



*INTER-AMERICAN DEVELOPMENT BANK
BANCO INTERAMERICANO DE DESARROLLO
BANCO INTERAMERICANO DE DESENVOLVIMENTO
BANQUE INTERAMÉRICAINÉ DE DÉVELOPPEMENT
WORKING PAPER CSI-154*

**TITLING AND CHRONIC DISEASES:
EVIDENCE FROM A NATURAL EXPERIMENT
IN URUGUAY**

BY

NÉSTOR GANDELMAN

UNIVERSIDAD ORT URUGUAY

DECEMBER 2008

**TITLING AND CHRONIC DISEASES:
EVIDENCE FROM A NATURAL EXPERIMENT IN URUGUAY**

Néstor Gandelman¹
Universidad ORT Uruguay

¹ The author wishes to thank the help of Giorgina Piani in the survey design and the work of the Odaly Triay as survey team leader. Jimena Chiara and Federico Montossi provided valuable research assistance. Finally, comments and suggestions by Ernesto Schargrodsky, Hugo Ñopo, Suzanne Duryea and Karen Macours were of much help. All errors are the author's own responsibility.

Abstract

In this paper we exploit a natural experiment to study the effects of granting formal property rights on health. Titling could improve health outcomes through various channels: housing investment, income or family cohesion. We found that titling diminishes the probability of suffering several chronic diseases (hypertension, diabetes, sinusitis and rheumatism) but could not find supporting evidence for the housing channel.

Keywords: Property rights, land titling, natural experiment, chronic diseases, health

JEL Classifications: Q15, P14, I19

1. Introduction

The goal of this paper is to study the effect on health of granting formal property rights to low-income households. Several types of effects have been argued that could be related to land and housing titling. These effects range from access to credit markets, to investment and real estate, and to personal values and beliefs. The results on the literature so far are somewhat mixed. The only area with a growing consensus is on the impact on housing investment and real estate values.²

A better housing environment is associated with better water distribution within homes, healthier treatment of fecal evacuation and garbage disposal, safer heating systems and better soil quality. The causal impact of housing on health, as intuitive as it is, has received little attention from the academic community. Notable exceptions are Cattaneo et al. (2007), who report reductions in parasitic infections after improvements in floor quality in Mexico, and Duvall and Booth (1978), who report beneficial effects of better housing environment for women in Toronto.³

Accepting that titling has a positive impact on housing environment and that housing quality has a positive impact on health, it could be argued by transitivity that housing titles should have an impact on health and that housing quality is an important channel.

In theory there are other channels for titling to produce and impact on health. Assuming that health services are normal goods, lower-income families are prone to worse health coverage. De Soto (2000) hypothesizes the existence of a virtuous circle in which the conferral of property rights would lead to access to credit markets, which could be used to improve productive activities and in turn increase access to credit. The empirical support for such a channel is low, as discussed in Galiani and Schargrodsky (2006) and Field and Torero (2003). Nonetheless, Field (2003) suggests that those who lack secure title may be required to protect their houses, thus reducing adult labor supply and family income. Either through the suggestions of De Soto (2000)

² Most studies found beneficial effects (see, for instance, Jiménez, 1984; Besley, 1995; Alston, Libecap, and Schneider, 1996; Lanjouw and Levy, 2002; and Jacoby, Li and Rozelle, 2002. On the contrary, there is a puzzling result that in Africa investment could be carried out in order to secure land tenure (Brasselle, Gaspard and Platteau, 2002).

³ For a review of the literature see Dunn (2000).

or the findings of Field (2003), the lower income of untitled families is likely to result in worse health outcomes.⁴

Galiani and Schargrotsky (2004) and more recently Vogl (2007) are the only analyses of the connection between titling and health. Both papers use anthropometric measures to address the impact of titling on children's health. Galiani and Schargrotsky (2004) exploit a natural experiment in suburban Buenos Aires (Argentina) and find better weight-for-height indicators but no effect on height for age in children. Vogl (2007) uses data of a child health survey of several communities in Peru where a massive land-titling program was undertaken and also finds increments in weight but not in height. In spite of their similar findings, the two studies interpret those findings differently. While Galiani and Schargrotsky (2004) suggest that titling is associated with short-run improvements in children's nutrition, Vogl (2007) disagrees, arguing that the weight of the children under study in the Argentinean case is close to the median international standard and presenting evidence of increases in overweight risk in the case of Peru.

Our paper has some points in common and some differences with these previous studies. First, as in Galiani and Schargrotsky (2004), our database is composed of a small-scale natural experiment. Although the Vogl (2007) results are robust to the inclusion of several exogenous controls, the author acknowledge baseline differences between the control and treatment groups, implying that the Peruvian program was not a natural experiment. Second, our paper focuses on the relation between titling and health, but instead of looking indirectly through anthropometric measures we focus on health outcomes (i.e., incidence of a wide range of diseases). Therefore, we avoid the discussion on the interpretation of the results. Third, our analysis is carried out for the whole population and not only for children. Finally, we explore the plausibility of the better housing environment channel.

According to our results, effective land titling is associated with certain improvements in health status. Titling diminishes the rates of several chronic diseases: hypertension, diabetes, sinusitis, rheumatism and, for females, skin infections. We could not find supporting evidence for the housing channel.

⁴ Pereyra, Rossi and Triunfo (2003) estimate Engel curves for different goods and services related to health care and found that expenditure in health care in Uruguay is a luxury good (income elasticity above 1) for the poorest.

The paper proceeds as follows. Section 2 presents the experiment and estimation strategy, Section 3 reports the results and finally Section 4 concludes.

2. The Experiment

The main methodological problem common to all titling studies is how to isolate the true effects of titling from other variables that are normally jointly determined. For instance: wealthier people are more likely to own their home and to have better health results.

Latin American household surveys differentiate housing tenure choices between those who own and have already finished paying, those that own and are still paying, those that rent and occupants that do not have any formal rights over the house where they are living (although the owner may in some cases be allowed them to live there). Recently, Gandelman (2007) presents evidence of gender differential probabilities of being a homeowner. In this paper the author analyses household surveys of 17 Latin American countries and presents summary statistics showing that owners are in general older, richer and more educated than non-owners.⁵ This type of analysis, although interesting and useful for other considerations, is unable to capture the effects of homeownership on any variable of interest. In fact, the opposite is the case, as it is natural to think that factors such as income, age, health, or life-cycle status determine homeownership.⁶

In this paper we use data from a natural experiment in Uruguay concerning nine small neighborhoods. These neighborhoods were formed by ex ante homogeneous households, but formal property rights could be assigned only to members of three communities due to reasons that are independent of any characteristic of the families living there or in the other communities.

Uruguay's Instituto Nacional de la Vivienda Económica (INVE, National Institute of Inexpensive Housing) was a public institution established in 1937 by Law N° 9.723 to provide affordable housing for low-income families. Several decades later, the Ministry of Housing was created in 1974 by Law N° 14.218 as the central public institution in charge of housing policies. At that time the INVE came under its jurisdiction.

In the mid-1970s the INVE built 13 small neighborhoods to meet the housing needs of its target. These neighborhoods, known as "comunidades" (communities), are the following: 18 de

⁵ However, the author also reports that owners and renters are very similar in many dimensions, and the main differences are between them and occupants.

⁶ The literature on the determinants of homeownership goes back at least as far as Kain and Quigley (1972).

Julio, Lavalleja, 25 de Agosto, 19 de Abril, Independencia, Sarandí, Rincón, Guayabos, Grito de Asencio, Las Piedras, Misiones, 19 de Junio and Ituzaingó.

In all cases purchase agreements were signed and implicit mortgage contracts were in place.⁷ Most of the communities were constructed on land owned by the INVE, and three communities were built on land owned by the Municipality of Montevideo (Misiones, 19 de Junio and Las Piedras). One community, Ituzaingó, was built on land of undetermined ownership.

Shortly after these communities were built, the Ministry of Housing was eliminated by Law N° 14.656 in May of 1977. The INVE was eliminated by Law N° 14.666 of the following month, and INVE's mandate and assets were assigned to the state-owned mortgage bank, Banco Hipotecario del Uruguay (BHU). Over the following decade various institutions were officially in charged of managing these communities. Such management entailed providing several public goods, receiving the payments implied in purchase agreements, transferring the formal property rights to those that finished paying and initiating the legal actions to force the sale of the property of those that did not comply with the required payments. In theory this last action should end up with the auction sale of the property and the transfer of title to the new landowner. As detailed in the next paragraph, the institutions involved in this task were not interested in the active management of the communities. Even though the entire population of the communities eventually stopped paying the required installments, authorities took no action whatsoever.

In November 1977 the BHU and the Ministry of Education signed an agreement in which the Ministry of Education would take over management of communities built on land currently owned by the BHU (formerly owned by the INVE and under the Ministry of Housing management). In January 1980, the Ministry of Education and the Municipality of Montevideo agreed to a joint management of the communities Misiones, 19 de Junio and Las Piedras, which were built on land owned by the municipality. In July 1984, however, the Ministry of Education transferred the management of all the communities to the Municipality of Montevideo (file N° 472.993), and in March 1987 the Municipality rejected this last agreement with the Ministry of Education, informing the BHU that it should take care of the management of the communities built on BHU-owned land.

⁷ See Figure 2 in the Appendix for a scan of an original mortgage agreement of one family from Guayabos.

In December 1987, the Executive branch of Government established a task force, including representatives of the Ministry of Education, the Ministry of Labor and Social Security, the BHU and the Municipality of Montevideo, to study the 13 communities' situation. The panel concluded that no institution was really taking care of the management of the communities and assuming that management would represent an excessive cost for the BHU. It was therefore in the best interest of the BHU to sell the houses to their occupants at whatever price they were able to pay. The board of the BHU approved these findings in November 1988.

The BHU subsequently set a nominal price of 10 U.R. (unidades reajustables), equivalent to approximately \$100, for those occupants who could not prove that they had made any previous payment. Those who made at least one previous payment were required to pay only titling expenses; the BHU negotiated a special agreement with the professionals in charge of titling registration (Asociación de Escribanos del Uruguay) so that those expenses were only about 2 UR (approximately \$20).

Although the BHU had decided to dispose of the property of these communities and there was the political support to sell them at an extremely low price (which was merely a nominal figure), the sale of the houses and the assignment of the formal property rights to the occupants could take place in only three communities (18 de Julio, Lavalleja, and 25 de Agosto). The other communities could not benefit from this political decision because there were no registered plans (area maps with the land division among houses) at the Municipality of Montevideo. As the architecture of the houses in all communities was basically the same, we could not find any reason why maps were registered in some cases and not in others. Families were apparently assigned to communities without authorities' knowing whether maps were or at some point would be registered with the municipality.

As shown above, inhabitants' ability or inability to acquire formal property rights in the early 1990s was not related to their personal characteristics. This situation therefore provides us with treatment and control groups for evaluating the effects of land titling.

2.1. Definition of the Treatment and Control Group

Table 1 summarizes aggregate information about the communities according to original information from the 1970s.

Table 1. The communities				
Name	Address	Number houses	Original owner of the land	Area maps
19 de Abril	Camino Maldonado y Rosario	98	INVE-BHU	No
Ituzaingó	Camino Maldonado y Barros Arena	60	Unknown	No
Independencia	E. Castro y A. Saravia	98	INVE-BHU	No
18 de Julio	A. Saravia y Trápani	34	INVE-BHU	Yes
Sarandí	Camino Carrasco y Oncativo	130	INVE-BHU	No
Rincón	Camino Carrasco y Oncativo	52	INVE-BHU	No
Grito de Asencio	Camino Carrasco y Oncativo	65	INVE-BHU	No
25 de Agosto	Irureta Goyena y Serratos	52	INVE-BHU	Yes
Las Piedras	Callao y Calamet	36	Municipality of Montevideo	No
Misiones	A. Saravia y San Martín	540	Municipality of Montevideo	No
Lavalleja	Camino Santos y Carcot	84	INVE-BHU	Yes
Guayabos	Camino Lecocq y A. Saravia	150	INVE-BHU	No
19 de Junio	Río de Janeiro y Haití	456	Municipality of Montevideo	No

In order to evaluate the effects of land titling, we define a treatment group to whom formal property rights were assigned and a control group that did not attain ownership. The treatment group is composed of a total of 71 households (314 individuals) from communities 18 de Julio, 25 de Agosto and Lavalleja that were awarded formal property rights.

The definition of the control group is somewhat more problematic because we do not want the control groups to differ from the treatment group in either observable or unobservable characteristics. To define our comparison exercises, we use two observable characteristics of the communities: the original landowner and the community location.

First, the Municipality of Montevideo was the owner of the land where the communities of Misiones, 19 de Junio and Las Piedras were built, and at several points in time their management differed from that of the other communities. In addition, the first two communities are much larger than the rest, and there may be size effects with potential impact on their development. Moreover, the task force of the 1980s was not able to establish the landowner of the Ituzaingó community. This lack of information is puzzling and may be reflecting conditions different from that other communities. Second, the ideal control should be contiguous to a treatment community, but communities were built in various areas of the city of Montevideo.

Table 2 classifies the 10 potential controls according to geographical proximity to one treatment community and according to the original landowner. Figure 3 in the Appendix presents a map of Montevideo with the locations of each community.

Table 2. Controls		
	Contiguous	Non-Contiguous
Same owner as treatment (BHU)	Independencia (18 de Julio)	19 de Abril Grito de Asencio Sarandí Rincón Guayabos
Different owner (BHU)	Las Piedras (25 de Agosto)	Ituzaingó Misiones 19 de Junio

With these factors in mind, we decided to work with communities that were built in land owned by the INVE-BHU, we surveyed all households in the intention to treat communities of 18 de Julio, 25 de Agosto and Lavalleja, as well as in the Independencia community. For the rest of the communities (19 de Abril, Grito de Asencio, Sarandí, Rincón and Guayabos) we extracted a random stratified sample of these communities. The sample of 165 houses implies an estimation error of approximately +-5%.

2.2. Pretreatment Characteristics

In order to be sure that the exercises are adequately defined, we need to show that the pre-intervention characteristics of the intention to treat and control groups are reasonably similar. With this purpose in mind we located the original files signed in the 1970s for the communities built on INVE's, which contained information on the following socioeconomic indicators of the original occupants: family composition, presence of children, age, income level and working status.⁸

⁸ Not all the files could be located. Overall we located 82 percent of the files of the communities that we are using in our exercises according to the following break-out: 19 de Abril, 98 percent; Independencia, 96 percent; 18 de Julio, 85 percent; Sarandí, 71 percent, Rincón, 94 percent; Grito de Asencio, 89 percent; 25 de Agosto, 90 percent; Lavalleja, 69 percent; and Guayabos, 70 percent..

Table 3 demonstrates that, indeed, ex ante the populations of the intention to treat and control groups were very similar. Both groups have a very large percentage of households with female heads (44 percent and 46 percent, respectively). Although we could not confirm this, the high rate female headship may result from INVE assignment policies targeting groups traditionally considered fragile.

The construction of houses followed the same design in all communities (the perimeter of the house was a rectangle with an outside bathroom). The only difference was in the amount of rooms, which averaged 2.6 for the controls and 2.3 in the intention to treat communities.

The family structure was also very similar. Houses in control communities were inhabited by an average of 5.0 individuals (47 percent of them minors) while in intention to treat communities there were on average 4.6 family members (42 percent minors).

The schooling attendance rate was 81 for control communities and 85 for intention to treat communities. While data from the 1970s are not available, the comparable figure for Montevideo's 2006 Household Survey was 90 percent. Finally, overall there do not seem to be overall differences in either employment (59 percent vs. 58 percent) or income.

Table 3. Pretreatment characteristics								
		%female household heads	Rooms	Family members	% minors	Schooling attendance	Employment rate	Income
Control	mean	44%	2,6	5,0	47%	81%	59%	471
	sd	(50%)	(1,0)	(2,7)	(27%)	(32%)	(31%)	(284)
Intention to treat	mean	46%	2,3	4,6	42%	85%	58%	449
	sd	(50%)	(0,9)	(2,5)	(28%)	(29%)	(31%)	(306)
Total	mean	45%	2,5	4,9	46%	82%	59%	466
	sd	(50%)	(0,9)	(2,6)	(28%)	(32%)	(31%)	(290)

2.3. Field Work

The survey was conducted during February-March 2007 by a team of four welfare workers and one sociologist especially trained to deal with populations in difficult socioeconomic environments.

The first stage of the census involved a census of the Independencia, 18 de Julio, 25 de Agosto and Lavalleja communities with a total target number of 268 surveys. The second stage was the survey of a sample of 165 houses in the communities of 19 de Abril, Grito de Asencio, Sarandí, Rincón and Guayabos. In 14 cases the survey could not be administered because the

inhabitants were not found at home after three attempts (10 cases) or declined to answer (four cases). The attrition rate of the census stage was 2 percent, and that of the sample stage was 5 percent. Thus we end up with 416 household surveys corresponding to 1,793 individuals.

2.4. *Estimation Strategy*

Once the exogeneity of the housing titling is established, the identification of the causal effects of land titling follows from simple econometric techniques. In this scenario there are two concerns that need to be addressed: non-compliance and attrition.

Although each family in the three intention to treat communities could have benefited from property rights, only about half of them went through the steps necessary to obtain formal rights. This non-compliance may be associated with personal or family characteristics (laziness, lack of knowledge of opportunities, family disputes, etc.) that may also impact on the variables under study. In order to avoid this situation, we run in all cases two sets of regressions. In the OLS or Probit regressions we use a dummy variable that takes the value 1 for the intention to treat communities. We also run instrumental variables regressions where we instrument the treatment (availability of property rights) with the completely exogenous intention to treat (all houses in the 18 de Julio, 25 de Agosto and Lavalleja communities).

By 1995, it was known which communities could benefit from transfers of property rights. As those who moved into the treatment or control communities after that date may have different characteristics than those who arrived before, and they may also differ between the treatment and control communities, we use data only for those who arrived before 1995. The final database is composed of 1,093 individuals.

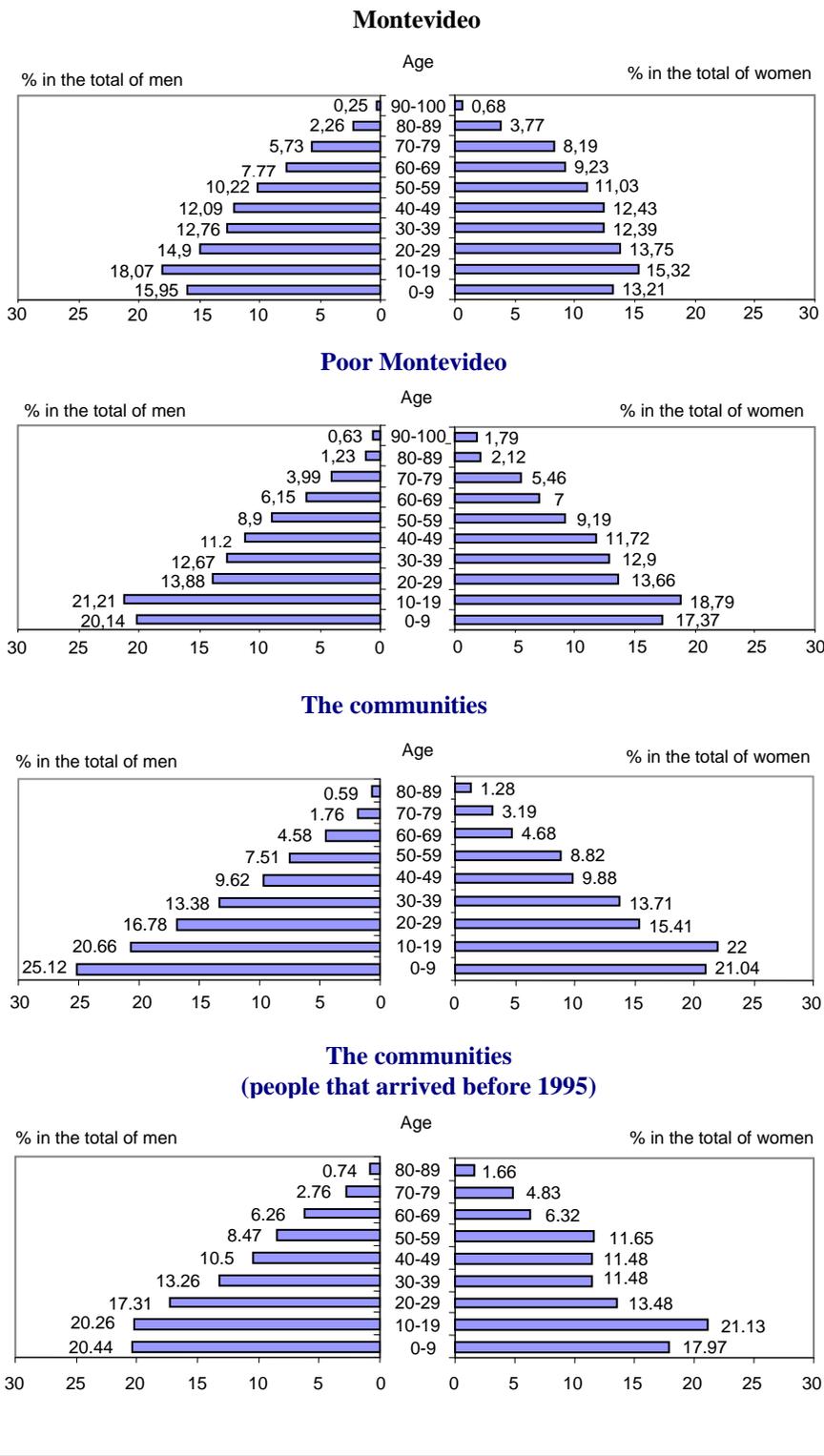
3. Results

3.1. *Demographics*

A stylized fact of Uruguayan income distribution is that children and adolescents are overrepresented in the poorest sector of society. This phenomenon is the combined result of higher fertility rates among poorer women and the constitutional reform of 1989 establishing that pensions should be quarterly quarterly by past CPI variation. This reform produced significant improvements in the relative economic situation of the elderly.

Figure 1 reflects that the demographics of the communities resembled those of the lowest socioeconomic level of Montevideo, with an overrepresentation of children and adolescents even stronger than the population classified by the National Institute of Statistics (INE) as having low socioeconomic level. It should also be noted that there are indeed differences between the population that arrived after 1995 and those that lived in the communities previous to that time; In particular, newcomers are on average younger than previous residents. Therefore, the population pyramid excluding the newcomers is more similar to the pyramid of the lowest stratum of Montevideo than the pyramid of the communities as a whole.

Figure 1. Population Pyramids



3.2. *Health indexes*

In our survey we asked about a detailed list of possible illnesses, and in Table 4 we classify health problems according to whether they are more or less related to housing condition. For instance, respiratory and infectious diseases have a direct relation with the quality of the living environment. On the other hand, hypertension or diabetes are more related to genetics and dietary habits.⁹

We then constructed a summary health index based on the presence or absence of diseases. Each disease that an individual suffers adds a point to his personal index. In the same fashion we also generate a summary index of housing related and non-housing related diseases. The overall index ranges from 0 to 7, and the housing-related and non-housing related indexes range from 0 to 4.

The mean value of the general index is 0.8 indicating that on average most people have at least one of the diseases of the list. The control population seems to have a worse health situation, with index values above those of the treatment (0.84 vs. 0.75). The greater prevalence of illness among the untitled, however, is produced mostly by non-housing related diseases. In the control, the mean value of the non-housing health index of 0.49 indicates that on average one in every two persons has one of those diseases. The mean value of the housing related index suggests that one every three persons has a housing-related illness.

The INE's household survey gathers information on a subset of the health conditions included in our survey. The values for hypertension and diabetes for the communities are reasonably similar to those of Montevideo as a whole. Surprisingly, however, the lower stratum of Montevideo has fewer people suffering from them. There are two complementary explanations for this. First, as shown in Figure 1, the age composition of the poorest sector is biased in favor of younger cohorts that are less likely to suffer from hypertension and diabetes. Indeed, if we compare the prevalence of these illnesses in the communities and in the city of Montevideo while restricting our comparison to the younger cohorts the differences vanishes. The second reason is that some diseases may be under-diagnosed among the poorest sectors (i.e., some people that suffer from these or other diseases do not consult with a physician or do not complete the required tests and examinations, thus failing to obtain a precise diagnosis).

The most common diseases in the population under study are hypertension, asthma and allergies, and there is no clear of differences between the intention to treat and control communities. The control communities have worse figures for hypertension, diabetes, sinusitis, rheumatism and other illnesses, but the intention to treat communities have higher rates of psychiatric disorders, intestinal parasites and allergies.

Table 4. Diseases (% of people suffering from them)					
	Control	Intention to treat	Total	Montevideo	Poor Montevideo
Health Index	0,84	0,75	0,80		
Health Index (no housing)	0,49	0,38	0,44		
Hypertension	15,5%	9,2%	12,6%	12,7%	10,6%
Diabetes	5,4%	1,2%	3,5%	3,9%	3,5%
Psychiatric disorders	6,9%	7,2%	7,0%		
Disabilities	4,1%	4,0%	4,0%		
Other illnesses	17,1%	16,0%	16,6%		
Health Index (housing)	0,35	0,38	0,36		
Asthma	9,3%	9,8%	9,5%		
Sinusitis	2,2%	0,8%	1,6%		
Other respiratory illnesses	4,2%	4,2%	4,2%		
Rheumatism	8,3%	5,4%	7,0%		
Intestine parasites	0,5%	4,2%	2,2%		
Allergies	8,8%	11,8%	10,2%		
Skin infections	1,4%	1,4%	1,4%		

Table 5 presents the regression results for the health indexes. We run three types of regressions. The first is a simple OLS against an exogenous dummy that takes the value 1 in the intention to treat communities. The second is an instrumental variable lineal regression where we instrument the effective availability of formal property rights by the intention to treat dummy. A deficiency of both previous types of regressions is that the health indexes have a discrete distribution and therefore it may be appropriate to estimate an ordered probit model.

According to the point estimate of the three estimation techniques, people living in the titled parcels experience lower rates of chronic disease, but the result is not statistically significant. This eventually better structural health status of titled individuals, however, does not result from lower rates of housing-related diseases. On the contrary, the only significant results

⁹ We acknowledge that there is room for discrepancy in the disease classification here presented. For instance, it could be argued that psychiatric disorders are exacerbated in overcrowding environments and that therefore they

are for the regression of the non-housing related index, which show that titled individuals suffer less from those diseases. Therefore the evidence so far does not support the housing investment channel.

We have argued that our data come from a natural experiment, but in order to check the robustness of our results in we include in Table 6 a set of controls for pretreatment characteristics. The control variables, all defined at the household level, are the following: number of family members, percentage of minors, a dummy if the household head is a female, the percentage of adults that were employed and total household income. The drawback of this analysis is that since we were unable to locate all the files from the 1970s we can use data only on the 70 percent of individuals who are not subject to attrition problems.

The results of Table 6 confirm that titled individuals suffer less from non-housing related diseases and, according to the general health index, they also have statistically significant overall better health status. Individuals who were in larger households in the 1970s tend to have a higher general index indicator due to housing-related illnesses, which suggests the results of diseases associated with overcrowding. The percentage of minors is associated with lower index values, while female headship does not have a significant effect. The larger the family income in the 1970s, the better the health status in 2007. This result suggests that income effects on health status have long-term impact.

Table 5. Effect of land titling on health indexes				
		Index General	Housing related index	Non-housing related Index
treat intention (OLS)	Coefficients	-0.086	0.029	-0.115
	Standard errors	(0.069)	(0.042)	(0.045)**
	Observations	1093	1093	1093
treat (IV)	Coefficients	-0.203	0.069	-0.272
	Standard errors	(0.164)	(0.100)	(0.108)**
	Observations	1093	1093	1093
treat intention (Order probit)	Coefficients	-0.067	0.035	-0.170
	Standard errors	(0.069)	(0.078)	(0.076)**
	Observations	1093	1093	1093

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

should be included as a housing related disease.

Table 6. Effect of land titling on health indexes after controlling for pretreatment characteristics				
		Index General	Housing related index	Non-housing related Index
OLS	<i>Treatment intention</i>	-0.184 (0.089)**	-0.022 (0.053)	-0.161 (0.058)***
	Family members	0.082 (0.026)***	0.075 (0.016)***	0.007 (0.017)
	Percentage minors	-0.691 (0.281)**	-0.623 (0.168)***	-0.068 (0.184)
	Female household head	0.010 (0.090)	0.010 (0.054)	-0.000 (0.059)
	Employment rate	0.149 (0.170)	-0.041 (0.102)	0.190 (0.111)*
	Income	-0.276 (0.170)	-0.224 (0.102)**	-0.052 (0.111)
	Observations	731	731	731
	IV	<i>Treatment</i>	-0.499 (0.243)**	-0.061 (0.145)
Family members		0.091 (0.027)***	0.076 (0.016)***	0.015 (0.018)
Percentage minors		-0.757 (0.289)***	-0.631 (0.172)***	-0.126 (0.189)
Female household head		0.017 (0.090)	0.011 (0.054)	0.006 (0.059)
Employment rate		0.250 (0.181)	-0.029 (0.108)	0.279 (0.119)**
Income		-0.333 (0.178)*	-0.231 (0.106)**	-0.103 (0.117)
Observations		731	731	731
Order Probit		<i>Treatment intention</i>	-0.170 (0.087)*	-0.061 (0.099)
	Family members	0.070 (0.025)***	0.126 (0.028)***	0.009 (0.028)
	Percentage minors	-0.712 (0.271)***	-1.162 (0.304)***	-0.098 (0.296)
	Female household head	-0.011 (0.087)	0.011 (0.099)	-0.034 (0.095)
	Employment rate	0.077 (0.165)	-0.087 (0.188)	0.326 (0.181)*
	Income	-0.145 (0.166)	-0.243 (0.191)	-0.054 (0.179)
	Observations	731	731	731

Note: Standard errors in parentheses

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

Women are more likely to do unpaid domestic labor and to spend more time at home than men. In 2007 the activity rate for men in Montevideo was about 70 percent, while for women it was on the order of 50 percent. It may thus be possible that the effects of housing quality on women are stronger than on men. Given the results of the literature on the impact of housing

titles on home investment, it is interesting to replicate the health index regressions restricting the sample to females as is done in Table 7

The main difference between Table 5 and 7 is that the general index results are now statistically significant, a result consistent with past research. Despite the fact that women live longer, they tend to report worse health condition than men. In part this is due to the fact that women suffer less from fatal diseases (coronary heart disease, cerebrovascular disease, atherosclerosis, etc.), but suffer more from chronic illnesses (e.g., varicose veins, hemorrhoids, constipation, dermatitis, anemia, etc.).¹⁰

With respect to housing related indexes, the point estimate suggest that titled females suffer less from those diseases, but the result remains statistically not significant.¹¹ This exercise of restricting the comparison to females is also unable to produce supporting evidence for the housing environment channel.

Table 7. Effect of land titling on health indexes for females				
		Index General	Housing related index	Non-housing related Index
treat intention (OLS)	Coefficients	-0.188	-0.022	-0.166
	Standard errors	(0.101)*	(0.060)	(0.068)**
	Observations	577	577	577
Treat (IV)	Coefficients	-0.417	-0.049	-0.368
	Standard errors	(0.227)*	(0.134)	(0.153)**
	Observations	577	577	577
treat intention (Order probit)	Coefficients	-0.143	-0.040	-0.228
	Standard errors	(0.093)	(0.105)	(0.102)**
	Observations	577	577	577

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

3.3. Diseases

In this section we turn to the analysis of which are the illnesses behind the worse health condition for the untitled. As in the previous subsection we first present the result of the population as a whole, then we include pretreatment controls and finally we restrict to females. In columns A we report the marginal effect of a probit model on the intention to treat. In columns B we report the marginal effects after instrumenting in a probit model the availability of formal property rights with a fully exogenous intention to treat dummy.

¹⁰ See for instance Verbrugge (1985) and Ross and Bird (1994).

¹¹ The reported results for female health status are robust to the inclusion of pretreatment controls as in Table 6.

The regression results reported in Table 8 show no significant results for asthma, other respiratory illnesses, allergies, skin infections, psychiatric disorders, disabilities and other illnesses. Two non-housing related diseases (hypertension and diabetes) and two housing-related diseases (sinusitis and rheumatism) are more prevalent among the untitled. Surprisingly, we found that titled individuals suffer more from intestinal parasites. This puzzling result with respect to intestinal parasites somewhat compensates for the expected results with respect to sinusitis and rheumatism and is probably responsible for the lack of significance in Table 5, 6 and 7 in the housing-related index regressions.

Table 8. Effect of land titling on the probability of having several diseases								
	Hypertension		Diabetes		Asthma		Sinusitis	
	A	B	A	B	A	B	A	B
Marginal effects	-0.064	-0.119	-0.042	-0.071	0.005	0.006	-0.014	-0.023
	(0.020)***	(0.030)***	(0.010)***	(0.021)***	(0.018)	(0.044)	(0.007)*	(0.011)**
Observations	1093	1093	1093	1093	1093	1093	1093	1093
	Other breath illnesses		Rheumatism		Intestine parasites		Allergies	
	A	B	A	B	A	B	A	B
Marginal effects	-0.000	-0.004	-0.029	-0.060	0.037	0.298	0.030	0.074
	(0.012)	(0.028)	(0.015)*	(0.026)**	(0.009)***	(0.123)**	(0.019)	(0.056)
Observations	1093	1093	1093	1093	1093	1093	1093	1093
	Skin infections		Psychiatric disorders		Disabilities		Other illnesses	
	A	B	A	B	A	B	A	B
Marginal effects	0.000	-0.000	0.003	0.006	-0.001	-0.004	-0.011	-0.025
	(0.007)	(0.017)	(0.016)	(0.038)	(0.012)	(0.027)	(0.023)	(0.050)
Observations	1093	1093	1093	1093	1093	1093	1093	1093

Note: In columns A we estimate marginal effect of a probit model on the intention to treat. In columns B we estimate marginal effects of an IV probit model where we instrument treatment with intention to treat. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Including controls for pretreatment characteristics does not alter the main results of Table 8. Titled individuals are still found to suffer less from hypertension, diabetes and rheumatism. The inclusion of the controls reduces the significance of intestinal parasites, which decreases in the probit regression and becomes non-significant in the IV regression. Sinusitis also loses significance, while results for asthma are significantly worse among the untitled. In summary, including pretreatment controls reinforces the view that titled individuals suffer less from an array of chronic diseases.

In respect to the control group, we find that a higher number of family members is associated with worse health outcomes primarily in housing-related diseases as asthma, other respiratory illnesses, rheumatism and skin infections, but also with respect to the occurrence of disabilities. As previously noted, it can be conjectured that this variable is actually capturing the effects of overcrowding. Households that in the 1970s had a larger percentage of minors suffer less from asthma, rheumatism, allergies and disabilities 30 years later. There are no significant results for female headship. Finally, households with higher initial income are less prone to suffer from other respiratory illnesses and disabilities.

Table 9. Effect of land titling on the probability of having several diseases after controlling for pretreatment characteristics

	Hypertension		Diabetes		Asthma		Sinusitis	
	A	B	A	B	A	B	A	B
<i>Titling effects</i>	-0.074 (0.025)***	-0.145 (0.036)***	-0.038 (0.013)***	-0.066 (0.025)***	-0.028 (0.022)	-0.071 (0.042)*	-0.006 (0.009)	-0.013 (0.014)
Family members	0.001 (0.008)	0.005 (0.008)	-0.002 (0.004)	0.000 (0.005)	0.017 (0.006)***	0.020 (0.006)***	0.000 (0.003)	0.001 (0.003)
Percentage minors	-0.008 (0.082)	-0.029 (0.084)	0.043 (0.042)	0.037 (0.052)	-0.164 (0.066)**	-0.183 (0.072)**	0.001 (0.029)	-0.000 (0.030)
Female household head	0.010 (0.027)	0.013 (0.027)	0.006 (0.013)	0.009 (0.016)	-0.013 (0.022)	-0.013 (0.023)	-0.013 (0.009)	-0.013 (0.009)
Employment rate	0.107 (0.050)**	0.147 (0.054)***	0.005 (0.024)	0.031 (0.033)	-0.070 (0.043)	-0.047 (0.047)	-0.003 (0.017)	0.000 (0.018)
Income	0.041 (0.047)	0.020 (0.049)	-0.007 (0.024)	-0.023 (0.032)	-0.049 (0.045)	-0.062 (0.048)	0.002 (0.019)	-0.001 (0.020)
Observations	731	731	731	731	731	731	731	731
	Other breath illnesses		Rheumatism		Intestine parasites		Allergies	
	A	B	A	B	A	B	A	B
<i>Titling effects</i>	0.005 (0.015)	0.001 (0.041)	-0.031 (0.018)*	-0.064 (0.031)**	0.013 (0.007)*	0.229 (0.224)	0.002 (0.024)	0.005 (0.067)
Family members	0.007 (0.004)*	0.007 (0.004)*	0.012 (0.005)**	0.014 (0.006)**	0.002 (0.001)	0.008 (0.004)*	0.008 (0.007)	0.008 (0.007)
Percentage minors	0.024 (0.049)	0.022 (0.050)	-0.107 (0.057)*	-0.122 (0.061)**	-0.003 (0.009)	-0.010 (0.041)	-0.162 (0.072)**	-0.163 (0.074)**
Female household head	0.013 (0.015)	0.011 (0.015)	0.005 (0.019)	0.007 (0.020)	0.001 (0.003)	0.003 (0.015)	0.008 (0.024)	0.008 (0.024)
Employment rate	-0.023 (0.029)	-0.022 (0.031)	0.106 (0.036)***	0.127 (0.041)***	-0.013 (0.008)	-0.074 (0.049)	-0.009 (0.044)	-0.009 (0.047)
Income	-0.065 (0.031)**	-0.069 (0.032)**	-0.027 (0.034)	-0.038 (0.037)	-0.006 (0.008)	-0.045 (0.033)	0.010 (0.046)	0.010 (0.047)
Observations	731	731	731	731	731	731	731	731
	Skin infections		Psychiatric disorders		Disabilities		Other illnesses	
	A	B	A	B	A	B	A	B
<i>Titling effects</i>	0.001 (0.007)	0.003 (0.023)	-0.022 (0.020)	-0.050 (0.038)	-0.004 (0.015)	-0.011 (0.033)	-0.026 (0.028)	-0.068 (0.061)
Family members	0.004 (0.002)**	0.004 (0.002)**	0.004 (0.006)	0.005 (0.006)	0.008 (0.004)*	0.008 (0.004)**	-0.005 (0.008)	-0.004 (0.009)
Percentage minors	-0.020 (0.022)	-0.020 (0.022)	-0.018 (0.063)	-0.027 (0.067)	-0.074 (0.043)*	-0.076 (0.044)*	0.015 (0.088)	0.008 (0.090)
Female household head	0.005 (0.008)	0.005 (0.008)	0.018 (0.020)	0.019 (0.021)	-0.002 (0.015)	-0.002 (0.015)	-0.040 (0.028)	-0.039 (0.028)
Employment rate	-0.025 (0.014)*	-0.026 (0.016)*	0.002 (0.038)	0.014 (0.042)	0.005 (0.028)	0.007 (0.029)	0.070 (0.054)	0.083 (0.057)
Income	-0.026 (0.017)	-0.027 (0.017)	-0.005 (0.039)	-0.013 (0.041)	-0.073 (0.033)**	-0.076 (0.034)**	-0.011 (0.054)	-0.019 (0.056)
Observations	731	731	731	731	731	731	731	731

Note: In columns A we estimate marginal effect of a probit model on the intention to treat. In columns B we estimate marginal effects of an IV probit model were we instrument treatment with intention to treat. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 9 show that, for females, the results on diseases among the titled and untitled is reasonably similar to the overall population of the communities. The only difference is that, although the point estimate for sinusitis implies that the titled suffer less from it, the result is not statistically significant. On the other hand, restricting to females we find that titled households suffer less from skin infections than the untitled. In summary, females in titled areas suffer less from two housing-related and two non-housing-related illnesses than the untitled. The puzzling effect with respect to intestinal parasites remains in the probit regression of column A but is not significant in the instrumented variable probit regression of column B.

Table 10. Effect of land titling on the probability of females having several diseases								
	Hypertension		Diabetes		Asthma		Sinusitis	
	A	B	A	B	A	B	A	B
Marginal effects	-0.079	-0,143	-0.057	-0,091	0.018	0,038	-0.011	
	(0.030)***	(0.045)***	(0.017)***	(0.029)***	(0.025)	(0.064)	(0.011)	
Observations	577	577	577	577	577	577	577	
	Other breath illnesses		Rheumatism		Intestine parasites		Allergies	
	A	B	A	B	A	B	A	B
Marginal effects	0.001	-0.004	-0.059	-0.108	0.029	0.132	0.015	0.024
	(0.017)	(0.036)	(0.024)**	(0.037)***	(0.013)**	(0.106)	(0.027)	(0.066)
Observations	577	577	577	577	577	577	577	577
	Skin infections		Psychiatric disorders		Disabilities		Other illnesses	
	A	B	A	B	A	B	A	B
Marginal effects	-0.015		0.011	0.023	0.005	0.012	-0.046	-0.094
	(0.009)*		(0.023)	(0.056)	(0.014)	(0.038)	(0.032)	(0.058)
Observations	577	577	577	577	577	577	577	577

Note: In columns A we estimate marginal effect of a probit model on the intention to treat. In columns B we estimate marginal effects of an IV probit model were we instrument treatment with intention to treat. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

4. Conclusion

In this paper we exploit a natural experiment concerning nine small neighborhoods to study the effects on health of granting formal property rights. Although these neighborhoods are not shantytowns, the population under study is at the bottom of Montevideo's socioeconomic ladder. We were able to locate the original files from the 1970s for a sizeable proportion of the population under study and confirm that the communities were made up of *ex ante* homogeneous households. Formal property rights could be assigned only to members of three communities due to reasons that are independent of any characteristic of the families living there or in the other communities.

We find that, even after controlling for pretreatment characteristics, titled families tend to have a better health status than the untitled. Looking at specific diseases, we find that titled households are less prone to suffer from hypertension, diabetes, sinusitis and rheumatism. Females in titled parcels also tend to suffer less from skin infections. In some specifications we also find decreases in asthma rates among the titled, but this result is not robust to the set of controls included.

Finally, several channels can be argued that could induce positive titling effects on health. Although we do not present supporting evidence for others (e.g., higher income, family cohesion), we were unable to find supporting evidence for the home investment channel. If titling induces better housing quality—and better housing environment produces better health outcomes—we should have found stronger evidence in favor of the housing channel. We conjecture several reasons for the failing of the transitivity in this case. First, it may be that the impact of titling on housing, although statistically significant, is of an insufficient magnitude to produce health differentials. Second, it may be that an intuitive belief regarding the impact on housing of titling is actually the result of other variables that jointly determine housing quality and health status. Finally, there is a timing issue. Chronic diseases, especially for adults, are the result of attitudes, habits and risk exposures over time. Although better housing environment may prevent someone from suffering from certain illnesses, a certain condition, improvements in housing outcomes are not enough to eliminate other conditions.

Summing up, we find that titling reduces the risk of certain chronic diseases but could not establish a causal link from housing environment to them.

References

- Alston, L., G. Libecap and R. Schneider. 1996. "The Determinants and Impact of Property Rights: Land Titles on the Brazilian Frontier." *Journal of Law, Economics & Organization* 12: 25-61.
- Besley, T. 1995. "Property Rights and Investments Incentives: Theory and Evidence from Ghana." *Journal of Political Economy* 103: 903-37.
- Brasselle, A-S., F. Gaspart and J-P. Platteau. 2002. "Land Tenure Security and Investment Incentives: Puzzling Evidence from Burkina Faso." *Journal of Development Economics* 67(2): 373-418.
- Cattaneo, M., S. Galiani, P. Gertler, S. Martinez and R.Titiunik. 2007. "Housing, Health and Happiness." World Bank Policy Research Working Paper 4214. Washington, DC, United States: World Bank.
- De Soto, H. 2000. *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*. New York: Basic Books.
- Dunn, J. 2000. "Housing and Health Inequalities: Review and Prospects for Research." *Housing Studies* 15(3): 341-66.
- Duvall, D., and A. Booth. 1978. "The Housing Environment and Women's Health." *Journal of Health and Social Behavior* 19(4): 410-417.
- Field, E. 2003. "Entitled to Work: Urban Property Rights and Labor Supply in Peru." Research Program in Development Studies Working Paper 220. Princeton, United States: Princeton University.
- Field, E., and M. Torero. 2003. "Do Property Titles Increase Access to Credit? Evidence from Peru." Cambridge, United States: Harvard University.
- Galiani, S., and E. Schargrotsky. 2004. "Effects of Land Titling on Child Health." *Economics and Human Biology* 2(3): 353-372.
- . 2006. "Property Rights for the Poor: Effects of Land Titling." Buenos Aires, Argentina: Universidad Torcuato di Tella. Mimeographed document.

- Gandelman, N. 2007. "Female Headed Households and Homeownership in Latin America." Washington, DC, United States: Inter-American Development Bank. Mimeographed document.
- Jacoby, H., G. Li and S. Rozelle. 2002. "Hazards of Expropriation: Tenure Security and Investment in Rural China." *American Economic Review* 92(5): 1420-47.
- Jiménez, E. 1984. "Tenure Security and Urban Squatting." *Review of Economics and Statistics*, 66(4): 556-67.
- Kain, J.F., and J.M. Quigley. 1972. "Housing Market Discrimination Home-ownership, and Savings Behavior." *American Economic Review* 62(3): 263-277.
- Lanjouw, J., and P. Levy. 2002. "Untitled: A Study of Formal and Informal Property Rights in Urban Ecuador." *Economic Journal* 112: 986-1019.
- Pereyra, A., M. Rossi and P. Triunfo. 2003. "El gasto en cuidados médicos de las familias uruguayas." *El Trimestre Económico* 70(1): 43-79.
- Ross, C., and C. Bird. 1994. "Sex Stratification and Health Lifestyle: Consequences from Men's and Women's Perceived Health." *Journal of Health and Social Behavior* 35(2): 161-178.
- Verbrugge, L.M. 1985. "Gender and Health: An Update on Hypotheses and Evidence." *Journal of Health and Social Behavior* 26(3): 156-182.
- Vogl, T.S. 2007. "Urban Land Rights and Child Nutrition Status in Peru, 2004." *Economics and Human Biology* 5: 302-321.

Appendix

Figure 2. Original Purchase Agreement between the INVE and One Household



MINISTERIO DE VIVIENDA Y PROMOCION SOCIAL



COMPROMISO DE COMPRAVENTA y SOLICITUD DE PRESTAMO

1. P. 51 a. / 49 CAT. VIV. a. LAUT. DORM. 3 VALOR U.R. 10.749

2. MONTEVIDEO, DE 21 JUN. 1975 DE

3. PROMITENTE VENDEDOR
I.N.V.B. Representado por el BANCO HIPOTECARIO DEL URUGUAY.

4. PROMITENTE COMPRADOR GOMEZ
Roberto CERREZA C.C. AGS 5147 c.i. 1.431.370
Marta PEREZ de CERREZA C. C. ALB 9734

5. DECLARACION JURADA DEL PROMITENTE COMPRADOR.

NUCLEO FAMILIAR		SALUD	LABOR	L. CIVIL	CONTR.	FECHA DE PATRIMONIO	INGRESOS
Nº	NOMBRE						
1	Roberto CERREZA	M.	44	C.	2a.		\$
2	Marta PEREZ de CERREZA	F.	31	C.	1a.		\$
3	Javier Mauricio CERREZA	M.	3				\$
4	Lourdes Gabriela CERREZA	F.	1				\$
5							\$
6							\$
7							\$
8							\$
9							\$
10							\$

NI el solicitante ni los integrantes del Núcleo Familiar son propietarios ni lo serán a la fecha de la escritura, de una vivienda adecuada a las necesidades del mismo, dentro de un radio de 35 kms. del lugar de trabajo principal del solicitante.

TOTAL INGRESOS \$ 80.000.-
GATED. INTR. A APORT. 6,99 %

6. OBJETO DEL PROGRAMA 51 a. EN EL BLOQUE 49 LA UNIDAD 49, en el edificio sito en la Sección Judicial del Departamento de Montevideo, Padrón Matriz Nº 46721 P 46722 P 406122, acuerdo al plano de fraccionamiento del Agr. Sr. INVE de BERRO de 1975 en poder del Banco Hipotecario.

7. PRECIO: U.R. 830 EQUIVALENTE AL DIA DE HOY A \$ 9.459.120.- M.N.

7.1 AHORRO A INTEGRAR: U.R. 88 EQUIVALENTE AL DIA DE HOY A \$ 945.912.-

7.2 CONDICIONES DE LA OPERACION: PRESTAMO: U.R. 792 \$ 8.513.208.-
PLAZO: 25 años - INTERES: 2% - CUOTA: Total U.R. 3,36 \$ 36.100.-
Subsidio U.R. 2,84 \$ 30.500.-

CUOTA A PAGAR U.R. 0,52\$ 5.600.-

8. ENTREGA DE LA VIVIENDA INMEDIATA

ABREVIATURAS: Promitente Comprador: P.C. - Promitente Vendedor: P.V. - Dirección Nacional de Vivienda: DIN-VI - Banco Hipotecario del Uruguay: BHI - Departamento de la Habitación: DHU - Unidad Reajustable: UR. - Proceso Compra Venta: PCV.

En la ciudad y día expresados en el punto 2., comparecen por una parte la(s) persona(s) indicada(s) en el punto 3., que en lo sucesivo se denominará(n) PROMITENTE VENDEDOR (P.V.) y por otra parte la(s) indicada(s) en el punto 4., que en lo sucesivo se denominará(n) PROMITENTE COMPRADOR (P.C.), quienes convienen en el presente COMPROMISO DE COMPRAVENTA.

PRIMERA: El P.V. se compromete a vender al P.C. quien se obliga a comprar libre de toda obligación y gravamen, -salvo lo que se dice-, la propiedad y posesión del inmueble descrito en el punto 6. Las partes declaran conocer las disposiciones del Decreto Nº 416/72 de 15 de Junio de 1972, especialmente sus arts. 14, 15 y 16. Por lo tanto el P.C. acepta que el área del predio que no sea destinado a vivienda, no sea objeto de transferencia definitiva a su favor, y el otorga el uso y goce de las áreas libres en común y pro indiviso, por un lapso renovable de 25 años. Oportunamente, en la escritura de compraventa, se harán las servidumbres de paso que correspondan.

SEGUNDA: El precio de esta compraventa es la cantidad indicada en el punto 7., que se integrará al por los suma indicada en el punto 7.1, pagando mensual

Figure 3. Map of the Treatment and Control Communities

