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Is tenure Security Pro-poor? Decomposing Welfare Effects

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Abstract:

We examine the impact of land tenure security on household welfare among poor households in rural Ethiopia. Using the 2005 land title certification program as a quasi-experiment, we exploit the variation in the differential timing of certification between treated and control groups. Estimated results from binary and continuous treatment effect models point out that land tenure security significantly improves the welfare of poor households in rural Ethiopia. This effect varies depending on the length of household's treatment duration. Households who have longer treatment duration receive a higher average welfare gain from the program. We also decompose the welfare effects of the program into different channels. Hired labor is the main mediator through which land title certification affects household welfare.

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Key words: Land tenure security, Pro-poor, Welfare decomposition, Difference-in-Difference, Ethiopia

JEL Codes: O13, P14, Q15, Q18, Q24, Q28

1 Introduction

A wide range of policies have been implemented to reduce poverty and foster rural development in developing countries (Besley and Burgess, 2000). Land reform programs such as redistribution and land tenure security, have been considered as few of them. Empirical evidences, for example, Besley and Burgess (2000) in India and Finan, Sadoulet, and de Janvry (2005) in Mexico, found that providing access to land for the poor can reduce rural poverty. Besley (1995) and Goldstein and Udry (2008) also showed that better land rights, by reducing risk of expropriation, facilitate investment activities in Ghana. Similar results were documented from Ethiopia (Deininger and Jin, 2006; Holden, 2013; Gebremedhin and Swinton, 2003), Rwanda (Ali, Deininger, and Goldstein, 2014), Burundi (Beekman and Bulte, 2012), China (Li, Rozelle, and Brandt, 1998) and Peru (Field, 2005). It is also argued in literature that having property rights on land can reduce border disputes (Toulmin, 2009; Deininger, Ali, Holden, and Zevenbergen, 2008) and land can be used as collateral for credit in areas where financial markets are fragmented (Van Tassel, 2004). Despite extensive literature on land tenure security, to the best of our knowledge, there is no empirical study that assesses the impact of land tenure security on the welfare of the poor rural households. Thus, questions such as whether land tenure security is pro-poor, and what the main channels through which land title certification affects household welfare are remain largely unanswered. In this study, we examine these questions using the differential timing of the 2005 land title certification program in Ethiopia as a quasi-experiment.

The Ethiopian land title certification program is one of the largest and cheapest land registration programs in the world where more than 20 million plots and 6 million households have certified their land holding between 1998 and 2007¹ (Adenew and Abdi, 2005; Deininger, Ali, and Alemu, 2011; Holden, Ghebru, et al., 2011; Jacoby and Minten, 2007). In addition, Ethiopia is one of the poorest countries in the world where more than 80 percent of the population use agriculture as their primary livelihood strategy and land policy has been the most sensitive issue in the last decades. These facts make Ethiopia as an important case study for rural land tenure security. This study focuses on the Amhara region, which started land title certificate distribution in 2005. The regional government's original plan was to implement the program in all woredas (districts) simultaneously. However, due to shortages in manpower and financial resources at both kebele (village) and woreda (district) levels, a sequential implementation of the program was designed. According to the Environmental

¹For example, Madagascar's program costs 150 USD, while it cost less than 1 USD per farm and 3.5 USD per household in Ethiopia.

Protection, Land Use and Administration Authority, arrival of the land title certification program at the village level is as good as random assignment. Once the program is introduced at the village level, all households living in the village were invited to participate in the program. This study uses the differential timing of the certification program as a quasi-experiment to exploit the variation between treatment and control groups: the treatment group consisting of households who get certified before February 2006² are classified as treated, and the control otherwise. We examine the possibility of household level self-selection by comparing the difference in difference and instrumental variable estimates using the Hausman test³. In addition to the binary treatment effect model, we also examine the short term and long term effects of treatment duration among treated individuals using a continuous treatment indicator.

Our study complements to the existing literature in the following dimensions. First, previous studies in this area focus on the average effect of land tenure security for all rural households. However, this study aims to examine the welfare effects of the program based on household's poverty status, particularly for the rural poor. An increase in average agricultural productivity may not necessarily improve the welfare of the poor unless associated with land owned by the poor and if the production effect outweighs the price effect. Such an increase in agricultural productivity due to tenure security will have two opposite effects on the welfare of the rural households. On the one hand, it will increase the output produced using fixed factors of production. On the other hand, it will create down-ward pressure on the price of the commodity produced. Similarly, an increased efficiency of land owned by the rich may not improve welfare of the poor unless landless poor workers are hired on their farms. Hence, examining the welfare effect of the program among poor households is a new contribution for the literature.

Second, to the best of our knowledge, our study is the first piece of empirical evidence which aims to decompose the welfare effects of land tenure security program in to different channels. After examining the impact of land tenure security on household welfare, we decompose the effects of the program into [investment, rental market participation and labor allocation channels](#). Understanding the main channels through which land title certification affects the welfare of poor households is key in determining how policy makers should direct resources to best enhance rural development and reduce poverty.

Finally, this study is the first of its kinds to shed light on ways in which land title certification

²February 2006 is the beginning of the last agricultural season in our sample period.

³Since take up rate varies across and within the village, we use village level certification indicator as an instrument for household level certification.

affects the labor allocation decision of farm households by measuring the amount of family members, hired labor, and community labor used on-farm productions. This addresses one of the top policy issues of the last decade, and will help policy makers understand how households respond if the government wants to implement similar policies. Particularly, the current land tenancy policy does not allow land to sell land and to use it as collateral due to the fear of concentrated land ownership and rural-urban migration. By understanding the behavior of farmers' land and labor allocation decisions once they receive right to rent out their holding will give an insight into whether or not policymakers should allow land to be sold and used as collateral.

Results from binary and continuous treatment models indicate that households who received a land title certificate before the start of the last agricultural season, February 2006, have a higher average welfare. We also find the program is pro-poor⁴. The result from the continuous treatment effect model also points out that longer duration of having a certificate is associated with higher welfare gain. Another finding is related to channels. Hired labor is the main channel through which land title certification affects household welfare in rural Ethiopian households. This could be due to the presence of active rental market participation after the program. That is, inefficient and female headed households are free to rent out their land for up to 25 years without losing their ownership title and participate in off-farm activities. On the other hand, efficient farmers may rent in land and produce more by hiring more labor, leading to a possible increase in welfare for both types of farmers. Similarly, the program may increase the welfare of landless poor households by providing opportunity for them to be hired by those who rented in land. After several robustness checks, results remain the same.

The organization of the paper is as follows. Sections two and three present the evolution of land tenure policy in Ethiopia and conceptual framework, respectively. The data sources and the empirical strategies are presented in section four. Section five discusses the main findings

⁴Under binary treatment model households who recieved a land title certificate before the beginning of the last agricultural season in our sample period, February 2006, are classified into treatment group, control otherwise. On the other hand, continious treatment refers to the duration of having land title.

and section six summarizes.

2 Land reform in Ethiopia

2.1 Evolution of land tenure policy in Ethiopia

Historically, land policy regimes in Ethiopia can be classified into three different periods: The Imperial Regime (Pre-1975), Derg Regime (1975-1991) and Ethiopian People's Democratic Republic Front (1991-present). Under the Imperial Regime, land was owned by elites and small scale farmers were landless. The major form of ownership were *rist* (*kinship*) and *gult* systems. The *rist* system, which was commonly practiced in the northern highlands of Ethiopia, is a type of collective ownership system based on descent. All descendants, both male and female, were entitled *usufruct* rights to land. However, they were not allowed to sell, lease, mortgage or bequeath their share of land outside the descendant group. The other major form of tenure, which was mostly practiced in the southern parts of the country, was the *gult* system. This system involved ownership rights acquired from the monarch or provincial rulers who had the power to make land grants. *Gult* owners collected tributes and taxes from peasants either in cash or in-kind in the form of labor service (Kebede, 2002). Apart from the *rist* and *the gult* systems, other forms of land ownership were granted to nobilities, relations and the church.

The land policy during this period hardly addressed the needs of the majority of farmers in rural Ethiopia. High concentration of land ownership in the hands of few (the church, nobility and high ranking military personnel), tenure insecurity in the tenant-landlord relationships, and the oppression of tenants initiated the strongest students' revolution in Ethiopian history. "*Land to the tiller*" became the popular slogan during the revolution. The movement expanded to communities at large and resulted in the military coup of Emperor Haileselassie in 1975 (Adenew and Abdi, 2005).

In 1975, the military government (Derg)⁵ implemented radical land reform to address the pressing demands of small farmers. Land owned by nobilities, feudal landlords, and the church was nationalized and redistributed to farmers through peasant associations.⁶ Each household gained the usufruct right to land. Transferring land rights through inheritance was only allowed to immediate family members, and required special permission from the peasant

⁵Derg is a military junta, which came to power in 1975 with a rigid Marxist - Leninist ideology.

⁶Peasant association is a local level administrative organization mandated to handle land related matters such as redistribution, tax collection, and arbitration of disputes.

associations. However, land transactions in the form of land renting, selling, mortgage, and share cropping was prohibited. Due to population pressure, frequent land redistribution was implemented by taking land from most land-rich households and giving it to the landless. Such an egalitarian allocation depends on household size and the maximum farm size set to be 10 hectares⁷. As eligibility and access to land was contingent on the physical presence on land, rural-urban migration of land holders were prohibited. Taken together, the land policy during the Derg regime was characterized by high level of tenure insecurity (Kebede, 2002; Adenew and Abdi, 2005; Holden, Ghebru, et al., 2011; Bezabih, Mannberg, Siba, et al., 2014).

In 1991, the military regime was overthrown by the Ethiopian People’s Revolutionary Democratic Front (EPDRF). Though the new government introduced a free market economy, land remained property of the state. In the 1995 constitution, Article 40 states: “The right to ownership of rural and urban land, as well as of all natural resources, is exclusively vested in the state and the people of Ethiopia.” Compared to the Derg regime, the new constitution made few improvements to tenure security. If land is needed for public purpose, land holders have the right to get compensated for any investment they had made on the land. The new government maintained much of the land policy of the Derg regime, which prohibited land transactions. The constitution states that “Land is a common property of Nations, Nationalities and peoples of Ethiopia and shall not be subject to sale or other means of exchange.” Thus, the existing tenure insecurity in rural households was only partially resolved by the 1995 constitution (Adenew and Abdi, 2005; Bezabih, Mannberg, Siba, et al., 2014).

To enhance tenure security and improve utilization of land, the Rural Land Administration and Use Proclamation was developed in 1997 and allocated legislative power to the federal government and delegated implementation responsibility to regional states. Drafted and revised in 1997 and 2005 respectively by the Ministry of Agriculture and Rural Development, it intends to grant land holders the right to transfer their land ownership to family members, lease out plots to other farmers or investors without displacing land administrative rules, and use land as collateral (Adenew and Abdi, 2005; Bezabih, Mannberg, Siba, et al., 2014). In 2002, the current government delegated greater legislative powers to regional states to draft their own regional land policies and establish new regional structures for land administration. As a result, the regions of Tigray, Amhara, Oromia and Southern Nations and Nationalities (SNNP) have drafted their own regional land policies that include land registration and certification. Some regional governments, such as Amhara and Tigray, have also established

⁷The feudal landlords were left with less than 10 hectares of land and excluded from local leadership positions.

Environmental Protection Land Use and Administration Authority (EPLAUA), which is responsible for the development and implementation of land administration systems.

2.2 The land title certification program

The Ethiopian Land Certification program has been one of the important reforms that the current government has implemented. It was first introduced in Tigray in 1998, followed by Amhara in 2003 and the Oromia and SNNP regions in 2004. It is also one of the largest land registration programs in the world, with more than 20 million plots and 6 million households having certified their land holdings between 1998 and 2007 (Adenew and Abdi, 2005; Holden, Ghebru, et al., 2011; Deininger, Ali, and Alemu, 2011).⁸ Compared to other African countries' land certification programs, the Ethiopian land certification program is one of the cheapest to implement. For example, Madagascar's program costs 150 USD, while costs less than 1 USD per farm and 3.5 USD per household in Ethiopia (Deininger, Ali, and Alemu, 2011; Jacoby and Minten, 2007).

This study focuses on the Amhara state of Ethiopia that started land registration in 2003/04 and began distributing land ownership certificates in 2005. The regional government's original plan was to implement the program in all Woredas (districts) simultaneously. However, due to shortages in manpower and financial resources both at Kebele (village) and Woreda (district) levels, a sequential implementation of the program was designed. Once the program is introduced at the village level, all households living in the village were invited to participate in the program. The implementation was conducted in five major steps. First, to increase farmers' awareness of the advantages of land registration and certification, meetings were conducted between Woreda (district) administrators and farmers at the Kebele (Village) level. Second, the Land Administration Committee (LAC), which is responsible for the implementation of the program, was directly elected in a democratic fashion. Then, a short-term training about program implementation was given to elected LAC members. In the third step, demarcation of individual household's plots were measured and marked jointly by LAC members, the household and its neighbor. Fourthly, all registered information is documented and the LAC passes on any outstanding conflicts to a court. Then, the result of the land adjudication is presented to the public as a month long verification. Finally, the holding of the household was registered jointly by the head of the Woreda EPLAUA and the LAC chairperson (Deininger, Ali, and Alemu, 2011; Bezabih, Mannberg, Siba, et al., 2014).

⁸It is similar to the land title certification program in Vietnam (1993-2000) and Thailand (1980-2005), which awarded over 11 million and 8.7 million titles respectively. It is also comparable to programs in Peru and Indonesia, which awarded around 2.7 and 1.8 million titles respectively.

The land title certificate, issued in the name of both husband and wife, contains the names of family members and their photographs, neighboring landholder's names, a list of all measured plots and their estimated areas, fertility standards of the land, the types of services that the land is used for, the roll-number and issuance date of the certificate, and the major rights and obligations of the landholder. According to the Amhara National Regional State Rural Land Administration and Use Proclamation No. 133/2006, landholders have the right to bequest land to family members, other farmers in the region, and rent-out their entire plot for up to 25 years. Any land rental contract made for more than 3 years should be made in writing and submitted to the Woreda EPLAUA. It should also explain the area of the land, the amount and system of payment, and year of rent. However, since the state and public are vested in land ownership rights, it is impossible to transfer land holdings to others via a sale or in exchange for another property. It is also prohibited to use land as collateral to get credit from any formal or informal financial institutions. The government's main justification for this is to avoid land ownership concentration to few hands and prevent massive rural-urban migration.

All farmers residing in the region have equal entitlements to receive a land title certificate for his/her holding, irrespective of any differences in farm size, owner gender, poverty status, or any other household characteristics. If a farmer is found to use the rural land without having a title certificate from the Woreda EPLAUA, he/she will be expropriated. However there are different legal measures that take place prior to such an eviction. In the first six months, the land owner will receive oral warning from the Kebele LAC members that encourage the owner to obtain a land title certificate. If the owner does not comply with the oral warning, he/she will receive a preliminary written warning in the last six months of the first year. Then, he/she will receive second and third level written warnings in the second year with 6 months interval. Finally, in the third year, the Woreda EPLAUA, Kebele Land Administration Office, and LAC members will suspend land use rights for a year or longer and decide if the land can be rented out to another user during the suspension. In the fourth year, the representative officer will decide to expropriate the owner from his/her land holding.

3 Theory

In this section, we develop a theoretical model by introducing land and labor markets in the work of [Deininger and Jin \(2006\)](#). It is argued that a secured property right on land may

increase agricultural productivity, thereby household welfare, through long term investment on land and/or changing input allocation. Besley (1995), points out three different channels through which property right on land can affect household's long term investment activities. First, a secured property right can reduce expropriation and encourage households to invest more on their land in the form of tree planting, conservation, manure, fertilizer, irrigation etc. Second, a well defined property right on land can ease using land as a collateral to get credit. This might relax financial constraints on land related investment. Third, better land rights can facilitate investment activities by encouraging households to rent or sell their land. Since the Ethiopian land title certification program does not allow households to use land as a collateral, we do not expect any welfare effect through credit channel. In addition to the investment and credit channels, a land title certification can also affect household welfare by change household's input allocation decision (land and labor).

Consider a two period model where a household endowed with fixed amount of labor (\bar{L}_t), land (\bar{A}_t) and first period land related capital stock (K_1), where $t = 1, 2$. The household produce output using a concave production function: $Y_t = f(L_t, A_t, K_t)$, where L_t is farm labor and A_t is amount of land used for the production, and land related capital stock (K_t). Household labor supply and farm labor demand at a given market wage rate (w_t), income (M_t) and degree of tenure security (S_t) are $L_t^S(w_t, M_t, S_t) = \bar{L}_t - l_t$ and $L_t^D = L_t^D(w_t, \bar{A}_t, S_t)$, respectively. Labor not used in the agricultural production can be allocated to leisure (l_t), off-farm activities (L_t^O), and land related investment activities (L_t^I). Assume the desired labor supply exceeds available off-farm opportunities and on-farm labor demand at the market wage rate. Second period land related capital stock is assumed to be a function of amount of hour spent on land related investment activities and cost of investment, $K_2 = K_1 + \phi(L_1^I, C_1^I(L_1^I))$ ⁹. Assume households can lose their land in the next period with a probability of $\rho(S_2(S_1, L_1^I))$, where $\rho \in [0, 1]$, $\frac{\partial \rho}{\partial S_t} < 0$, S_1 and S_2 are the degree of tenure security in period 1 and 2, respectively. Since the Ethiopian land title certification program was exogenously given for each individual, the amount of land related investment activities may not affect tenure security. Hence, the degree of tenure security in both periods will be identical, $S_2(S_1, L_1^I) = S_1$. Further assume that p_t is the price of output, w_t is the wage rate for labor, and r_t is a price of one unit of land.¹⁰

The household's problem is to maximize the following profit function subject to the budget and resource constraints.

⁹Here, we assume no depreciation and $\phi(L_1^I, C_1^I(L_1^I))$ is positively related to amount of labor hour used for investment activities and negatively on cost of investment. That is, $\frac{\partial \phi(L_1^I, C_1^I(L_1^I))}{\partial L_1^I} > 0$, $\frac{\partial^2 \phi(L_1^I, C_1^I(L_1^I))}{\partial L_1^I \partial L_1^I} < 0$, $\frac{\partial \phi(L_1^I, C_1^I(L_1^I))}{\partial C_1^I} < 0$, $\frac{\partial C_1^I(L_1^I)}{\partial L_1^I} > 0$, and $\frac{\partial C_1^{2I}(L_1^I)}{\partial L_1^I \partial L_1^I} < 0$.

¹⁰Notice that p_t is normalized to one

$$\begin{aligned} & \underset{\{L_t^h, L_t^c, L_t^o, L_1^I, A_t^h, A_t^m, l_t\}_{t=1,2}}{\text{Max}} (1 + \delta)[f(L_1^a, A_1, K_1) + w_1 L_1^o + r_1 A_1^m - w_1 L_1^h - r_1 A_1^h - w_1 L_1^c - w_1 l_1 - \\ & C_1] + [(1 - \rho(S_1))f(L_2^a, A_2, K_1 + \phi(L_1^I)) + w_2 L_2^o + r_2 A_2^m - w_2 L_2^h - r_2 A_2^h - w_2 L_2^c - w_2 l_2 - C_2] \end{aligned}$$

$$\begin{aligned} \text{Subject to: } & L_t^f + L_t^h + L_t^c = L_t^a, A_t^f + A_t^h = A_t, \\ & A_t^f + A_t^m = \bar{A}_t, L_1^f + L_1^o + L_1^I + l_1 \leq \bar{L}_1, L_2^f + L_2^o + l_1 \leq \bar{L}_2 \end{aligned}$$

$$C_t, l_t, L_t^f, L_t^h, L_t^o, L_t^c, L_t^I, A_t^f, A_t^h, A_t^m \geq 0 \text{ and } t = 1, 2$$

, where δ is a time discount factor, L_t^h is hired labor, A_t^h is rented in land, and A_t^m is rented out land at time t . ¹¹

Substituting the binding constraints of land and labor, $\bar{A}_t + A_t^h - A_t^m = A_t$, $L_1^f = \bar{L}_1 - L_1^o - L_1^I - l_1$, $L_1^a = L_1^h + L_1^c + \bar{L}_1 - L_1^o - L_1^I - l_1$, $L_2^f = \bar{L}_2 - L_2^o - l_2$ and $L_2^a = L_2^h + L_2^c + \bar{L}_2 - L_2^o - L_2^I - l_2$ and take the first order derivative with respect to labor and land variables will give us the following first order conditions (FOCs):

$$L_1^h, L_1^c, L_1^o, l_1 : f'(L_1^a, A_1, K_1) - w_1 = 0 \quad [\text{FOC1}]$$

$$L_2^h, L_2^c, L_2^o, l_2 : -(1 - \rho(S_1))f'(L_2^a, A_2, K_1 + \phi(L_1^I, C_1^I(L_1^I))) - w_2 = 0 \quad [\text{FOC2}]$$

$$A_1^h, A_1^m : f'(L_1^a, A_1, K_1) - r_1 = 0 \quad [\text{FOC3}]$$

$$A_2^h, A_2^m : -(1 - \rho(S_1))f'(L_2^a, A_2, K_1 + \phi(L_1^I, C_1^I(L_1^I))) - r_2 = 0 \quad [\text{FOC4}]$$

$$L_1^I : -(1 + \delta)f'(L_1^a, A_1, K_1) + (1 - \rho(S_1))f'(L_2^a, A_2, K_2)\phi'_{L_1^I}(L_1^I, C_1^I(L_1^I))C_1^{I'}(L_1^I) = 0 \quad [\text{FOC5}]$$

The first two first order conditions imply that in equilibrium the marginal product of labor used in the agricultural production is equal to the wage rate in the off-farm market in both periods. The opportunity cost of leisure time is also equal to the market wage rate. Similarly, the marginal productivity of rented-in and rented-out land are equal to the rental price of land. Substituting the first two FOCs in the last first order condition provides:

$$-(1 + \delta)w_1 + (1 - \rho(S_1))w_2\phi'_{L_1^I}(L_1^I, C_1^I(L_1^I))C_1^{I'}(L_1^I) = 0$$

¹¹Here, we are assuming separability between consumption and production decisions. Under separable agricultural household model, the production and consumption decisions can be separated in two stages. First, the household maximizes profit by producing an optimal level of output. Then, given the maximum level of profit, the household maximizes utility.

Total differentiating the above equation with respect to L_1^I and S_1 helps us to examine the effect of land tenure security on long term investment on land. That is,

$$(1 - \rho(S_1))w_2[\phi''_{L_1^I}(L_1^I, C_1^I(L_1^I))(C_1^I(L_1^I))^2 + \phi'_{L_1^I}(L_1^I, C_1^I(L_1^I))C_1^{I''}(L_1^I)]dL_1^I - \rho'(S_1)w_2\phi'_{L_1^I}(L_1^I, C_1^I(L_1^I))C_1^I(L_1^I)dS_1 = 0$$

$$\frac{dL_1^I}{dS_1} = \frac{\rho'(S_1)\phi'_{L_1^I}(L_1^I, C_1^I(L_1^I))C_1^I(L_1^I)}{(1 - \rho(S_1))[\phi''_{L_1^I}(L_1^I, C_1^I(L_1^I))(C_1^I(L_1^I))^2 + \phi'_{L_1^I}(L_1^I, C_1^I(L_1^I))C_1^{I''}(L_1^I)]} > 0$$

The above expression clearly indicates that tenure security will encourage households to spend more time on land related investment activities. That is, by reducing the risk of loss, it encourages long-term investment in tree planting, conservation, manure, fertilizer, irrigation, etc. Similarly, we can see the effect of land title certification on land and labor allocation by taking the total differential of the first four FOCs.

Taking the total differential of FOC two with respect to L_2^h and S_1 provides:

$$(1 - \rho(S_1))f''(L_2^a, A_2, K_1 + \phi(L_1^I, C_1^I(L_1^I)))dL_2^h - \rho'(S_1)f'(L_2^a, A_2, K_1 + \phi(L_1^I, C_1^I(L_1^I))) = 0$$

$$\frac{dL_2^h}{dS_1} = \frac{(1 - \rho(S_1))f''(L_2^a, A_2, K_1 + \phi(L_1^I))}{\rho'(S_1)f'(L_2^a, A_2, K_1 + \phi(L_1^I))} > 0$$

Similarly, differentiating with respect to $(L_2^o$ and $S_1)$, $(L_2^0$ and $S_1)$, $(l_2$ and $S_1)$, $(A_2^h$ and $S_1)$, and $(A_2^m$ and $S_1)$ will give us:

$$\frac{dL_2^o}{dS_1} = \frac{dL_2^0}{dS_1} = \frac{dl_2}{dS_1} = \frac{dA_2^h}{dS_1} = \frac{dA_2^m}{dS_1} = \frac{(1 - \rho(S_1))f''(L_2^a, A_2, K_1 + \phi(L_1^I, C_1^I(L_1^I)))}{\rho'(S_1)f'(L_2^a, A_2, K_1 + \phi(L_1^I, C_1^I(L_1^I)))} > 0$$

In this model, tenure security on land increases farm labor demand in the form of family, community and hired labor used for production, thereby output and household welfare. Moreover, it helps land owners to increase their willingness to rent out the land and generate additional income without losing their right to use land for insurance or old-age protection. Inefficient land owners and female headed households may also rent out their land and participate in different off-farm activities without losing their land title. Hence, efficient farmers are able to consolidate and cultivate larger farm areas. To sum up, property right on land is expected to increase household welfare by encouraging households to invest more and efficiently allocate their factors of production (land and labor).

4 Data and empirical strategy

4.1 Data

We use three rounds of the Sustainable Land Use in Ethiopian Highland (SLUEH) panel data, 2002, 2004, and 2007, in our analysis. It was collected by Addis Ababa University in collaboration with University of Gothenburg, Ethiopian Development Research Institute (EDRI), and the World Bank. The data covers South Wollo and East Gojjam zones of the Amhara National Regional State which are parts of the central and northern parts of Ethiopian highlands. These two zones are intentionally selected to reflect the agro-ecological diversity within the region. Compared to South Wollo zone, East Gojjam has a high agricultural potential, less rugged topography and a reliable rain fall pattern (Bezabih, Mannberg, Siba, et al., 2014). This might result in different policy interventions, such as food for work and safety nets programs, undertaken in South Wollo but not in East Gojjam. To avoid the possible confounding factors, our study only consists randomly selected rural households from seven Kebeles (villages) of East Gojjam zone.

The survey includes detailed information on household demographic characteristics, land use, production, off-farm income and remittance, consumption, access to services, and community characteristics. It also contains data on land related investment activities and households' land title certification status. The land title certification indicator, one of our variables of interest, provides on information whether or not the household has a land title certificate for his/her landholding. Before the household gets a land title certificate, he/she should register the plot in collaboration with the LAC members and neighboring landholders. There was an average a five months delay between registration completion and certificate distribution. Table 1 presents the percentage of households who received a land title certificate in each village during our sample period. Though the land title certification program was introduced in all villages, the Welkie and Skela Deber villages did not begin land title certificate distribution before 2007. Panel A of Table 1 shows the percentage of all households who received a land title certificate in each village, whereas panel B presents for only poor households on the baseline. More than 93 percent of farmers in Amanuel, Debre Elias and Telma villages get certified during the sample period. This figure increases to 98 percent for households who were poor on the baseline. Notably, introduction of land title certificates at the village level is not dependent on village size nor distance to the center of the district (Woreda).¹²

¹²Though the distance from the district to Kebi and Wolkie kebeles are the same, Wolkie did not begin land title certification during the sample period.

Though arrival of the program at the village level is as good as random assignment, take up within may not be. Once the program is introduced at the village level, all households in the village were invited to participate in the program. The differential timing of certification is used as a means to exploit the variation between treated and control groups using the DID approach. To examine the possibility of household level self-selection, we run instrumental variable regression and compare it to the standard DID using the Hausman test. Village level certification is used as an instrument for household level certification.

Table 1: Percentage of households who get a land title certificate

Woreda	Kebele	Area in hectare	2004/5	2005/6	2006/7	Total
Panel A: All households						
Machakel	Amanuel	4373	1.8	72.7	23.6	98.1
Machakel	Debre Elias	1790	0	88.8	4.7	93.5
Enemyay	Kebi	1964	0	7.5	68.75	76.25
Enemyay	Wolkie	2560	0	0	0	0
Gozamin	Telma	630	0	6.5	86.9	93.4
Gozamin	Skela Deber	2670	0	0	0	0
Gozamin	Addis Gulit	2172	36.8	45.6	1.8	84.2
Panel B: Poor households on the base line						
Machakel	Amanuel	4373	1.8	72.7	23.6	98.1
Machakel	Debre Elias	1790	0	94.6	5.4	100
Enemyay	Kebi	1964	0	8.6	74.3	82.9
Enemyay	Wolkie	2560	0	0	0	0
Gozamin	Telma	630	0	8	90.1	98.1
Gozamin	Skela Deber	2670	0	0	0	0
Gozamin	Addis Gulit	2172	40.6	50	0	90.6

Source: Author's computation from SLUEH dataset

Household welfare, the other variable of interest, is proxied by household's real per-capita consumption expenditure. It is constructed by taking the sum of market values of consumption from household production as well as the market value of goods purchased, transfers and gifts.

4.2 Empirical strategy

Table 2 shows the mean difference between treated and control groups at the baseline. Households who got a land title certificate before the beginning of the last agricultural season in our sample period, February 2006, are considered as treated, control otherwise. The implicit assumption is that households who received tenure security before February 2006 had incentives to adjust both economic decisions of land usage and decisions regarding labor market participation, which in turn has effects on welfare indicators. Thus, we assume that any land rights obtained after this period will not have any welfare effects. Panel A of Table 2

presents the mean differences between treated and control groups for all households in our sample, whereas panel B shows the mean differences for poor households at the baseline. No statistically significant mean differences were observed in the household characteristics of treated and control groups at the baseline with the exception of household size, which becomes statistically insignificant if we consider only poor households in 2004. The standard binary DID model is used to examine the welfare impacts of the program between treated and control groups. We estimate the following fixed effect model for household i at time t :

$$y_{it} = \beta_0 + \beta_1 Post_t + \beta_2(Post_t * Treatment_i) + \beta_3 x_{it} + \alpha_i + u_{it}$$

where y_{it} is the real per-capita consumption expenditure for household i at time t , $Post_t$ is an indicator variable which takes a value of one if the time period is before the last agricultural season in the sample (February 2006) and zero otherwise, $Treatment_i$ is a treatment indicator which takes a value of one if the household is treated, zero otherwise, and x_{it} represents different control variables (for example, household size, farm size etc) which likely affect household welfare. The parameter α_i and u_{it} represents the individual fixed effect and the error term, respectively. The effect of the program between treated and control households is captured by a homogeneous treatment effect, β_2 . In addition to the binary treatment effect model, we use a continuous treatment indicator to examine if there is heterogeneity in the average treatment effect based on the length of treatment duration. Treatment duration, which ranges from 1 to 12 months, is measured by the number of months elapsed from the time of certification to the starting of the last agricultural season in our sample period.

Table 2: Mean difference between treatment and control groups

	Control	Treatment	Difference	p-value
Panel A: All households				
Real Per-capita Consumption Expenditure	2312.62	2245.92	66.70	0.748
Head Male	0.87	0.85	0.02	0.725
Age of Household Head	48.09	46.95	1.14	0.578
Head Education (Read and Write)	0.38	0.42	-0.04	0.551
Land Ownership Dummy	0.98	0.98	-0.00	0.848
Farm Size	1.59	1.42	0.17	0.174
Head Married	0.85	0.87	-0.01	0.772
Household Size	6.28	5.62	0.67*	0.034
Panel B: Poor households on the base line				
Real Per-capita Consumption Expenditure	1811.76	1945.29	-133.53	0.115
Head Male	0.88	0.85	0.03	0.545
Age of Household Head	48.04	47.92	0.11	0.959
Head Education (Read and Write)	0.38	0.45	-0.08	0.275
Land Ownership Dummy	0.98	0.98	-0.01	0.815
Farm Size	1.59	1.43	0.15	0.255
Head Married	0.87	0.89	-0.02	0.700
Household Size	6.40	5.79	0.61	0.058

Source: Author's computation from SLUEH dataset

5 Results and discussion

This section presents the main findings of the study. First, the welfare effect of land tenure security is estimated using the standard binary treatment indicator. Second, continuous treatment duration is estimated in order to examine the average treatment effect of the program for the treated households. Finally, we decompose welfare effects of the program in to different mediators and run robustness checks.

5.1 Binary treatment effect model

Table 3 compares the welfare effects of the program between treated and control groups using Instrumental Variable (IV) and the standard DID model. Sequential implementation of the land title certification program helps us to use village level certification as an instrument for household level treatment¹³. Result from the IV model, presented in the first column, shows that households who received a land title certificate before the start of the last agricultural season have an average of 516.3 Ethiopian Birr (ETB)¹⁴ higher real per-capita consumption

¹³Village level certification indicators classify households who are living in Villages (Kebeles) which undergo certificate distribution before the last agricultural season as treated, control otherwise.

¹⁴Birr is the domestic currency in Ethiopia. One US Dollar was equivalent to 8 Ethiopian Birr during 2005.

expenditure. A similar result is obtained by employing the standard binary treatment effect model, presented in column (2). Having property right on land before February 2006 increases the average real per-capita consumption of households by 642.6 ETB. It can be interpreted as the causal effect of land tenure security under the assumption that in the absence of land title certification, the differences between treated and control groups would not have been systematically different.

The Hausman test statistic is used to examine whether there is a systematic difference in the coefficient that measures the impact of the program between the IV and DID estimates. The test statistics, presented at the bottom of Table 3, shows the absence of any systematic difference between the IV and the DID estimates at the conventional 5 % level of significance. As we fail to reject the null hypothesis that the difference in coefficients in the two models are not systematic, the DID estimation technique is used for our analysis. Column (3) controls household size and gender of the household head. Household size which was different between treated and control groups at the baseline, reduces real-consumption expenditure by 166.6 ETB, whereas we could not find any welfare difference between female and male headed households. The fixed effect regression eliminates time invariant factors that are likely correlated with household's participation decision to the program. For example, before the introduction of the program there was a public meeting about the relevance of having a land title certification which likely affects the households' certification decision¹⁵.

Examining the differential welfare effects of the program based on household's poverty status is the main contribution of this study. In order to do this, we split the sample and analyze the program impact on households who were poor on the baseline. Column (4) to (6) present the welfare effects of land tenure security among poor households. Results indicate that land title certification improves the welfare of households who were poor in 2004. Estimated results from the IV and the DID models, presented in column (4) and (5), show that treated poor households have around 664.8 and 573.5 ETB higher average real per-capita consumption expenditure, respectively. Similar to the full sample analysis, the Hausman test statistic fails to reject the null hypothesis of no systematic difference in coefficients in the two models. Controlling household size and gender of the household head does not change the main result. Compared to the control group, poor households who got a land title certificate before the starting of the last agricultural season have 577.6 ETB more average real-consumption expenditure. These results suggest that land tenure security improves the welfare of the poor households in rural Ethiopia.

¹⁵Participation on land tenure meeting was voluntary and all households, who are living in the village, were invited.

Table 3: Welfare effects of the program

	All Households			Poor Households		
	(IV)	(DID)	(DID)	(IV)	(DID)	(DID)
Treatment	516.336* (307.825)			664.765*** (221.729)		
year=2007		28.781 (93.857)	109.571 (109.142)		399.477*** (70.655)	439.189*** (81.163)
Treatment x year=2007		642.626** (282.314)	664.704** (279.083)		573.462** (257.220)	577.571** (258.867)
Household size			-166.600* (92.298)			-85.033 (77.391)
Male Household Head			249.580 (243.603)			189.184 (200.933)
Fixed Effect	NO	YES	YES	NO	YES	YES
Constant	2233.121*** (53.897)	2237.720*** (41.808)	3047.562*** (628.618)	1957.033*** (40.499)	1817.569*** (30.518)	2185.726*** (530.142)
Number of Obs.	1233	1233	1233	1001	1001	1001
wald chi2	2.8			9		

Notes: The dependent variable is real per capita consumption expenditure measured in Ethiopian currency (Birr). It is used as a proxy for household welfare. During the sample period, one US dollar was equivalent to eight Ethiopian Birr. Column (1) and (4) are estimated by Instrumental Variable (IV) estimation technique and the rest are DID models estimated by fixed effect regression. Robust standard errors are reported in parentheses. Column 1 to 3 depicts the estimates for all households in the sample, whereas the last three columns present the effects of the program only for households who were poor at the baseline. The Hausman test statistics is used to compare IV and DID estimates. It gives as, Chi2(1)=2.42 and Prob > chi2=(0.1197) for all households, and Chi2(1)= 2.47 and Prob > Chi2=(0.1158) for poor households. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

5.2 Continuous treatment effect model

In addition to the standard binary treatment model, we have estimated the effect of the program among treated households using a continuous treatment indicator. Treatment duration, measured by the number of months elapsed from the time of certification to the beginning of the last agricultural season in the sample period, is used as a continuous treatment indicator. Our hypothesis is that households that have longer treatment duration have higher per-capita consumption expenditure.

Table 4 reports the average welfare effect of an additional month of treatment duration for treated households. Column (1) - (3) and (4) - (6) present the marginal effects of having an additional month of certification duration on real per-capita consumption expenditures for all and poor households, respectively. In both cases, estimated results show that early certified households have a higher average welfare gain compared to late certified households. The first and fourth columns indicate the welfare effect of having a one month certificate duration without covariates for all and poor households, respectively. A one month increment in treatment duration is associated with an average increase in household real per-capita consumption by 78.6 ETB in the full sample and 121.3 ETB for the poor households. When controlling for household size, the effect increases to 116.6 ETB for the full sample and decrease to 105.5 ETB for poor households.

Table 4: Effect of treatment duration on household welfare

	All Households				Poor Households	
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment Duration	78.645** (2.07)	103.918** (2.30)	116.553** (2.40)	121.331*** (3.09)	156.141*** (3.87)	105.482** (2.59)
Household size			-174.577 (-0.41)			981.950** (2.22)
Fixed Effect	NO	YES	YES	NO	YES	YES
Constant	2287.925*** (16.06)	2219.298*** (16.00)	3179.174 (1.34)	2033.583*** (21.34)	1936.574*** (16.81)	-3577.631 (-1.42)
Number of Obs.	118	118	118	97	97	97

Notes: The dependent variable is real per capita consumption expenditure measured in Ethiopian currency (Birr). It is used as a proxy for household welfare. During the sample period, one US dollar was equivalent to eight Ethiopian Birr. Column (1) and (4) are Ordinary Least Square (OLS) estimates, whereas the rest are Fixed Effect coefficients. Treatment duration is measured by the number of months elapsed from the time of certification up to the beginning of the last agricultural season. t statistics are reported in parenthesis and standard errors are robust. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

5.3 Decomposition of welfare effects into channels

This section presents the decomposition of the welfare effect of the program into different mediators. Estimated results from binary and continuous treatment models indicate that households who received a land title certificate before February 2006 have higher welfare. Theoretical literature suggests that long term investment on land, efficient allocation of inputs (land and labor), and relaxation of credit constraints are potential mediators through which land tenure security affects household welfare. Before conducting the decomposition analysis, it is important to examine the effect of the program on these potential mediators.

Empirical literature has found a positive correlation between land property rights and long term land related investment. For example, [Besley \(1995\)](#) and [Goldstein and Udry \(2008\)](#) found that better land right facilitates investment activities in Ghana. More specifically, reducing the risk of expropriation, relaxing investment fund constraints, and enhancing possibilities of gains from selling and renting land encourage households to invest more on their land. Similar investment-enhancing impacts of tenure security are also found in West Africa ([Fenske, 2011](#)), Ethiopia ([Gebremedhin and Swinton, 2003](#); [Deininger and Jin, 2006](#); [Deininger, Ali, and Alemu, 2011](#); [Holden, 2013](#)), Kenya ([Kabubo-Mariara, 2007](#)), Rwanda ([Ali, Deininger, and Goldstein, 2014](#)), Burundi ([Beekman and Bulte, 2012](#)), Peru ([Field, 2005](#)), and China ([Li, Rozelle, and Brandt, 1998](#)).

Table 5 presents the DID estimation for the effect of land tenure security on land related investment activities using five main indicators of land investment. In line with the theoretical literature, we find a positive and significant program effect on long term investment on land in the form of soil conservation. That is, compared to the control villages, households

who received a land title certificate before the last agricultural season of the survey period spent around 75.8 hours more on soil conservation. However, we did not find any significant difference between the two groups on other indicators. This result is in line with the findings of [Ali, Deininger, and Goldstein \(2014\)](#). Using a geographic discontinuity design with spatial fixed effects, they find that land regularization program has a large impact on soil conservation measures in Rwanda. [Beekman and Bulte \(2012\)](#) also found a positive impact of tenure security on investment in soil erosion management in Burundi. However, no effect was found on fertilizer use. Unlike erosion management, the use of fertilizer and improved seed lead to a short term private gain. As a result, we may not see any difference on the probability of fertilizer and improved seed usage between treated and control groups. Column (1) and (2) also show that the soil conservation hours and the likelihood of fertilizer use decrease overtime for both treatment and control groups. This could be associated with the average increase in the probability of off-farm and rental market participation. Households who rent-out their land holding and participate in off-farm activities could spend lesser hours on soil conservation and less likely to use fertilizer.

Table 5: Effects of the program on land related investment activities

	Conservation Hour	Fertilizer use	Tree planting	Irrigation	Improved Seed
year=2007	-30.311*** (5.059)	-0.064*** (0.022)	0.123*** (0.028)	-0.008 (0.029)	0.017 (0.026)
Treatment x year=2007	75.841** (35.768)	-0.044 (0.060)	-0.020 (0.049)	0.074 (0.052)	0.055 (0.073)
Household size	7.708** (3.636)	-0.005 (0.020)	-0.009 (0.025)	0.026 (0.021)	0.056** (0.024)
Fixed Effect	YES	YES	YES	YES	YES
Constant	-8.339 (20.886)	0.897*** (0.123)	0.739*** (0.154)	-0.057 (0.125)	-0.174 (0.150)
Number of Obs.	1229	1174	1232	1232	1226

Notes: The dependent variable in column (1) is the amount of hours spent on soil conservation activities. Similarly, the dependent variable in column (2) to (5) are indicator variables taking the value of 1 if the household uses fertilizer, plants tree on his land, practices irrigation and uses manure, respectively. All regressions are the standard DID estimated by including fixed effects. t statistics are reported in parenthesis and standard errors are robust. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels. market.

The second possible channel through which land tenure security affects household welfare is through the efficient allocation of land and labor ([Field, 2002](#); [Deininger, Ali, and Alemu, 2011](#)). Table 6 reports the effect of tenure security on labor hour allocation and rental market participation. One of the contributions of this paper is to examine the effect of the program on household’s hired, family and community labor allocation decisions. The estimated DID result shows that households who got certified before the last agricultural season have used more hired labor in their production process. That is, compared to the control group, on average treated households have used around 19.15 more hours of hired labor. However,

we did not find any significant difference in the use of family labor, community labor, and off-farm market participation. In line with the findings of [Deininger, Ali, and Alemu \(2011\)](#), who examine the impact of tenure security on investment and rental market participation in Ethiopia, we find that treated households have an average 15.4 percentage point higher probability to participate in rental market. Table 6 also shows that the average probability of off-farm and rental market participation increase for both treatment and control groups, whereas the amount of community labor hour is declines. Households who rent-out land may substitute off-farm activities for community labor.

Table 6: Effects of the program on labor hour allocation and rental market participation

	Family labor Hr.	Hired labor Hr.	Community labor Hr.	Off-farm	Rental Market
year=2007	2.526 (0.24)	-18.474 (-1.50)	-59.766* (-1.82)	0.183*** (5.08)	0.362*** (12.02)
Treatment x year=2007	-185.938 (-0.79)	19.146* (1.87)	39.599 (1.44)	0.140 (1.46)	0.154* (1.93)
Household size	28.785* (1.69)	8.300 (1.35)	20.155 (1.22)	0.048 (1.53)	0.018 (0.60)
Fixed Effect	YES	YES	YES	YES	YES
Constant	-38.790 (-0.38)	-35.706 (-1.00)	-71.071 (-0.75)	0.109 (0.57)	-0.087 (-0.47)
Number of Obs.	954	954	954	996	996

Notes: The dependent variable from column (1) to (3) are the amount of family, hired and community labor hours that the household spent on farm activities, respectively. Similarly, in column (4), the dependent variable is the amount of hours that the household spent on off-farm activities. Finally, the dependent variable in column 5 is an indicator variable which takes 1 if the household participated in the rental market. All regressions are the standard DID estimated by including fixed effects. t statistics are reported in parenthesis and standard errors are robust. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

The DID estimates from Table 5 and 6 clearly indicate that land title certification has a significant and positive effect on long term investment in land and on the reallocation of land and labor. Once the potential mediators are identified, it is possible to do the decomposition analysis. Table 7 indicates the decomposition of the welfare effects of the program into different mediators, investment and input allocation channels. The first column presents the welfare effects of the program by controlling only household size, whereas column two shows the effect of the program after taking into account the investment channel. Controlling the potential investment channel does change the effect of the program on households' welfare. We still observe a significant welfare difference between treated and control groups even after controlling the amount of hours spent on soil conservation. The coefficient of the triple interaction effect of treatment and soil conservation is found to be negative and statistically significant. This could be due to the fact that spending more hours on soil conservation can reduce the amount of potential money that could be earned by participating in paid non-farm activities. Moreover, soil conservation in the form of tracing or dam construction may also require a lump-sum payment that may reduce household welfare. Column (3)

reports the welfare effects of the program by taking in to account labor hour allocation and rental market participation. Finally, the last column combines both the investment and input allocation channel. While the DID estimate found to be statistically insignificant, its interaction with hired labor found to be statistically significant. This can be taken as evidence that supports labor allocation as an important channel through which land title certification affects household welfare. Compared to the control group, on average, the use of additional hour of hired labor increases the welfare of the treated households by 17 ETB.

Table 7: Decomposing the welfare effects of the program

	(1)	(2)	(3)	(4)
year=2007	107.605 (0.99)	108.263 (0.96)	8.901 (0.08)	0.380 (0.00)
Treatment x year=2007	657.461** (2.30)	763.893*** (2.66)	122.466 (0.22)	231.639 (0.43)
Household size	-170.664* (-1.87)	-173.859* (-1.90)	-136.099 (-1.47)	-129.636 (-1.39)
Conservation		-0.032 (-0.04)		-0.191 (-0.27)
Treatment*year=2007*Conservation		-1.898** (-2.48)		-11.563** (-2.10)
Community Labor			-0.158 (-1.64)	-0.159 (-1.64)
Hired Labor			-0.270* (-1.96)	-0.265* (-1.93)
Treatment*year=2007*Community labor			5.117 (0.55)	7.759 (0.85)
Treatment*year=2007*Hired labor			16.827** (2.53)	16.922** (2.36)
Treatment*year=2007*Rental Market			811.870 (1.41)	912.480 (1.56)
Fixed Effect	YES	YES	YES	YES
Constant	3281.966*** (5.89)	3302.430*** (5.92)	3098.698*** (5.37)	3065.822*** (5.28)
Number of Obs.	1229	1229	1172	1172

Notes: The dependent variable is real per capita consumption expenditure measured in Ethiopian currency (Birr). It is used as a proxy for household welfare. During the sample period, one US dollar was equivalent to eight Ethiopian Birr. Column (1) is the standard DID estimates without taking in to account the channels, whereas column (2) presents the DID estimates, by including land related investment activities. Similarly, column (3) is estimated by including labor and rental market participation and finally column (4) includes all the potential channels. All regressions are the standard DID estimated by including fixed effects. t statistics are reported in parenthesis and standard errors are robust. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Increased productivity following the use of hired labor is the main channel through which land title certification improves household welfare. This could be due to the fact that households who received title certification have a higher probability of participating on rental markets. That is, efficient farmers may rent in land and produce more by hiring more labor. On the

other hand, inefficient and female headed farmers may rent out their land and work on off-farm activities. Similarly, the program may increase the welfare of landless poor households as it creates the opportunity to be hired by farmers who rented out land.

5.4 Internal validity checks

In this section, we present several tests that support the validity of the identification assumption of this study. The first test is related to the parallel trend assumption. Our main identification assumption is that in the absence of the treatment the average change in consumption per-capita for the treated group equals the observed average change in consumption per-capita for the controls. Using the pre-treatment panel data from 2002 and 2004 surveys, we examine whether or not the treatment and control groups have the same trend in per-capita consumption expenditure over time.

The evidence supports our identification assumption. Table A1 in the appendix presents the welfare effects of a placebo treatment before the introduction of the land title certification program. Column (1) presents the effect of the treatment on household welfare without controlling household size, whereas column (2) depicts the welfare effect by taking in to account household size. In both cases, the interaction between the placebo treatment and the post intervention period (2004) indicator is found to be very small in magnitude and statistically insignificant. That is, there is no statistical welfare difference between treated and control groups before the land title certification program starts. This can be taken as evidence in favor of our parallel trend assumption.

The second concern is related to the timing of certification, and what determines the order in which households become certified. To understand this issue, we run a fixed effect by regressing the timing of certification on different observed characteristics of the household at the baseline. Estimated results, presented in Table A2 in the appendix, point out that the timing of certification is not affected by different observed characteristics of the household, both across and within the villages. The first two models indicate the effect of observed covariates on the timing of certification in all and treated villages, respectively while the last two columns present the effect within the villages. In all cases, none of the controlled observed covariates affect the timing of certification at the baseline. This can be taken as evidence against self-selection based on observed characteristics.

The difference in the timing of certification is not a threat to our identification strategy as long as it is uncorrelated with the pre-treatment changes in outcome variable (De Janvry, Emerick,

Gonzalez-Navarro, and Sadoulet, 2015). However, if timing of certification is correlated with the pre-program change in consumption per-capita, the estimated average program effect will be biased. To test this hypothesis, we run the fixed effect regression on pre-program changes in consumption per-capita on different certification times. Estimated results in Table A3 in the appendix confirm the absence of significant correlation between timing of certification and consumption per-capita at the baseline. It can be concluded that pre-program levels of consumption are not correlated with the timing of certification. Treatment duration, which is measured by the number of months elapsed from the time at which households received a land title certificate until February 2006, does not have a statistically significant effect on household's real per-capita consumption expenditure at the baseline. Similarly, there is no significant welfare effects from having a land title certificate for either one or two agricultural seasons. Moreover, we have also tested the internal validity of our identification.

In our identification strategy, we have implicitly assumed that land tenure security will affect household welfare if and only if households get certified before the last agricultural season. However, our estimate could be underestimating the actual program effect if households who got certified after February 2006 change their behavior and benefited from the program. To test this implicit assumption, from the control group we classify households who got certified between February 2006 and the last sample survey period (2007) as placebo treated group, and those who did not get certified during the sample period as a control group. If there is any systematic difference in welfare effects of the placebo treatment between the two groups, the average treatment effect in the previous section will be biased and lower bound.

Table A4 in the appendix presents the welfare effects of the program for all households and for poor households using only those who are in the original control group. The first three columns show the effect of land title certification on per-capita consumption expenditure for all households, whereas the last three columns show estimates for the poor households at the baseline. Column (1) and (4) are estimated using the Ordinary Least Square (OLS) with out controlling household size. The DID estimate, indicated by the interaction of the pseudo treatment and the post treatment indicator, is found to be statistically insignificant. In addition, the estimated average treatment effect of the program is found to be statistically insignificant. That is, there is no significant welfare difference between households that received a land title certificate after the last agricultural season and those who do not, which supports our identification assumption. The result seems robust if we use a fixed effect estimation technique without controlling household size in column (2) and column (4) and by taking in to account the household size as depicted in column (3) and column (6).

The fourth concern is that results from binary and continuous treatment indicators also

assume the absence of spillover effects between treated and non-treated households who are living in the same village. However, ruling out the existence of externality without testing may attenuate the credibility of our results. Hence, we use a village level treatment indicator to test the existence of spillover effects. In order to check the existence of spillover effect, we only use households that did not get certified before February 2006. That is, all households who were treated in our binary and continuous treatment analysis are ignored for this analysis. Then, we classify households who are living in villages that started certificate distribution before the last agricultural season as treated and control, otherwise. Estimated results show that there is no any statistically significant welfare difference between households who are living in treated and control villages. This supports the absence of spillover effects between certified and non-certified households with in the village.

Finally, since we use both an IV and DID estimation, we need to test the validity of the instrument. The village level certification indicator, which classifies households who are living in villages (Kebeles) that undergo certificate distribution before the last agricultural season as treated, is used as an instrument. The exclusion restriction is that the household level land title certification program does not affect household welfare once we control for the village level treatment indicator. To test this hypothesis, we run a falsification test as it is presented in Table A5 in the appendix. Column (1) examines the effect of the land title certification program if we use household level treatment indicators. The estimated result reveals that households that received a land certificate before February 2006 have nearly a 400 ETB higher real per-capita consumption expenditure compared to those that did not. Similarly, column (2) presents the effect of the program if we only use village level treatment indicator. Here, we find a 232.4 ETB higher real per-capita consumption expenditure if the household is living in a village that undergoes a certificate distribution before the beginning of the last agricultural season in the sample period. However, if we run our regression by using both village and household level treatment indicators, as is presented in column (3), we do not find any evidence that village level treatment indicator affects real per-capita consumption expenditure. That is, once we control for household level treatment indicator, our instrument does not affect our dependent variable above and beyond its effect through household level treatment indicator.

6 Concluding remarks

Theoretical literature on property rights has suggested that land tenure security can be used as a potential tool for rural development and poverty reduction in developing countries.

Having land rights, by reducing the risk of land eviction, encourage long-term investment on land in the form of tree planting, soil conservation, fertilizer and irrigation use. It has been also argued that a well defined and easily transferable land right relax credit constraints, reduce border conflicts among neighborhoods, and maximizes allocative efficiency through reallocation of factors of production. Despite an extensive theoretical literature, well-defined empirical evidences on the impact of tenure security on welfare of rural poor households as well as the channels through which it affects welfare are limited.

In this paper, we used the Ethiopian land title certification program in Amhara region as a quasi-experiment to examine the effect of the land tenure security on the welfare of the poor. Results from binary and continuous treatment effect models showed that land title certification significantly improved the welfare of poor rural households in Ethiopia. We also documented heterogeneity in the average effects of the program depending on the length of treatment duration. Households who had longer treatment duration gained more from the land title certification program. Decomposing the welfare effects into different channels suggested that labor allocation, specifically hired labor, is found to be the main pathway through which land title certification improves household welfare. Understanding the impact of land tenure security on the welfare of the poor households is key for policy making in developing countries where a large share of the population live in rural area and poverty is pervasive. Decomposing main channels through which land title certification affect welfare can also help policy makers to enhance rural development and poverty reduction by redirecting resources towards these channels.

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7 Appendix

Table A1: Welfare effects of the program : parallel trend test

	All Households		Poor Households	
	(1)	(2)	(3)	(4)
year=2004	951.061*** (11.82)	1131.150*** (10.95)	765.642*** (12.41)	912.331*** (11.83)
Treatment x year=2004	-212.377 (-0.48)	-255.409 (-0.55)	-26.958 (-0.06)	-65.311 (-0.15)
Household size		-239.850*** (-2.91)		-189.588*** (-2.91)
Fixed Effect	NO	YES	YES	YES
Constant	1011.379*** (17.17)	2319.162*** (5.14)	929.107*** (18.19)	1981.490*** (5.38)
Number of Obs.	1086	1086	908	908
wald chi2				

Notes: The dependent variable is real per capita consumption expenditure measured by Ethiopian currency (Birr). During the sample period, one US dollar was equivalent to eight Ethiopian Birr. It is used as a proxy for household welfare. The first two columns depict the estimates for all households in the sample, whereas the last two present the effects of the program only for households who were poor at the baseline. All regressions are the standard DID estimated by including fixed effects. t statistics are reported in parenthesis and standard errors are robust. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table A2: Effects of timing of certification on pre-treatment consumption expenditure

	(1)	(2)	(3)	(4)	(5)
Treatment duration	-1.877 (-0.11)				
One month treatment duration		-297.675 (-1.10)			-366.297 (-1.28)
Seven month treatment duration			-161.141 (-0.64)		-190.681 (-0.74)
One year treatment duration				-3.388 (-0.02)	-7.785 (-0.04)
Village Fixed Effect	YES	YES	YES	YES	YES
Constant	2318.044*** (32.69)	2309.217*** (39.27)	2317.117*** (38.31)	2307.035*** (34.79)	2323.735*** (33.61)
Observations	628	651	651	651	651

Notes: The dependent variable is real per capita consumption expenditure measured by Ethiopian currency (Birr). During the sample period, one US dollar was equivalent to eight Ethiopian Birr. It is used as a proxy for household welfare. Treatment duration is measured by the number of months elapsed from the timing of certification up to the beginning of the last agricultural season in our sample period, February 2006. t statistics are reported in parenthesis and standard errors are robust. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table A3: Internal validity test

	Certification duration	Certification duration
Real Per-capita Consumption Expenditure	0.00009 (0.0001)	0.0004 (0.0003)
Farm Size	-0.048 (0.232)	-0.019 (0.388)
Head Age	0.001 (0.011)	-0.007 (0.022)
Head Male	0.890 (0.569)	2.195 (1.214)
Household Size	-0.071 (0.079)	0.034 (0.168)
Training	0.505 (0.378)	-0.127 (0.711)
Head Married	-0.375 (0.559)	-0.514 (1.120)
Head Education (Read and Write)	-0.210 (0.325)	-0.516 (0.694)
Poor in 2004	0.517 (0.654)	1.683 (1.076)
District Fixed Effect	YES	NO
Village Fixed Effect	NO	YES
Constant	1.985* (1.005)	2.276 (2.302)
Observations	626	286

Notes: The dependent variable is the duration of certification which is measured by the number of months elapsed from the time of certification up to the beginning of the last agricultural season in our sample period, February 2006. t statistics are reported in parenthesis and standard errors are robust. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table A4: Welfare effects of the program: restricted sample

	All Households			Poor Households		
	(1)	(2)	(3)	(4)	(5)	(6)
Pseudo Treatment	12.147 (0.10)			97.084* (1.85)		
post (year=2007)	-93.737 (-0.75)	118.615 (0.83)	178.158 (1.16)	374.251*** (3.92)	428.740*** (4.52)	482.070*** (4.80)
Pseudo Treatment x post	-32.629 (-0.19)	-167.092 (-0.88)	-144.703 (-0.77)	-2.076 (-0.01)	-56.566 (-0.40)	-45.022 (-0.32)
Household size			-150.608* (-1.65)			-131.636* (-1.75)
Fixed Effect	NO	YES	YES	NO	YES	YES
Constant	2302.595*** (24.31)	2241.947*** (50.94)	3178.404*** (5.66)	1771.174*** (50.76)	1804.311*** (57.14)	2638.830*** (5.57)
Number of Obs.	1115	1115	1115	904	904	904

Notes: The dependent variable is real per capita consumption expenditure measured by Ethiopian currency (Birr). During the sample period, one US dollar was equivalent to eight Ethiopian Birr. It is used as a proxy for household welfare. Column (1) and (4) are estimated by Instrumental Variable (IV) estimation technique and the rest are DID models estimated by fixed effect regression. Robust standard errors are reported in parentheses. Column 1 to 3 depicts the estimates for all households in the sample, whereas the last three columns present the effects of the program only for households who were poor at the baseline. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table A5: Welfare effects of the program: Spillover-effect test

	All Households			Poor Households		
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	12.598 (0.10)			102.556 (1.58)		
year=2007	-150.466 (-1.53)	-75.779 (-0.74)	-6.710 (-0.07)	366.096*** (4.88)	386.069*** (4.74)	430.118*** (5.19)
Treatment x year=2007	195.896 (0.91)	14.013 (0.07)	48.794 (0.25)	127.196 (0.61)	-25.358 (-0.14)	8.614 (0.05)
Household size			-153.591*** (-6.78)			-106.954*** (-5.56)
Fixed Effect	NO	YES	YES	NO	YES	YES
Constant	2305.246*** (29.69)	2288.676*** (36.45)	3242.398*** (20.15)	1789.808*** (61.21)	1812.210*** (66.36)	2489.551*** (19.99)
Number of Obs.	1115	1115	1115	904	904	904
wald chi2	3.5			34		

Notes: The dependent variable is real per capita consumption expenditure measured by Ethiopian currency (Birr). During the sample period, one US dollar was equivalent to eight Ethiopian Birr. It is used as a proxy for household welfare. Column (1) and (4) are OLS estimates and the rest are estimated by fixed effect regressions. Column 1 to 3 depicts the estimates for all households in the sample, whereas the last two columns present the effects of the program only for households who were poor at the baseline. t statistics are reported in parenthesis and standard errors are robust. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table A6: Validity of the instrument: falsification test

	(1)	(2)	(3)
	Consumption per capita	Consumption per capita	Consumption per capita
Household level treatment	399.6*** (3.46)		299.0** (2.21)
Village level treatment		232.4*** (3.02)	128.0 (1.42)
Constant	1982.8*** (55.23)	1958.9*** (48.99)	1958.1*** (49.07)
<i>N</i>	1001	1001	1001

Notes: The dependent variable is real per capita consumption expenditure measured by Ethiopian currency (Birr). Village level treatment indicator is used as an instrument for household level treatment. It is used as a proxy for household welfare. t statistics are reported in parenthesis and standard errors are robust. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Figure A1: Map of the study Area



