

Titling, credit constraints and rental markets in rural Peru: exploring channels and conditioned impacts

**Eduardo Zegarra
Javer Escobal
Ursula Aldana**

GRADE

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Motivation

- Peru Rural Title Program is one of the largest in the region (more than 1 million titles). Two phases: 1996-2001 (PTRT 1), and 2002-2006 (PTRT 2)
- Previous impact evaluations (Field and Torero, Zegarra) find no ATT impacts on most variables (income, credit, land markets, investment).
- However, in Zegarra (2006) some impacts start to appear when we analyze specific sub-groups.
- In particular, we are interested in:
 - Differences in impacts for credit constrained/unconstrained farmers
 - Land markets in more densely titled areas
- It is possible than some channels get activated only under certain conditions?

Main effort: empirical estimations using impact evaluation data of a titling program in Peru

- We hypothesize that the impact of titling varies for different subgroups defined according to:
 - Their access to formal credit (so we need a way of measuring unobservable access to credit)
 - The title density in area which affects transaction costs in the local land rental market.
- We estimate the impact of titling for *each* subgroup.

Titling in Peru: procedures and potential biases for an impact evaluation

Titling Process in Rural Peru

- There are four main entities which intervene in the titling process:
 - Aerophotograph National Service (Public Firm, called SAN)
 - PETT-Central Office
 - PETT-Regional Offices
 - SUNARP (National Registry)

SAN is hired by the program to take aerial photos at specific locations.

These locations are required by PETT regional offices.

The Titling Process

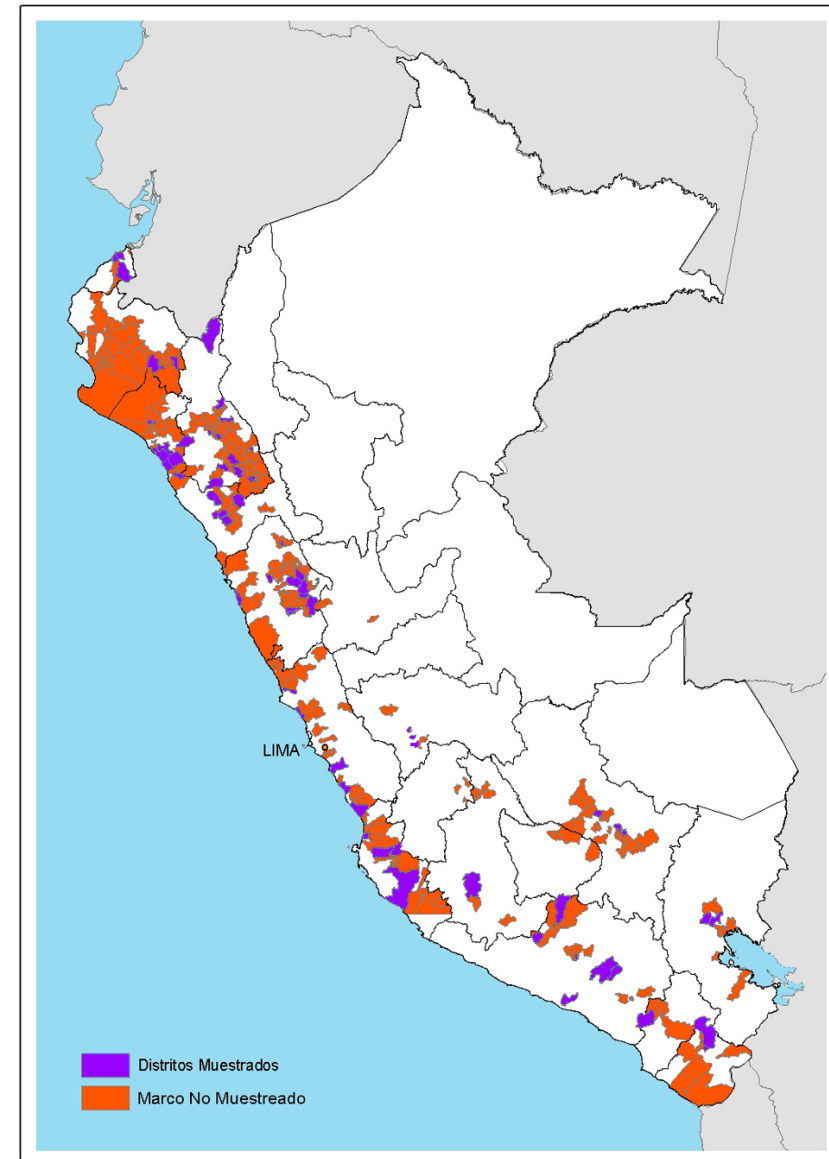
- In regional office use photo and collect information on all the plots in the photo.
- They gather geographical information (demarcation) and about owners, also documents which can be used to show possession or property of the plot. This is the basis for the CADASTER, which is important for this evaluation
- This field information together with documents is combined with the data processed by the PETT (titling) central office to form a legal file which is sent to SUNARP (register).
- In SUNARP they might register the property, observe the request, or reject it altogether.
- After the property had been registered they print the titles in the regional office and these titles are delivered to the communities, mostly in massive ceremonies, but also are picked up by farmers.

Cadaster and the Sampling Process

- Titled and titles-in-process plots are in the cadaster, and we use cadaster 2004 as sampling framework assuming plots in the process of being titled to be appropriate candidates for baseline. Sample was surveyed in 2004 and the same in 2006. Titled plots in 2006 become treatments and non-titled plots are controls

Blue districts: in sample

Red districts: not in sample



Potential biases (household level)

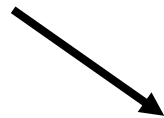
- Migration. Families whose members present higher migration levels might have a lower likelihood of being titled since the owner of the plot might be absent when PETT personnel arrive to the town.
- Access ID. Since these documents are a requisite, the access to these documents should be correlated with the access to a PETT title.
- Conflicts. The presence of conflicts would be correlated with the access to a title, since PETT personnel do not process plots under conflict.
- Rejection of the title. Some farmers are not willing to cooperate with titling process, since they are afraid of being taxed, as a consequence of being titled. Some characteristics that might be positively associated with rejection include risk aversion.
- Human capital. Higher levels of human capital might be associated with receiving the title faster, since mistakes in the legal file, delay the process and are less likely to occur when the farmer has a higher human capital level.

Potential biases (community level)

- Land productivity. The regions that present higher levels of productivity might receive preferential treatment, by the PETT office, in the titling process. This preferential treatment might be traduced in higher productivity regions being titled earlier.
- Land fragmentation. The impact of land fragmentation on the likelihood of being titled earlier is ambiguous. More fragmented zones could receive a lower priority since they imply lower levels of profitability for agriculture. On the other hand, more fragmented zones imply that a higher number of titles could be delivered in less time.
- Isolation. More isolated areas might receive lower priority since they imply higher logistic costs.

Included observable variables in participation equation.

and excluded from control group those plots with conflicts and also those whose owner say they would not want title (in EMA 2005)



Determinants of receiving a title at the plot level

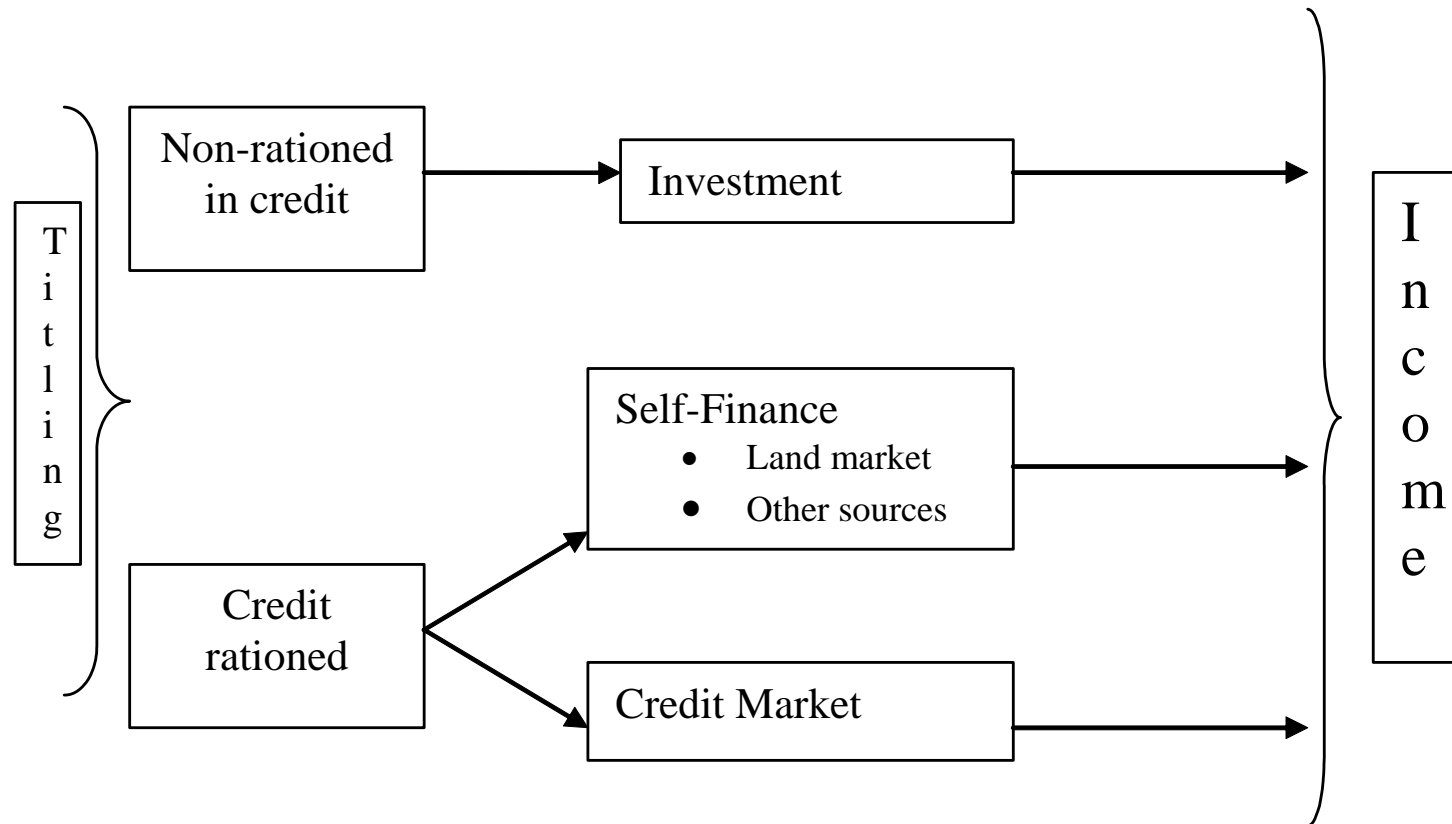
(Marginal effects of a probit model)

	Between 2002 and 2004		Before 2002	
	Coef	Std Err	Coef	Std Err
Individual Characteristics				
Area owned (hectares)	-0.0050	0.0021 **	-0.0036	0.0016 **
Age of head (years)	0.0039	0.0017 **	-0.0002	0.0011
Years of education of head	0.0049	0.0053	-0.0098	0.0038 ***
Mother tongue of head is spanish	0.1619	0.0436 ***	-0.2716	0.0279 ***
Family size	-0.0121	0.0096	0.0355	0.0064 ***
Time from plot to farmer house	-0.0001	0.0007	0.0014	0.0004 ***
Plot has high slope	0.0307	0.0739	0.1177	0.0490 **
Plot is in middle altitude area	0.0061	0.0468	0.1064	0.0304 ***
Plot is in high altitude area	0.2027	0.0481 ***	0.0684	0.0351 *
Percentage of plot with irrigation	0.0012	0.0005	0.0019	0.0003 ***
Index of erosion in plot	0.0267	0.0296	-0.0431	0.0220 **
Index of quality of plot	-0.0830	0.0450 *	-0.0683	0.0279 **
Index of livestock	0.0000	0.0000	0.0000	0.0000
Area of the plot	-0.0002	0.0052	-0.0034	0.0043
Head has ID	0.1516	0.0597 **	0.0253	0.0404
Spouse has ID	-0.0502	0.0574	-0.0331	0.0365
Group Characteristics				
Time from plot to province capital	-0.1801	0.0457 ***	0.0289	0.0315
Time from plot to district capital	-0.0013	0.0002 ***	0.0003	0.0002 **
Level of land concentration (district)	-9.5688	1.7134 ***	-9.0545	1.0941 ***
Value of production per hectare (district)	0.0328	0.0197 *	-0.0011	0.0108
<hr/>				
Number of obs		845		1794
LR chi2(20)		188		303
Prob> chi2		0.0000		0.00000
Pseudo R2		0.1608		0.1217

Source: GRADE-CUANDO Final Households Survey

The credit channel

Different impacts according to (non-observable) credit rationing regimes



Titling Impact for Credit rationed and non Credit rationed households

- We estimate the impact of titling according to whether the household is rationed in their access to credit or not.
- To determine if the household is rationed or not, we estimate a mixture model. In these type of models, it is not observed to which regime the household belongs.
- Guirkinger and Boucher (2006) showed formally that if the household was rationed in the formal credit market their productivity (value of production per hectare) will depend on their resource endowments (labor (family size) and land. On the other hand, if the household is unconstrained in the formal credit market, their productivity will not depend on their endowments.
- We estimate a model characterized by two regimes (credit constrained and credit unconstrained) and for each regime we estimate the determinants of income per hectare

Credit constraint model

- Formally, we characterize the household behaviour in a three equation model:

$$C^* = z\gamma + \eta$$

$$y^c = x\beta_1 + \varepsilon_1$$

$$y^u = x\beta_2 + \varepsilon_2$$

The household will be credit constrained if $C^* < 0$, and the outcome variable (income per hectare) depends in a different manner on the variables x , according to their situation in the credit market. The likelihood function is given by:

$$\Pr(\eta < -Z\gamma / Z, \varepsilon_1) f(\varepsilon_1) + \Pr(\eta \geq -Z\gamma / Z, \varepsilon_1) f(\varepsilon_2)$$

Estimation results

Net Income According to Credit Rationing Regime (based on endogenous switching)				Net Income According to Credit Rationing Regime (based on endogenous switching)			
	Switching	Ex-ante Constrained	Ex-ante Unconstrained		Switching	Ex-ante Constrained	Ex-ante Unconstrained
	Equation	Net Income per hectare	Net Income per hectare		Equation	Net Income	Net Income
Title	-0.315 *** (0.04)	904.168 *** (284.56)	-87.418 (104.43)	Erosion Index	0.547 *** -0.03	-2257.993 *** -196.725	-47.802 -95.619
Land Size	-0.01 *** (0.00)	140.506 *** (20.09)	-1.444 (7.27)	Percentage of plots in high altitude land	-2.011 *** (0.06)	-1071.398 ** (651.22)	193.692 (196.14)
Fragmentation Index	-1.734 *** (0.10)	11158.95 *** (968.96)	-50.348 (268.12)	Percentage of plots with high slope	-0.967 *** (0.06)	3312.869 *** (479.55)	58.516 (154.72)
Maternal Language is Spanish	0.892 *** (0.04)	-3559.34 *** (528.95)	-68.694 (130.21)	Quality Index	-0.009 (0.01)	569.907 * (362.98)	27.807 (22.28)
Years of Education	-0.04 *** (0.01)	135.857 *** (40.15)	-2.22 (15.05)	Number of Male Adults	-0.011 (0.02)	-62.229 (128.88)	10.574 (47.81)
Gender (Head of household is	-0.665 *** (0.05)	429.178 * (279.31)	-59.303 (155.68)	Number of Female Adults	0.022 (0.02)	-120.885 (124.53)	-48.807 (47.36)
Age of head of household	0.017 *** (0.00)	-109.782 *** (12.66)	-3.643 (4.12)	Number of Children	0.562 *** (0.03)	-1450.382 *** (217.83)	-33.361 (81.99)
Remoteness (time to district capital)	0.001 *** 0.00	3.017 *** (1.50)	-0.921 (0.72)	Formal Financial Institutions	0.382 *** (0.05)		
Percentage of irrigated land	0.001 0.00	25.139 *** (0.05)	-1.449 (0.02)	Title density in district	0.295 *** (0.06)		
Distance from district capital to province capital	-0.513 *** (0.04)	2243.435 *** (274.95)	218.083 (100.03)	Constant	-1.114 *** (0.15)	767.358 (1559.46)	124.073 (401.68)
			**	Adjusted R- squared	0.8277	0.8006	0.0326

Titling and presence of formal credit institutions

Random effects panel probit regression on the presence of financial institutions in the community

	Coef.	Std. Err.
Titling density	0.09	0.89
Year	0.22	0.09 ***
Irrigation Infraestructure	0.96	0.52 **
Access to Electricity	0.56	0.52
Access to paved highway	1.05	0.69
Constant	-443.82	182.17 ***
Town specific effects		
Titling density	0.43	1.27

Number of towns

137

Number of years

7 (2000-2006)

Source: 2006 Cadastre and community survey.

**Impact of Titling According to Credit Rationing Regime
(based on endogenous switching model)**

	Highly Credit Unconstrained		Highly Credit Constrained	
	ATT	Std Dev	ATT	Std Dev
Total Income	2247.50	4795.30	-1378.32	2631.81
Non Agricultural Income	-2786.44	3869.58	1124.26	2007.97
Wage Income	-3126.18	2553.41	1319.05	1600.73
Non Wage Income	248.37	2716.86	227.68	941.87
Agricultural Income	5033.12	3556.28	-2502.58	1597.90
Livestock value	1762.44	1229.62	1285.21	1353.49
Supply of Land (tenancy or rent)	-0.11	0.12	0.11	0.14
Supply of Land (tenancy, rent or loaned)	-0.08	0.13	0.17	0.17
Access to formal credit	-0.09	0.10	-0.11	0.09
Investment in Instalations	0.05	0.13	0.01	0.10
Investment in Permanent Crops	0.20	0.12	0.14	0.11
Investment in Conservation Practices	0.06	0.12	0.05	0.09
Agric Inc per Hectare	-337.83	388.24	-557.97	613.73

Initial results for credit model

- The access to formal financial institutions and titling density of the area increase the likelihood of not being credit constrained
- There is no relationship between titling and higher presence of formal financial institutions, so title density does not seem to be “attracting” more formal credit suppliers to rural areas
- Only one impact detected using the credit model, investment in permanent crops for credit unconstrained (who make this effect to occur at the aggregate). Some evidence of an impact on rental land market supply for credit constrained.

The land rental market channel

Titling and the land rental market

- As usual: individual titling increases the likelihood of offering the plot in the land rental market because titling decreases the probability of eviction of the rented land.
- Additionally: a massive increase in the number of titled plots in the area may increase the number of transactions in the land rental market (through the individual effect of titling multiplied by n), and this change decreases search costs (that characterize thin markets).

- Formally, the household maximizes the following income function:

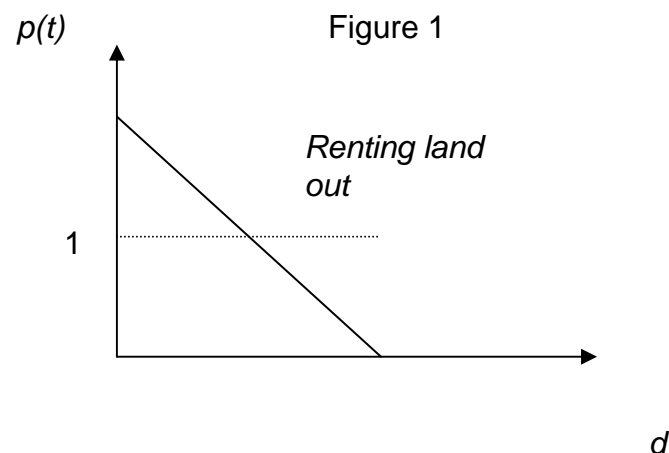
$$\underset{R^o R^I}{Max} \quad A_i F(T + R^i - R^o) + R^o (r - c(d)) - R^I (r + c(d)) + v(p(t)T + (1 - p(t))(T - R^o)) \quad (3)$$

- A_i is a parameter that represents technology,
 - F is the agricultural production function,
 - T is the household's endowment of land,
 - R^i is the amount of land rented in,
 - R^o is the amount of land rented out,
 - r is the land rental rate,
 - $c(d)$ are the transaction costs, which depend on the titling density: d
 - v is the sale price of one unit of land and
 - $p(t)$ is the probability of the land rented out not being evicted,
 - t is 1 if the plot is titled and 0 otherwise
- It will be profitable for the household to leave the autarchy regime and rent land out if the following condition holds:

$$(r - c(d)) \geq A_i F_T(T) + v(1 - p(t)) \quad (4)$$

- In autarchy the marginal income of renting one unit of land is greater or equal to the marginal cost of renting one unit of land
- We can see that having a title will decrease the marginal cost of renting one unit of land and an increase in d will increase the marginal income of renting one unit of land

- The last equation defines a threshold (which depends on the parameters of the model) that determines if a household will rent land out or not. Taking the technology parameter, the land endowment and prices as given, we can graph the threshold as a function of $p(t)$ and d :



- For very low values of titling density, the access to a title may not be enough in order for the household to change her regime.
- A household characterized by a higher titling density, will be more likely to actually respond to this increase in $p(t)$, by renting land out

- We expect the impact of titling to be higher in areas characterized by a higher levels of titling density.

Matching estimators of impact of titling on renting out land

	Treated	Controls	Difference	S.E.	T-stat
Unconditioned impacts					
Land rented out or sharecropped	0.022	0.020	0.002	0.018	0.09
Land rented out, sharecropped or lent	0.024	0.034	-0.011	0.020	-0.52
For plots in sectors of high density					
Land rented out or sharecropped	0.021	-0.040	0.060	0.033	1.84 *
Land rented out, sharecropped or lent	0.021	-0.019	0.039	0.038	1.04

So, there is evidence that land rental markets can be activated by titling due to accumulating (high density) effects

Conclusions

- Standard impact evaluations based on ATT estimates may not be enough for uncovering some channels and conditioned impacts from titling.
- Exploring conditioned impacts may allow for better design of future impact evaluation of titling program. Specifically, more careful attention to credit and land markets (better sampling strategies)
- So far, in Peru there was no clear relationship between titling and credit supply, so there is no much of a credit channel and we did not find that titling is impacting differently according to credit access
- We found evidence that massive titling may be more effective for promoting land supply effects given impacts on transaction costs.