2.65)		(-2.64)	(-3.04)
	Repairs and new investment last 12 months: Probit models			**Hours spent on repairs and new investment in last 12 months: Tobit models**[a]		
	I	**II**	**Chamberlain**	**I**	**II**	**Chamberlain**
Female-headed household		-0.042**	0.068		-0.458***	0.510*
		(-2.05)	(1.47)		(-3.14)	(1.77)
Household head can read and write		-0.010	0.010		-0.093	0.061
		(-0.67)	(0.56)		(-0.97)	(0.46)
Year 2007	-0.067***	-0.065***	-0.053***	-0.350***	-0.357***	-0.260***
	(-6.08)	(-5.63)	(-4.41)	(-4.56)	(-4.45)	(-2.93)
Number of observations	8671	8671	8671	8671	8671	8671
Number of households	856	856	856	856	856	856
Log likelihood	-3662.079	-3625.047	-3596.866	-9747.794	-9713.545	-9686.255
Chi-squared	294.122	348.923	387.019	293.521	361.972	419.962
Rho	0.672	0.656	0.647	0.619	0.603	0.594
Sigma_u	1.432	1.380	1.354	7.439	7.175	7.023
Likelihood-ratio test of rho = 0	-4760.517	-4613.590	-4555.439			
Chibar^2	2196.876	1977.085	1917.145			

[a] The dependent variable is log ((number of hours spent on repairs and new investment last 12 months + 0.01)/0.01).

Notes: The Chamberlain specification includes the mean value of the time-varying household level variables (Chamberlain 1980), coefficients for which are not reported. A constant term is included in all the regressions.

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

output of ETB 3,300,[9] the investment-induced certification impact would amount to ETB 87 per hectare (0.29*0.09*3,330). Even if we assumed that half of the investment actually involved repairs to existing structures and was discounted at 10 percent, our conservative estimate implied that the increment in output resulting from certification-induced investment in the first year post

[9] ETB = Ethiopian birr; it was exchanged at US$ 0.125 at the time of the last survey.

certification alone would be sufficient to cover program costs (US$ 1 per plot or $3.20 per hectare).

Coefficients on other variables suggested that the propensity for land-related investment increased with plot size, but decreased in overall holding size. This is consistent with the notion that the presence of some fixed-cost element increased payoffs from investment in conservation for larger fields, but that for larger holdings, there was increased competition among plots for investment. It also declined with time and gender of the household head, but increased marginally with the number of dependents in the Chamberlain specification. The propensity to undertake investment was significantly lower on flat plots, consistent with the fact that such plots are less prone to erosion and land degradation than hilly plots and implying less need to adopt soil conservation measures. As the investments considered did not involve any cash outlays, there was little reason to expect impacts to be differentiated by wealth, as indeed was suggested by the consistent lack of significance of the certification dummy's interaction with the various measures of wealth (not reported) throughout.

3.3 Rental Market Participation

To test whether, as predicted, certification affected the propensity to rent out, but left the demand-side of the market unaffected, Tables 8 and 9 present results from probit and Tobit estimates of equation (3). In both cases, columns 1–3—which contain, respectively, the simple and the Chamberlain specifications without dynamic effects—strongly support our hypothesis. While the treatment variable was weakly significant in the simple specification, the dynamic (columns 3 and 6 in both tables) suggested a strong positive state of dependence in participation decisions and the amount of land transacted on both sides of the rental market. Such path dependence implies that policy interventions, which affect rental market participation, will have effects on households' trajectories in the long term. Estimated marginal effects suggested that certification increased the propensity to rent out by 13 percentage points and the amount of land rented out by about 9 points, or 1/10 of a hectare for the average farm in the sample. Estimated impacts for renting in were consistently insignificant.

Socio-cultural norms and factor market imperfections make cultivation of land by female household heads extremely rare, implying that they either rent out their land or—often because of insecure tenure—leave it fallow (Adal 2005). To the extent that they allow productive use of plots left uncultivated, certification-induced rental market effects would enhance productivity as well as equity. Higher levels of tenure security could affect productivity in a number of ways, e.g., by allowing landlords to negotiate longer-term contracts or select more productive tenants

Table 8. Certification Impact on Rental Market Participation: Marginal Effects from Probit Models

	Rented out			Rented in		
	Simple probit	**Chamberlain**		**Simple probit**	**Chamberlain**	
Land use certificates issued	0.097*	0.134**	0.126**	-0.002	-0.014	-0.010
	(1.82)	(2.35)	(2.38)	(-0.04)	(-0.32)	(-0.23)
Total owned plot(s), in hectares	0.062***	0.065***	0.055***	-0.099***	-0.103***	-0.091***
	(4.98)	(5.30)	(4.77)	(-5.75)	(-5.88)	(-5.81)
Share of good quality plots	-0.001	-0.016	-0.032	-0.061	-0.050	-0.053
	(-0.03)	(-0.37)	(-0.74)	(-1.34)	(-1.14)	(-1.19)
Number of dependents in household	-0.007	-0.006	0.001	0.016	-0.029	-0.019
	(-0.66)	(-0.25)	(0.04)	(1.31)	(-1.17)	(-0.79)
Number of adult males in household	-0.025	-0.028	-0.031	-0.010	-0.061*	-0.044
	(-1.63)	(-0.78)	(-0.87)	(-0.62)	(-1.71)	(-1.24)
Number of adult females in household	0.024	0.006	0.021	-0.001	-0.015	-0.009
	(1.48)	(0.19)	(0.68)	(-0.05)	(-0.49)	(-0.27)
Number of oxen	-0.181***	-0.080***	-0.086***	0.134***	0.077***	0.089***
	(-9.93)	(-3.54)	(-3.87)	(7.76)	(3.39)	(3.91)
Value of other animals x 10^{-3} (ETB)	-0.018**	-0.002	0.003	0.014***	0.011	0.008
	(-2.50)	(-0.24)	(0.35)	(2.65)	(1.61)	(1.01)
Corrugated iron roof on house	-0.088**	-0.057	-0.078	0.113***	0.104**	0.114**
	(-2.00)	(-0.87)	(-1.17)	(3.24)	(2.10)	(2.15)
Age of household head (years)	-0.005	-0.012*	-0.011*	-0.001	0.004	0.007
	(-0.75)	(-1.69)	(-1.65)	(-0.15)	(0.41)	(0.85)
Age of household head squared	0.000*	0.000*	0.000*	-0.000	0.000	-0.000
	(1.70)	(1.72)	(1.69)	(-0.92)	(0.02)	(-0.52)
Female-headed household	0.373***	0.143	0.225**	-0.204***	-0.148**	-0.177***
	(5.87)	(1.39)	(2.19)	(-7.70)	(-2.53)	(-2.61)
Household head can read and write	0.067*	0.082	0.090	-0.019	0.019	0.038
	(1.81)	(1.41)	(1.54)	(-0.57)	(0.37)	(0.74)
Initial year participation as landlord			0.124***			
			(2.83)			
Lagged participation as landlord			0.332***			

			(7.51)			
Initial year participation as tenant						0.174***
						(5.30)
	Rented out			**Rented in**		
	Simple probit	**Chamberlain**		**Simple probit**	**Chamberlain**	
Lagged participation as tenant						0.273***
						(7.44)
Year 2007	0.086***	0.067**	0.032	0.163***	0.163***	0.171***
	(2.74)	(2.09)	(0.90)	(5.09)	(4.76)	(4.65)
Number of observations	1424	1424	1302	1424	1424	1302
Number of households	736	736	736	736	736	736
Log likelihood	-579.050	-554.254	-462.474	-657.789	-645.424	-553.642
Chi-squared	231.821	212.860	408.046	160.423	157.457	348.339
Rho	0.395	0.424	0.038	0.502	0.502	0.038
Sigma u	0.807	0.857	0.199	1.003	1.005	0.200
Likelihood-ratio test of rho = 0	-591.925	-568.202	-461.949	-680.949	-668.285	-553.291
Chibar2	25.749	27.896	1.050	46.319	45.722	0.701

Notes: The Chamberlain specification includes the mean value of the time-varying household level variables (Chamberlain 1980), but is not reported. A constant term is included in all the regressions.

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

ETB = Ethiopian birr

who are not part of their immediate social network. As virtually all of the land is rented under sharecropping contracts, any such effects would translate directly into improved welfare for female landlords. Although it is beyond the scope of this paper, further study of this issue and non-economic impacts, e.g., female empowerment, would interesting.

Our results also pointed to a significant impact of land endowments on renting out (positive) and renting in (negative), as would be expected if rental markets contribute to equalization of factor input ratios. Total owned plot area had a positive and significant effect in the leasing-out regressions, as compared to a negative and significant effect on the leasing-in regressions. However, the absolute value of the marginal effect of total owned plot(s) on the amount of land rented out or in (Table 9) was less than 1, indicating that rental market participation allowed only partial adjustment toward the desired area of cultivated land (Bliss and Stern 1982).

Table 9. Certification Impact on Size of Land Rented: Marginal Effects from Tobit Models

	Land rented-out			Land rented-in		
	Simple Tobit	**Chamberlain**		**Simple Tobit**	**Chamberlain**	
Land use certificates issued	0.073**	0.088***	0.092***	0.016	0.007	0.020
	(2.30)	(2.77)	(2.83)	(0.65)	(0.29)	(0.78)
Total owned plot(s), in hectares	0.086***	0.086***	0.074***	-0.059***	-0.061***	-0.051***
	(10.88)	(11.07)	(9.54)	(-6.24)	(-6.48)	(-5.45)
Share of good quality plots	0.022	0.013	-0.002	0.003	0.008	0.006
	(0.82)	(0.50)	(-0.09)	(0.10)	(0.31)	(0.25)
Number of dependents in household	-0.010	-0.002	-0.003	0.008	-0.013	-0.017
	(-1.32)	(-0.10)	(-0.23)	(1.14)	(-0.96)	(-1.25)
Number of adult males in household	-0.013	-0.016	-0.027	-0.000	-0.041**	-0.039*
	(-1.33)	(-0.70)	(-1.18)	(-0.03)	(-2.00)	(-1.88)
Number of adult females in household	0.016	0.008	0.016	-0.001	-0.004	-0.003
	(1.53)	(0.41)	(0.83)	(-0.10)	(-0.20)	(-0.17)
Number of oxen	-0.152***	-0.094***	-0.095***	0.075***	0.041***	0.044***
	(-13.29)	(-6.24)	(-6.30)	(8.56)	(3.29)	(3.34)
Value of other animals x 10^{-3} (ETB)	-0.013***	-0.003	0.003	0.011***	0.009**	0.006
	(-2.69)	(-0.50)	(0.52)	(3.71)	(2.10)	(1.37)
Corrugated iron roof on house	-0.055**	-0.054	-0.061	0.069***	0.063*	0.073**
	(-2.15)	(-1.38)	(-1.50)	(2.88)	(1.83)	(2.18)
Age of household head (years)	-0.006	-0.009**	-0.008*	-0.002	0.001	0.002
	(-1.40)	(-2.29)	(-1.79)	(-0.43)	(0.24)	(0.47)
Age of household head squared	0.000***	0.000**	0.000**	-0.000	0.000	-0.000
	(2.61)	(2.32)	(1.99)	(-0.67)	(0.34)	(-0.04)
Female-headed household	0.191***	0.076	0.096*	-0.166***	-0.119**	-0.122**
	(5.47)	(1.42)	(1.68)	(-6.41)	(-2.36)	(-2.47)
Household head can read and write	0.051**	0.063*	0.088**	-0.002	0.002	0.016
	(2.10)	(1.69)	(2.25)	(-0.13)	(0.08)	(0.51)
Initial value of rented-out plot(s), in hectares			0.035			
			(1.57)			
Lag of rented-out plot(s), in hectares			0.082***			
			(3.48)			
Initial value of rented-in plot(s), in						0.112***

hectares						(6.34)
	Land rented-out			**Land rented-in**		
	Simple Tobit	**Chamberlain**		**Simple Tobit**	**Chamberlain**	
Lag of rented-in plot(s), in hectares						0.137*** (8.37)
Year 2007	0.052*** (2.61)	0.047** (2.34)	0.039* (1.81)	0.078*** (4.23)	0.082*** (4.13)	0.077*** (3.50)
Number of observations	1424	1424	1302	1424	1424	1302
Number of households	736	736	736	736	736	736
Log likelihood	-980.509	-960.667	-819.983	-1001.082	-987.542	-863.362
Chi-squared	481.280	523.044	538.654	306.883	329.675	442.059
Rho	0.307	0.326	0.188	0.283	0.289	0.000
Sigma u	0.600	0.606	0.442	0.507	0.506	0.000

Notes: The Chamberlain specification includes the mean value of the time-varying household level variables (Chamberlain 1980), but is not reported. A constant term is included in all the regressions.

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

Our results also pointed to a significant impact of land endowments on renting out (positive) and renting in (negative), as would be expected if rental markets contribute to equalization of factor input ratios. Total owned plot area had a positive and significant effect in the leasing-out regressions, as compared to a negative and significant effect on the leasing-in regressions. However, the absolute value of the marginal effect of total owned plot(s) on the amount of land rented out or in (Table 9) was less than 1, indicating that rental market participation allowed only partial adjustment toward the desired area of cultivated land (Bliss and Stern 1982).

We noted that—contrary to what is found in studies from other countries, but consistent with other evidence from Ethiopia (Deininger, Ali, and Alemu 2008)—rental markets transferred land from relatively resource-poor households (mainly in terms of oxen power), which are often female-headed, to comparatively resource-rich households. Consistent with the notion that imperfect labor markets, together with social and cultural norms, make cultivation of plots by female-headed households difficult (and which is exacerbated by ill-functioning markets for draught animals), the gender of the household head and the number of oxen have a significant impact on the nature and magnitude of rental market transactions. This is estimated to have large

and significant effects (smaller in the Chamberlain specification) that discourage renting out, but encourage renting in.

The significant coefficient on possession of an iron roof in the rent-in equation reinforces this notion, suggesting that there may also be imperfections in other financial markets that make renting in easier for those with more wealth. To the extent that the certification-induced higher propensity to rent out implied greater freedom in the choice of transaction partner, certification could, by allowing women to chose more able partners, have an impact not only on the productivity of rental transactions (and land use in general) but also on the welfare of a vulnerable group. But, this is a topic for future research. At the same time, older households are more likely to rent out and literate households more likely to rent out larger areas of land.

4. Conclusion and Policy Implications

This paper explores whether the land certification program in Amhara in Ethiopia had positive economic impacts and could provide lessons for others. Despite its recent nature (less than ten years) and clear gaps in the local policy environment, we found evidence of significant economic benefits that exceed program costs significantly. Follow-up research to assess non-economic effects of the program—especially on female empowerment, the channels through which specific program effects materialize, the path of their evolution over time, and how benefits are distributed across the population—would be of great interest. More immediately, though, our results give rise to a number of conclusions.

For Ethiopia, the evidence of clear benefits implies that completion of certification is warranted. However, there is a need to revise the institutional set up for this process. For instance, should it continue as is under the Environmental Protection and Land Administration and Use Authority or should it fall under the Ministry of Agriculture and Rural Development? There is also need for specific rules for administration and use of communal lands, women's participation, spatial records, and a policy framework for leasing land. Second, while tenure security and investment benefits can further increase over time, especially as other factors, which allow such effects to materialize (e.g., non-agricultural employment opportunities or better marketing channels), come into play, they can easily be undermined if the beneficiaries' lose confidence in the value of the certificates. Land grabs by the government—whether for urban expansion, outside investors, or internal redistribution—without land title certificates to determine compensation levels or award compensation—could jeopardize the credibility of the certificates. On a more technical level, failure to keep registration of land titles up to date, e.g.,

because of deficiencies in record-keeping, would have the same effect and could result in the certificates losing their value.

The evidence presented here suggests not only that implementing a decentralized, transparent, and cost-effective process of land registration is possible but also that failure to do so may squander significant economic and possibly social benefits. Assessment of impacts of similar programs in other contexts is needed and could be a fruitful avenue for research that looks at land titling as one of many avenues to secure and gradually formalize land rights.

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Appendix

Table 1A. Determinants of Value of Crop Output: Household Fixed Effect Estimates

	Value of crop output (log)
Plot has soil and water conservation structures	0.091***
	(5.60)
Plot size (hectares)	0.276***
	(23.56)
Male adult labor (days)	0.334***
	(21.84)
Female adult labor (days)	-0.001
	(0.09)
Hired labor (days)	0.023
	(1.16)
Oxen (days)	0.128***
	(10.96)
Chemical fertilizer (kg)	0.155***
	(14.54)
Manure (kg)	0.027**
	(2.27)
Dummy female family labor[a]	-0.011
	(0.31)
Dummy hired labor[a]	-0.087**
	(2.33)
Dummy chemical fertilizer[a]	0.125***
	(3.40)
Dummy manure[a]	0.213***
	(2.92)
Number of year plot(s) possessed	-0.000
	(0.02)
Good soil quality	0.185***
	(9.55)
Medium soil quality	0.110***
	(6.12)
Flat plot	0.031
	(0.97)

Gently sloped plot	0.055*
	(1.70)
Irrigated plot	0.138***
	(3.47)
Year 2002	-0.884***
	(42.02)
Year 2004	0.383***
	(18.25)
Year 2007	0.671***
	(32.09)
Constant	4.259***
	(40.46)
Number of observations	11689
Number of households	844
R^2	0.554

[a] The value of the dummy is 1 if the input is not used, and the value is 0 if the input is used. All inputs are in logs.

Notes: Absolute value of *t* statistics is in parentheses.

* Significant at 10%; ** significant at 5%; *** significant at 1%.