Titling and chronic diseases: evidence from a natural experiment in Uruguay.

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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 trough various channels: housing investment, income or family cohesion. We found that titling diminishes the probability of suffering of several chronic diseases (hypertension, diabetes, sinusitis and rheumatism) but could not find supporting evidence for the housing channel.

Keywords: home ownership, property rights, chronic diseases, Uruguay

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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, real estate and 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 casual 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) that report reductions in parasitic infections after improvements in floor quality in Mexico and Duvall and Booth (1978) that 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 argue 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) hypothesize the existence of a virtuous circle that after conferring property rights would grant access to credit markets that could be used to improve productive activities and this itself would improve credit access. The empirical support for such a channel is low (Galiani and Schargrodsky 2006 and Field and Torero 2003). Field (2003) suggests that to protect their houses those lacking of secure titles may

[2] Most studies found beneficial effects (see for instance Jimenez (1984), Besley (1995), Alston, Libecap, and Schneider (1996), Lanjouw and Levy (2002), 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, Gaspart and Platteau (2002).

reduce adult labor supply, thus reducing family income. Either through De Soto (2000) suggestions or by the findings of Field (2003), the lower income of untitled families is likely to end up in worse health outcomes.[4]

Galiani and Schargrodsky (2004) and 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 Schargrodsky (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. Although the similitude in the findings the interpretation of the results is different. Galiani and Schargrodsky (2004) suggest that titling is associated with short run improvements in children nutrition. Vogl (2007) disagrees, arguing that the weight of the children under study in the Argentinean case are 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 Schargrodsky (2004) our database is composed of a small-scale natural experiment. Although 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 focus on the relation between titling and health but instead of looking indirectly through anthropometric measures we focus on health outcomes (occurrence 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.

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

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

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 households 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 right over the house where they are living (although the owner may in some cases 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 seventeen 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, quite the opposite, it is natural to think that income, age, health, life-cycle status, etc. 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

[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 dates at least since Kain and Quigley (1972).

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.

The Instituto Nacional de la Vivienda Económica (INVE, National Institute of Inexpensive Housing) was a public institution whose goal was to provide affordable housing solutions to low income families. It was created in 1937 by law Nº 9.723. Several decades later, in 1974 the Ministry of Housing was created (law Nº 14.218) as the central public institution in charge of housing policies. As such the INVE was under its jurisdiction.

In the mid-seventies the INVE built thirteen small neighborhoods to attend the housing needs of their objective population. These neighborhoods received the name of "comunidades" (communities). They are: 18 de 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 in land owned by the INVE. Three communities were built in land owned by the Municipality of Montevideo (Misiones, 19 de Junio and Las Piedras) and one was build in land that nowadays the authorities are not clear about which public institution is the actual owner (Ituzaingó).

Just a couple of years after the building of the communities, by a law of May 1977 (law Nº 14.656) the Ministry of Housing was eliminated and in June 1977 (law Nº 14.666) the INVE was also eliminated. INVE's goals and property were assigned to the state-owned mortgage bank, Banco Hipotecario del Uruguay (BHU). Over the following decade various institutions have been officially in charged of the management of these communities. The management of the communities implied taking care of the provision of several public goods, receiving the payments implied in the purchase agreement,

[7] See figure 2 in the appendix for a scan of an original mortgage agreement of one family from Guayabos.

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 title deeds by the new landowner. But as is detailed in the next paragraph the institutions involved in this task were not interested in the active management of the communities. As time passed by, the entire population of the communities stopped paying the required installments but no action was taken at all.

On November 1977 the BHU and the Ministry of Education signed an agreement in which the Ministry of Education should take care of the management of the communities built in land currently owned by the BHU, (formerly owned by the INVE and under the Ministry of Housing management). On January 1980 the Ministry of Education and the Municipality of Montevideo agree to a joint management of the communities Misiones, 19 de Junio and Las Piedras built in land owned by the municipality. After four years on July 1984 the Ministry of Education transferred the management of all the communities to the Municipality of Montevideo (file Nº 472.993). Less than three years later, on March 1987 the Municipality rejected this last agreement with the Ministry of Education and informed the BHU that it should take care of the management of the communities built on BHU's owned land.

In December 1987, the Executive branch of Government designed a task group to study the situation of all the communities with representatives of the Ministry of Education, the Ministry of Labor and Social Security, the BHU and the Municipality of Montevideo.

The conclusions of this task group were that no institution was really taking care of the management of the communities and that it would imply an excessive cost for the BHU to assume it. Therefore it was in the best interest of the BHU to sell the houses to the actual occupants in whatever price they were able to pay. The board of the BHU approved the conclusions on November 1988.

Subsequently, the BHU set a nominal price of 10 U.R. (unidades reajustables) equivalent

to approximately $100 for those occupants that could not prove to have made any previous payment. Those that made at least one previous payment just had to pay the housing titling expenses. For the housing titling expenses the BHU negotiated a special agreement with the professionals in charge of titling registration (Asociación de Escribanos del Uruguay) so that the cost was about 2 UR (approximately $20).

Although, the BHU had decided to dispose of the property of these communities and although there was the political support to sell them at an extremely low price (really, just a nominal figure), the selling of the houses and the assignment of the formal property rights to the occupants could be done only in 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. The architecture of the houses in all communities was basically the same. We could not fin any justification in the authorities to explain why in some cases maps were registered and why in others they were not. Obviously, families were assigned to communities without knowing if maps were or would be registered at some point in the municipality.

Thus, the reason why the inhabitants of three communities were able to acquire formal property rights in the early nineties while the inhabitants of the other communities were not able to acquire formal ownership is not related to any characteristic of them. Therefore we have an intention to treat and control groups to evaluate 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 seventies.

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 Serratosa	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 is composed by 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 controls is a bit more problematic because we do not want the control groups to differ from the treatment group in observable nor in 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 its management differ from the other communities. Besides that, the first two communities are much larger than the rest and there may be size effects that could have some impact

on its development. The task group form the nineties was not able to establish the landowner of the Ituzaingó community. This lack of information is puzzling and may be reflecting conditions different from the 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 ten 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

Based on this we decided to work with communities that were built in land owned by the INVE-BHU and we surveyed all household in the intention to treat communities of 18 de Julio, 25 de Agosto and Lavalleja and 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. We were able to locate the original files signed in the seventies for the

communities built in INVE's land. In this files there was information on the following socioeconomic indicators of the original occupants: family composition, presence of children, age, income level and working status.[8]

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% and 46%). Although we could not confirm it, it may be that this high share of female headship is the result INVE's assignment policies targeted to benefit groups traditionally considered to be 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 that 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 in average by 5.0 individuals (47% of them minors) while in intention to treat communities there were on average 4.6 family members (42% minors).

The schooling attendance rate was 81% and 85%. We do not have data from the seventies, but according to the 2006 Household survey the attendance rate in Montevideo was 90%. Finally, overall there does not seem either to be differences in employment (59% vs. 58%) nor in income.

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

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 specially trained to deal with population of 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 19 de Abril, Grito de Asencio, Sarandí, Rincón and Guayabos. In 14 cases the survey could not be done because the habitants were not found at home after three attempts (10 cases) or declined to answer (4 cases). The attrition rate of the census stage was 2% and of the sample stage was 5%. Thus we end up with 416 house surveys corresponding to 1793 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: no-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 trough the steps necessary to finally obtain formal rights. This no-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 were 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. Those that arrived to the treatment or control communities after that date may have different characteristics than those that arrived before and may also differ among the treatment and the control communities. Therefore we use data only of those that arrived before 1995. The final database is composed of 1093 individuals.

3. Results

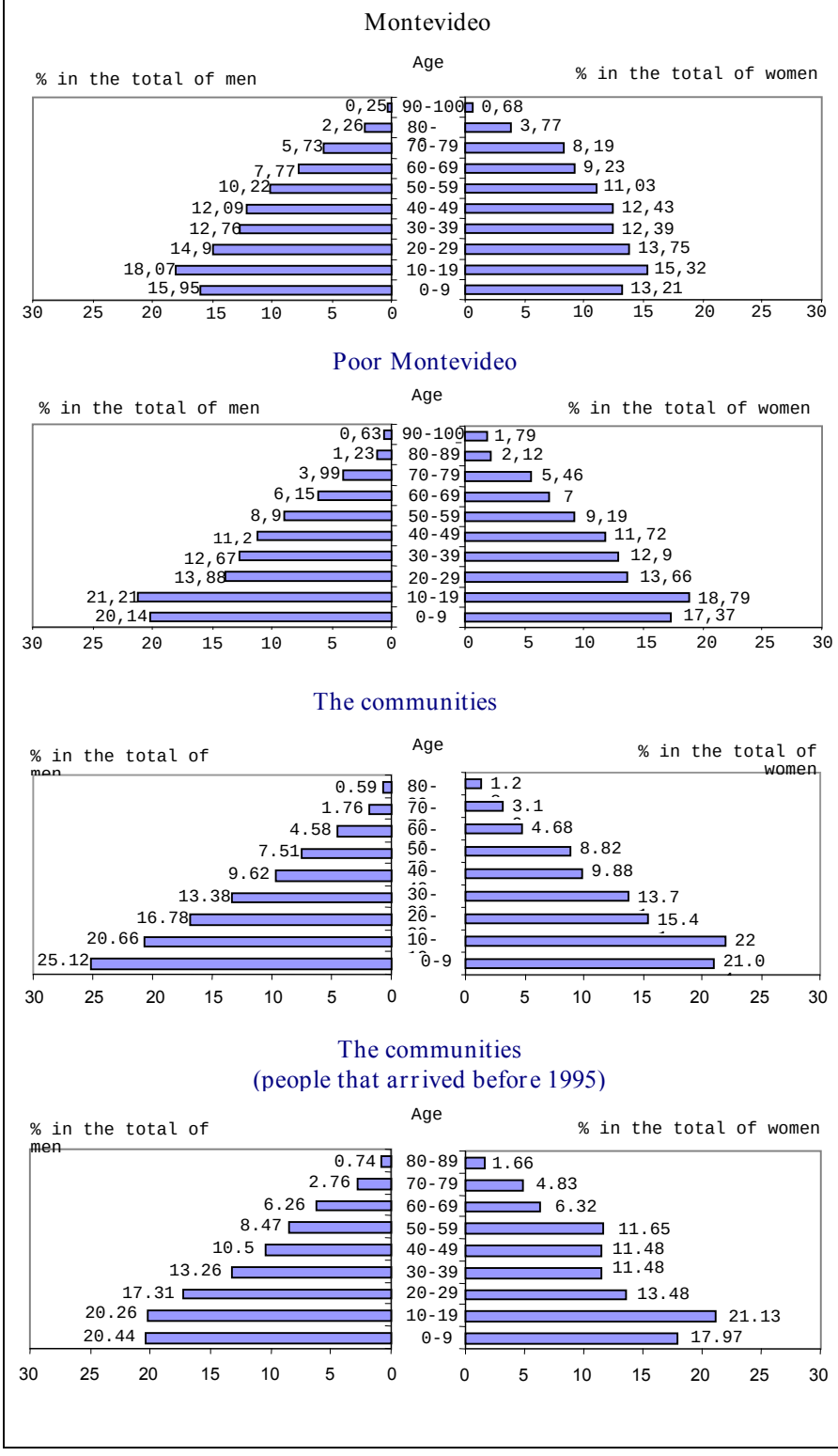
3.1. Demographics

A stylized fact of Uruguayan income distribution is that children and adolescents are over represented in the poorest sector of society. This phenomenon is the combined result of poorer women having more children and the constitutional reform of 1989 that established that pensions should be quarterly adjusted 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. Note also that indeed, there are differences between the population that arrived after 1995 and those that lived in the communities previous to that time. The newcomers are on average younger than the older

habitants of the communities. Therefore, the population pyramid excluding the newcomers is more similar to the pyramid of the lowest stratum of Montevideo than the pyramid for the whole population of the communities is.

Figure 1. Population Pyramids



3.2. Health indexes

In our survey we asked about a detailed list of possible illnesses. In tables 4 we divided this health problems whether they are more or less related to housing condition. For instance, breath illnesses or infection illnesses have a direct relation with the quality of the living environment. On the other hand, hypertension or diabetes are more related to genetics and food ingestion habits.[9]

We constructed a summary health index based on the presence or absence of diseases. Each disease that an individual suffers ads a point to his personal index. In the same fashion we also generate a summary index of housing related and no-housing related diseases. The overall index ranges from 0 to 7, the housing-health and no-housing related indexes range from 0 to 4.

The mean value of the general index is 0.8 indicating that that on average most people have at least one of the diseases of the list. The population of the control seems to have a worse health situation with index values above those of the treatment (0.84 vs. 0.75). The larger prevalence of illness for the untitled is produced mostly by the no-housing related diseases. In the control, the mean value of the no-housing health index of 0.49 indicates that on average every two persons they have one of these diseases. The mean value of the housing related index suggests that one every three persons have 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. Surprising 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.

[9] We acknowledge that there is room for discrepancy in the disease classification here presented. For instance, it could be argued that psychotic disorders are exacerbated in overcrowding environments and that therefore they should be included as a housing related disease.

Indeed, if we compare the prevalence of these illnesses in the communities and in the city of Montevideo but we restrict to the younger cohorts the differences vanishes. The second reason is that it is possible that in poorest sectors there is a problem of sub-diagnosis (i.e. some people that suffer this or other diseases do not consult or they do not complete the required tests and examinations and therefore do not have a precise diagnostic).

The more common diseases in the population under study are hypertension, asthma and allergies. There is not a clear pattern 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 suffer more from psychotic disorders, intestine 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%
Psychotic 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 were 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 suffer from less chronic diseases but the result is not statistically significant. This eventual better structural health status of the titled individuals is not produced by less housing related diseases. On the contrary, the only significant results are for the regression of the non-housing related index that show that the 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 comes from a natural experiment but in order to check the robustness of our results in Table 6 we include a set of controls for pretreatment characteristics. The control variables are all defined at the household level. They are: 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 seventies we can use data only on 70% of the individuals that are not subject to attrition problems.

The results of Table 6 confirm that the 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 that in the seventies were in larger households tend to have a larger general index indicator. This larger general index is due to housing related illnesses so it can probably be the results of diseases associated with overcrowding. The percentage of minors is associated with lower index values. Female headship does not have a significant effect. The larger the income of the family in the seventies the better the health status in 2007. This result suggests that income effects on health status have long run impact.

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

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

Table 6. Effect of land titling on health indexes after controlling for pretreatment characteristics

		Index General	Housing related index	Non-housing related Index
OLS	*Treatment intention*	-0.184	-0.022	-0.161
		(0.089)**	(0.053)	(0.058)***
	Family members	0.082	0.075	0.007
		(0.026)***	(0.016)***	(0.017)
	Percentage minors	-0.691	-0.623	-0.068
		(0.281)**	(0.168)***	(0.184)
	Female household head	0.010	0.010	-0.000
		(0.090)	(0.054)	(0.059)
	Employment rate	0.149	-0.041	0.190
		(0.170)	(0.102)	(0.111)*
	Income	-0.276	-0.224	-0.052
		(0.170)	(0.102)**	(0.111)
	Observations	731	731	731
IV	*Treatment*	-0.499	-0.061	-0.438
		(0.243)**	(0.145)	(0.160)***
	Family members	0.091	0.076	0.015
		(0.027)***	(0.016)***	(0.018)
	Percentage minors	-0.757	-0.631	-0.126
		(0.289)***	(0.172)***	(0.189)
	Female household head	0.017	0.011	0.006
		(0.090)	(0.054)	(0.059)
	Employment rate	0.250	-0.029	0.279
		(0.181)	(0.108)	(0.119)**
	Income	-0.333	-0.231	-0.103
		(0.178)*	(0.106)**	(0.117)
	Observations	731	731	731
Order Probit	*Treatment intention*	-0.170	-0.061	-0.239
		(0.087)*	(0.099)	(0.095)**
	Family members	0.070	0.126	0.009
		(0.025)***	(0.028)***	(0.028)
	Percentage minors	-0.712	-1.162	-0.098
		(0.271)***	(0.304)***	(0.296)
	Female household head	-0.011	0.011	-0.034
		(0.087)	(0.099)	(0.095)
	Employment rate	0.077	-0.087	0.326
		(0.165)	(0.188)	(0.181)*
	Income	-0.145	-0.243	-0.054
		(0.166)	(0.191)	(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 stay more time at home than men. In 2007 the activity rate for men in Montevideo was about 70% while for women it was in the order of 50%. Therefore it may be that the effects of housing quality on women are stronger than in 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. This result is 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, athersoclerosis, 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 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	Coefficients	-0.188	-0.022	-0.166
(OLS)	Standard errors	(0.101)*	(0.060)	(0.068)**
	Observations	577	577	577
Treat	Coefficients	-0.417	-0.049	-0.368
(IV)	Standard errors	(0.227)*	(0.134)	(0.153)**
	Observations	577	577	577
treat intention	Coefficients	-0.143	-0.040	-0.228
(Order probit)	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

[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.

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.

The regression results reported in Table 8 show no significant results for asthma, other breath illnesses, allergies, skin infections, psychotic disorders, disabilities and other illnesses. Two non-housing related diseases (hypertension and diabetes) and two housing related diseases (sinusitis and rheumatism) are more suffered by the untitled. Surprisingly we found that the titled individuals suffer more from intestine parasites. This puzzling result with respect to intestine parasites somewhat compensates 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		**Psychotic 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 were 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. The titled individuals are still found to suffer less from hypertension, diabetes and rheumatism. The inclusion of the controls reduces the significance of intestine parasites decreases in the probit regression and becomes non-significant in the IV regression. Sinusitis also looses significance but asthma significantly reports a worse condition for

the untitled. In summary, including pretreatment controls reinforces the view that the titled individuals suffer less from a set of chronic diseases.

In respect to the controls, we find that more family members is associated with worse health outcomes basically in housing related diseases as asthma, other breath illnesses, rheumatism and skin infections but also with respect to the occurrence of disabilities. As mentioned before it can be conjecture that this variable is actually capturing the effects of overcrowding. Households that in the seventies had larger percentage of minors, thirty years latter suffer less from asthma, rheumatism, allergies and disabilities. There are no significant results for female headship. Finally, households with larger initial income are less prone to suffer from other breath 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
Titling effects	-0.074	-0,145	-0.038	-0.066	-0.028	-0.071	-0.006	-0.013
	(0.025)***	(0.036)***	(0.013)***	(0.025)***	(0.022)	(0.042)*	(0.009)	(0.014)
Family members	0.001	0,005	-0.002	0.000	0.017	0.020	0.000	0.001
	(0.008)	(0.008)	(0.004)	(0.005)	(0.006)***	(0.006)***	(0.003)	(0.003)
Percentage minors	-0.008	-0.029	0.043	0.037	-0.164	-0.183	0.001	-0.000
	(0.082)	(0.084)	(0.042)	(0.052)	(0.066)**	(0.072)**	(0.029)	(0.030)
Female household head	0.010	0.013	0.006	0.009	-0.013	-0.013	-0.013	-0.013
	(0.027)	(0.027)	(0.013)	(0.016)	(0.022)	(0.023)	(0.009)	(0.009)
Employment rate	0.107	0.147	0.005	0.031	-0.070	-0.047	-0.003	0.000
	(0.050)**	(0.054)***	(0.024)	(0.033)	(0.043)	(0.047)	(0.017)	(0.018)
Income	0.041	0.020	-0.007	-0.023	-0.049	-0.062	0.002	-0.001
	(0.047)	(0.049)	(0.024)	(0.032)	(0.045)	(0.048)	(0.019)	(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
Titling effects	0.005	0,001	-0.031	-0.064	0.013	0.229	0.002	0.005
	(0.015)	(0.041)	(0.018)*	(0.031)**	(0.007)*	(0.224)	(0.024)	(0.067)
Family members	0.007	0.007	0.012	0.014	0.002	0.008	0.008	0.008
	(0.004)*	(0.004)*	(0.005)**	(0.006)**	(0.001)	(0.004)*	(0.007)	(0.007)
Percentage minors	0.024	0.022	-0.107	-0.122	-0.003	-0.010	-0.162	-0.163
	(0.049)	(0.050)	(0.057)*	(0.061)**	(0.009)	(0.041)	(0.072)**	(0.074)**
Female household head	0.013	0.011	0.005	0.007	0.001	0.003	0.008	0.008
	(0.015)	(0.015)	(0.019)	(0.020)	(0.003)	(0.015)	(0.024)	(0.024)
Employment rate	-0.023	-0.022	0.106	0.127	-0.013	-0.074	-0.009	-0.009
	(0.029)	(0.031)	(0.036)***	(0.041)***	(0.008)	(0.049)	(0.044)	(0.047)
Income	-0.065	-0.069	-0.027	-0.038	-0.006	-0.045	0.010	0.010
	(0.031)**	(0.032)**	(0.034)	(0.037)	(0.008)	(0.033)	(0.046)	(0.047)
Observations	731	731	731	731	731	731	731	731
	Skin infections		**Psychotic disorders**		**Disabilities**		**Other illnesses**	
	A	B	A	B	A	B	A	B
Titling effects	0.001	0.003	-0.022	-0.050	-0.004	-0.011	-0.026	-0.068
	(0.007)	(0.023)	(0.020)	(0.038)	(0.015)	(0.033)	(0.028)	(0.061)
Family members	0.004	0.004	0.004	0.005	0.008	0.008	-0.005	-0.004
	(0.002)**	(0.002)**	(0.006)	(0.006)	(0.004)*	(0.004)**	(0.008)	(0.009)
Percentage minors	-0.020	-0.020	-0.018	-0.027	-0.074	-0.076	0.015	0.008
	(0.022)	(0.022)	(0.063)	(0.067)	(0.043)*	(0.044)*	(0.088)	(0.090)
Female household head	0.005	0.005	0.018	0.019	-0.002	-0.002	-0.040	-0.039
	(0.008)	(0.008)	(0.020)	(0.021)	(0.015)	(0.015)	(0.028)	(0.028)
Employment rate	-0.025	-0.026	0.002	0.014	0.005	0.007	0.070	0.083
	(0.014)*	(0.016)*	(0.038)	(0.042)	(0.028)	(0.029)	(0.054)	(0.057)
Income	-0.026	-0.027	-0.005	-0.013	-0.073	-0.076	-0.011	-0.019
	(0.017)	(0.017)	(0.039)	(0.041)	(0.033)**	(0.034)**	(0.054)	(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 for the titled and untitled is reasonably similar to the whole 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 contrary, restricting to females we find that the 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 illness than the untitled. The puzzling effect with respect to intestine 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		**Psychotic 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 of granting formal property rights on health. Although these neighborhoods are not shantytowns, the population under study is at the bottom of Montevideo's socioeconomic lather. We were able to locate the original files from the seventies for a sizeable proportion of the population under study and confirm that the communities were formed by 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 the pretreatment characteristics titled families tend to have a better health status that 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 decrements in the risk of suffering asthma for 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 (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 find 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 a magnitude not enough to produce health differentials. Second, it may be that the intuitive believe over the impact on housing on titling is actually the result of other variables that joint determine housing quality and health status. Finally, there is timing issue. Chronic diseases, especially for adults, are the result of attitudes, habits and risk exposures over time. Although it may be that better housing environment may preclude someone from suffering from certain illnesses it may be that after developing a certain condition,

improvements in housing outcomes are not enough to eliminate it.

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

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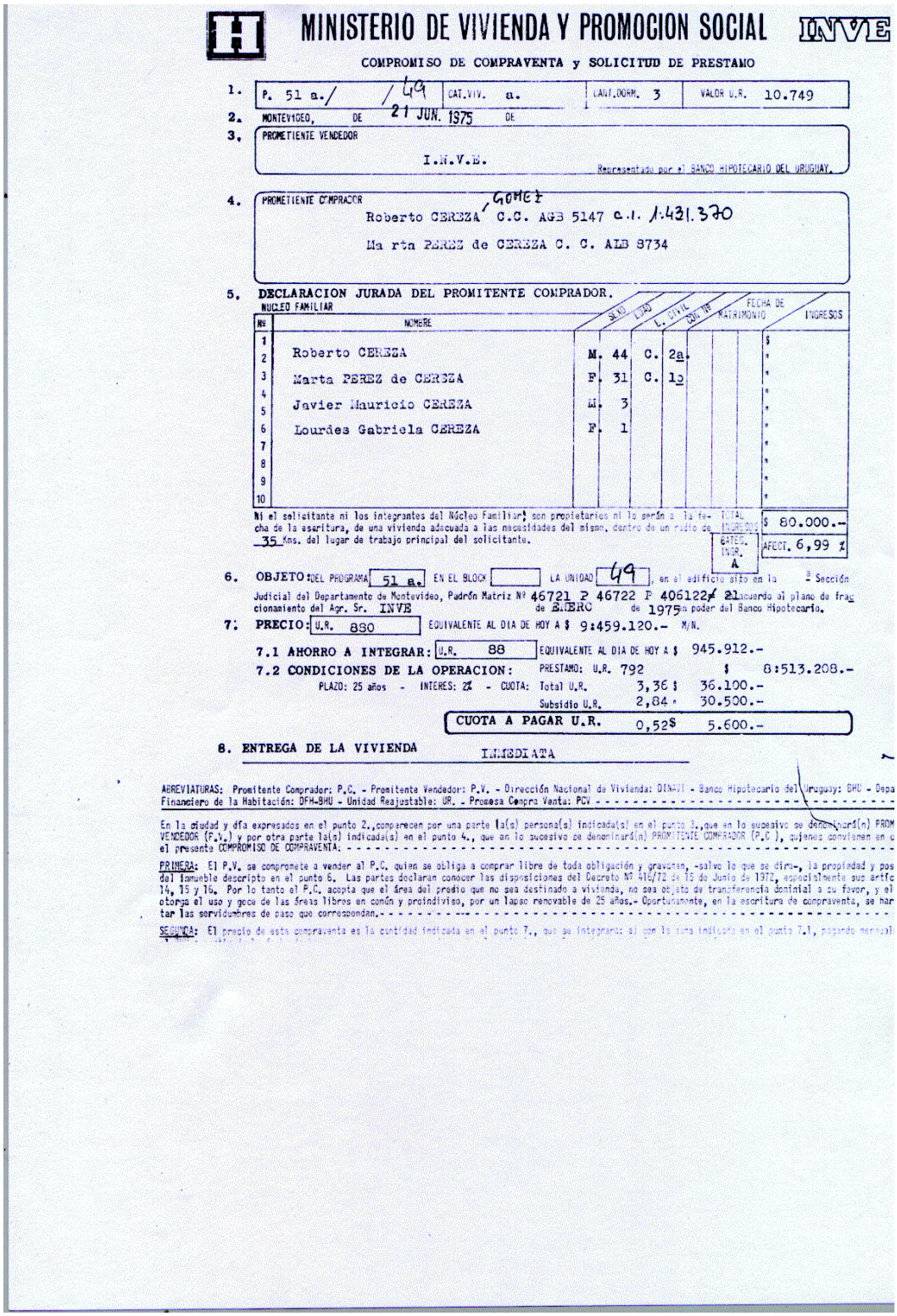
Appendix

Figure 2 – Original purchase agreement between the INVE and one household



MINISTERIO DE VIVIENDA Y PROMOCION SOCIAL — INVE

COMPROMISO DE COMPRAVENTA y SOLICITUD DE PRESTAMO

1. P. 51 a./ / 49 | CAT.VIV. a. | LAV.DORM. 3 | VALOR U.R. 10.749
2. MONTEVIDEO, DE 21 JUN. 1975 DE
3. PROMETIENTE VENDEDOR: I.N.V.E. — Representado por el BANCO HIPOTECARIO DEL URUGUAY.
4. PROMETIENTE COMPRADOR: Roberto CEREZA / GOMEZ C.C. AGB 5147 c.i. 1.431.370; Ma rta PEREZ de CEREZA C. C. ALB 8734
5. DECLARACION JURADA DEL PROMITENTE COMPRADOR. NUCLEO FAMILIAR

Nº	NOMBRE	SEXO	EDAD	L. CIVIL	CONYUGE	FECHA DE MATRIMONIO	INGRESOS
1							$
2	Roberto CEREZA	M.	44	C.	2a.		*
3	Marta PEREZ de CEREZA	F.	31	C.	1o		*
4							*
5	Javier Mauricio CEREZA	M.	3				*
6	Lourdes Gabriela CEREZA	F.	1				*
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.- ; GRTES. INVE. A ; AFECT. 6,99 %

6. OBJETO: DEL PROGRAMA 51 a. EN EL BLOCK ____ LA UNIDAD 49, en el edificio sito en la 3ª Sección Judicial del Departamento de Montevideo, Padrón Matriz Nº 46721 Y 46722 Y 406122 y 21 acuerdo al plano de fraccionamiento del Agr. Sr. INVE de ENERO de 1975 en poder del Banco Hipotecario.
7. PRECIO: U.R. 880 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: DINAVI - Banco Hipotecario del Uruguay: BHU - Departamento Financiero de la Habitación: DFH-BHU - Unidad Reajustable: UR. - Promesa 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 celebrar 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 dirá-, la propiedad y posesión del inmueble descripto en el punto 6. Las partes declaran conocer las disposiciones del Decreto Nº 478/72 de 15 de Junio de 1972, especialmente sus artículos 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 dominial a su favor, y el P.V. otorga el uso y goce de las áreas libres en común y proindiviso, por un lapso renovable de 25 años.- Oportunamente, en la escritura de compraventa, se harán constar las servidumbres de paso que correspondan.

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

Figure 3 – Map of the treatment and control communities