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Determinants of Urban Vacant Land

Evidence from Santiago, Chile

Felipe Morandé · Alexandra Petermann · Miguel Vargas

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Abstract It is a planners' common argument that one of the main sources of vacant land is developers' speculation. Consequently, in order to reduce vacant land, it is also a common policy to charge extra taxes to this kind of lots as a way to force development. Using a rich data base from Santiago, Chile, this paper investigates on the determinants of urban vacant land. We find that amongst the most important elements driving unused sites in Santiago are public regulations. Hence, practitioners must be aware about this issue before implement a policy to reduce vacant land because it could have the opposite result.

Keywords Urban vacant land · Infill development · Categorical respond model

JEL Classifications R14 · C13 · H23

F. Morandé
Department of Economics, Universidad de Chile,
257 Diagonal Paraguay, Santiago, Chile
e-mail: fmorande@fen.uchile.cl

A. Petermann
School of Government, Universidad Adolfo Ibañez,
2640 Diagonal las Torres, Santiago, Chile
e-mail: alexandra.petermann@uai.cl

M. Vargas (✉)
School of Business, Universidad Diego Portales,
253 Manuel Rodríguez Sur, Santiago, Chile
e-mail: miguel.vargas@udp.cl

Introduction

Vacant land is a phenomenon observed in every city in the world, even in those cities having high land prices. For instance Bartholomew (1955), Niedercorn and Hearle (1963), Northam (1971), and Pagano and Bowman (2004) have shown that in U.S. vacant land occupies, on average, about 20% of the urban area. Besides, this average has been constant at least for the last 50 years. Therefore it is worth to ask: Why is there vacant land? One planners' common answer to this question is that it is the outcome of developers' speculation (see, for instance, Kivel 1993; and Goldstein et al. 2001). Accordingly, planners in order to reduce idle sites implement extra taxes to them. This approach has some important drawbacks. First, it is not clear the importance of this speculation as a generator of vacant lots, due, mainly, to that little empirical research has been made quantifying it. Consequently, a policy of these characteristics could be unsuccessful. Second, and more important, even it is the case that market speculation generates vacant land, economic theory tells us that it is not necessarily bad (Titman 1985).

Inspired on such a predicament, this research has as objective to cast light, empirically, upon the determinants of urban vacant land, considering vacant land as unused lots inside the city, i.e. lots where either never a building of any kind has been built or where a building used to be but it has been demolished. In order to do that, we have used a data base from Santiago, Chile. Through the use of this data base it has been possible to test some hypotheses that literature has pointed out upon the forces driving the existence of idle sites. In particular, our intention has been to determine which elements can explain the probability of a lot being vacant, for instance public regulations, and in which extent they can do it. To answer these questions we have developed a categorical dependent variable model.

To have a deep understanding of this phenomenon is important because of it has a negative impact upon quality of life and because this underutilization of land contributes to a vicious cycle of inner cities underdevelopment by dropping property values (Goldstein et al. 2001). Hence, to know what forces are behind idle lots can be useful to generate appropriate public policies, and by this mean to deal with the negative effects of vacant land.

The data base used is not from the whole city of Santiago, but from the central county of Santiago, which is one of the most populous and important counties of the Great Santiago, the capital of Chile. This county hosts the downtown area, it is a highly urbanized district, and it is geographically located in the middle of the city, faraway from peripheral zones. The case of Santiago is interesting because during the last 15 years a repopulation policy has been implemented, mainly by the use of a subsidy to housing demand; as a consequence an important real estate market reborn has been observed, and because of that an important land demand has been observed too. Despite these facts still some vacant land remain, and in order to reduce it Chilean planning authorities have proposed to make the current vacant land extra taxes higher. Under Santiago circumstances is that a good policy? Although this is

not a hypothesis that we are going to test explicitly, through the investigation of vacant land driving forces we will try to approximate an answer to that.

The novelty of this work is given by three facts. First, the focus has been on the forces driving the existence of vacant lots in highly urbanized areas. The latter is different from what has been done in literature, which main focus has been on land development in the urban fringe -investigating on the use of land's change- (Ding 2001; Brueckner 1990; Peiser 1987; and McMillen 1989), where the forces behind the land development process would be different. Second, we haven't paid attention on financial side of this phenomenon as it has been previously done in literature (for instance see Titman 1985; Geltner 1989; Isakson 1997 and Cunningham 2005), but on regulatory aspects of it. Finally, to the best of our knowledge, this is the first time that an empirically work of these characteristics has been done for a Latin American city, and hence for Santiago.

The next section presents a brief review of economic theory on vacant land, then the "Some Facts about Santiago and its Land Policy" section presents some facts about Santiago and its Land Policy, the "Data" section the data, the "The Econometric Model" section the econometric model, the "Results" section presents the results and, finally, the "Conclusions and Policy Implications" section gives the conclusions and some policy recommendations.

A Brief Literature Review

According to literature vacant land values come to be central to find an explanation to the intensity of land development (Brueckner 1990; and Ding 2001). Hence, the forces that are behind land values are behind vacant land too. Amongst these determinants of vacant land values it is possible to identify physical characteristics and policy and neighborhood variables (Ding 2001). Physical variables are those related to lots' size and access to commercial activities and employment, meanwhile policy neighborhood variables consider regulations, land uses and zoning ordinance.

Vacant land can be classified depending upon the forces that are behind it: structurally unemployed land, frictionally unemployed land and land held in reserve for the future (Schenk 1978).[1] Structurally unemployed land is the land for which the cost needed to make it productive is greater than the present value of the yield from any productive use. It is a consequence of, among other things, ownership problems, lack of utilities, strict regulation, expected flood hazard, slope or foundations problems, odd-sized or odd-shaped sites left over in neighborhoods where land was deeded in fixed sites sizes, small lots resulting

[1] In his article Schenk also proposed a third spring of vacant land: the optimal harvest time, notwithstanding, as in this same paper is pointed out, that explanation has a limited applicability.

from old subdivisions, and neighborhoods externalities. On the other hand, frictionally unemployed land would arise in the absence of perfect and costless information about present and future prices, quantities and qualities. Under these circumstances, although markets clear they have an equilibrium level of unemployed land.

The third case appears when landowners must wait for the optimal moment to develop an investment project (Titman 1985). Following previous literature on irreversible investment decisions Titman concludes that it is often optimal to delay the project's start. The basic intuition is that it may be advantageous to wait for additional information before deciding upon the exact specification of the investment project.

This classification became important to deal with the development of policies related to land use. For instance, Titman's results imply that if the authority implements a policy to stimulate building activity, it may lead to a decrease in it if there is uncertainty about such policy's duration or its effect. This result is also pointed out by (Evans 2004) and implies that vacant land existence is not necessarily bad or a signal that the market is not functioning. In the case of frictional unemployed land or land held for future use, due to its nature, an attempt to speed-up building on it could lead to uses which in the long run are socially undesirable. Other researches have showed that there are several cases where the existence of vacant land implies an efficient use of the resources (Ohls and Pines 1975). But if unemployed land is structural then some intervention may be required. Consequently, the authority must be careful and aware about the type of vacant land is trying to correct, otherwise attempts to reduce the amount of it may be welfare deteriorating.

Some Facts about Santiago and its Land Policy

The Great Santiago is an urban conurbation made out of 32 counties. The county of Santiago is the sixth most populated county of the Great Santiago, with a population of 201,000 inhabitants. It has a surface of 22 km^2 and it has a density of 9,000 inhabitants per km^2. It hosts the main governmental organizations, and the downtown area. Geographically, it is located in the middle of the city faraway from the urban fringe.

The Great Santiago's territorial plan relies upon several legal instruments that determine the land use. The main one is the regulatory plan called Plan Regulador Metropolitano. It sets the general conditions for land occupation, such as urban densities, areas for urban equipment, services and public facilities, ecological areas, and structural roads. In addition, every county belonging to Great Santiago, as the county of Santiago, has its own plan, called Plan Regulador Comunal. The latter provide a more detailed regulations on land uses like minimum size of lots, maximal heights of buildings, quality of construction required, square meters of public facilities, etc. These regulations are implemented trough the definition of different zones within the county. Every zone has different specifications about the land use.

Since the 60's the county of Santiago's population has fallen from 450,000 inhabitants to the current 201,000 as a consequence of a massive migration to the peripheral counties of the city (in the same period, Great Santiago's population has grown from 2,000,000 to 6,000,000). As a way to reverse this process in 1990 it was implement a plan of repopulation. The main strategy established by this plan was a scheme of incentives to the private sector in order to get an urban renewal. Amongst these incentives the most important has been a subsidy to housing demand. The amount of this subsidy is US$8,000 and is independent of the price of the house that is being purchased (the average price of a dwelling in the county of Santiago is US$75,000). Although there are no quantitative studies analyzing the impact of this plan, and in particular of this subsidy, the fact is that the offer of new flats in the county of Santiago grew 2,000% from 1993 to 2003, meanwhile the offer in the whole city grew 144%; the sales, during the same period, grew 2,000% in the county and 3,000% in the whole city; and population grew 4%. Hence, it is possible to conjecture that the subsidy has been quite successful.

Natural consequences of this process have been a momentous construction activity, an increment of the land demand, a decrement of land offer, and, obviously, a land price rise.

Another issue related to land policy and urban vacant land that is worthy to take into account is the extra taxes that are charged to idle sites. Every vacant lot in Chile must pay an extra tax of 100%. Even tough the intention of this extra-tax has been to stimulate the inner city development, as a way to avoid the negative externalities that vacant lots would produce, in the end of the day its effectiveness in achieving this objective is rather questionable, and it seems to be more a tax charged to the non-use than a way to correct any externality.

Despite this intense necessity for land and the extra taxes charged to vacant land, a 2% of the total residential land still remains vacant in the county. Because of that, the authority has proposed to raise the extra-tax till 200%.

Data

We have used a cross section sample of 4,885 sites, 16% of the total sites of the County of Santiago.[2] The data were gathered in 2003 from public records, and some variables were generated using a geographical information system, like accessibility variables. According to this source of information, the percentage of vacant sites is about 2% of total land in the County of Santiago. It is interesting to note that this percentage is very low if we compare it with the average percentage of vacant land in US and other Latin American cities.[3]

[2]The sources of this information are basically the Municipality of Santiago and the Santiago Intendancy, which keep a complete record of every site's characteristics.

[3]Larangeira (2004) shows that the percentage of sites that correspond to vacant land in Quito (Ecuador) is 21.7%, in Guadalajara (México) is 26.6%, in Buenos Aires (Argentina) is 32%, in Guayaquil (Ecuador) is 39.4% and in Río de Janeiro (Brazil) is 44%.

Every record of the sample, according to what theory suggests on vacant land determinants, has information about lots' physical characteristics, policy and neighborhood and block (here we are talking about a city block, 1.74 acres) variables. Amongst physical characteristics we have: size, accessibility to commercial centers, schools, transportation services (roads and underground), health services and green areas (public parks). Amongst neighborhood and block characteristics: quality of edification of surrounding buildings, neighborhood level of criminality, inhabitants density per block, inhabitants income (percentage of inhabitants belonging to a determined income quintile), if the neighborhood belongs to a area of historic value (conservation zones) or if in the block there is a building with a historic value (listed buildings), and if the site is in area that is mainly either commercial or residential (there

Table 1 Variables' description

Variable	Description
ERIAZO:	This a dummy variable coded 1 if plots are vacant
FRENTE:	Site's width
LARGO:	Site's length
MT_VIAS:	Distance to the nearest structural road
MT_METRO:	Distance to the closest underground station
MT_SALUD:	Distance to the closest health service
MT_EDUCA:	Distance to the closest school
MT_AVERDE:	Distance to the closest green area
MT_HITOSCO:	Distance to the closet shopping center
CALIDAD_ED:	Quality of edification of the block's buildings This is an index that indicates the percentage of edification being in good condition (the higher, the better)
HAB_HA:	Inhabitant's density
P_E_02:	Inhabitants' percentage belonging to the poorest quintile of the population
P_D_02:	Inhabitants' percentage belonging to the second income quintile of the population
P_C3_02:	Inhabitants' percentage belonging to the third income quintile of the population
P_C2_02:	Inhabitants' percentage belonging to the fourth income quintile of the population
P_ABC1_02:	Inhabitants' percentage belonging to the richest quintile of the population
DELITOS:	Index of criminality, higher values indicate higher levels of criminality (the lower, the better) this variable is a qualitative index ranged from 0 to 8
SUP_EXP:	Percentage of the plot's surface that could be expropriated by the government
PROM_SPMIN:	Minimal site's surface allowed for subdivisions
PROM_CC:	Constructability Coefficient This norm regulates how many square meters can be built given a particular site's size
PROM_ALT:	Maximum height allowed
CONSERV_D:	A dummy variable coded 1 if sites are in a conservation area
INMUE:	A dummy variable coded 1 if sites are in a block where there is at least one listed building

is no industrial areas in Santiago county). And finally, amongst policy and regulations: minimal size allowed to subdivisions in the block, the surface allowed to be built in a lot, maximum height allowed, and percentage of the lot that would be potentially expropriated by the State. This last sort of regulation is defined as a part of the lot that would be taken by the Estate in order to build either public facilities or roads, and this part is defined as a percentage of the lot size in the Plan Regulador.

Table 1 shows a data description and Table 2 summarizes variables' statistics.

With regards to these variables' impact on the probability of a lot being vacant, the first thing that we can say is that all of them having a negative impact on land value or expected land value are going to have a positive impact on the vacant land probability. For instance, regulations, in general, raise development costs, so the parameters associated to regulations must be positive. Something similar must be with those variables that raise uncertainty, in line with Titman's results. In the case of accessibility variables, better access imply higher land prices, as the basic urban economic theory says; therefore the impact of these sort variables must be negative. The lots' size increments land value at a decreasing rate, so we must expect a negative impact of lots' size upon vacant land probability; however empirical studies have shown that the lot size has a positive impact on vacant land probability, something that is

Table 2 Variables' statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
mt_metro	4884	870.7759	477.287	48.382	2159.412
mt_vias	4884	75.23945	50.02955	3.51	271.123
mt_salud	4884	409.7783	160.9868	3.174	1006.02
mt_educa	4884	159.7442	89.18263	2.769	475.231
mt_averde	4884	244.5177	121.1683	14.506	646.16
calidad_ed	4793	.5506866	.287391	0	1.02326
hab_ha	4884	256.586	187.3657	2.1	1514.7
prom_spmin	4884	467.2195	331.2244	250	2000
prom_cc	4884	2.598485	.6656532	2	6
prom_alt	4884	15.94001	4.676148	12	35
eriazo	4884	.0241605	.1535631	0	1
sup_exp	4884	.0020124	.0075962	0	.16654
mt_hitosco	4884	1280.989	531.2433	12.158	2623.245
p_e_02	4884	8.891333	2.482589	3.28	14.07
p_d_02	4884	28.45245	5.554183	14.56	35.17
p_c2_02	4884	28.99149	5.31047	16.18	43.32
p_abc1_02	4884	6.749986	2.819618	3.17	14.06
delitos	4884	.5182228	.9207128	0	8
conserv_d	4884	.0321458	.1764052	0	1
inmue	4884	.0835381	.2767222	0	1
frente	4546	12.81026	11.26545	1	215
mt_metro2	4884	986006.9	962441	2340.818	4663061
largo	4546	.0029142	.0035607	.0001376	.1206243
hab_ha2	4884	100935.1	190232.3	4.409999	2294316

particularly true for residential developments due to land development comes to occur after subdivisions (Ding 2001).

The Econometric Model

As our intention is to estimate a probabilistic model we have used a Probit model, because it has been showed that it is the best way to treat this sort of dependent variables (Maddala 1983; Pindyck and Rubinfeld 1991; Train 2003). The reasons to use this approach instead of the more traditional linear approach are mainly two: first, linear probabilistic models generate, by construction, heteroscedasticity that results in a loss of efficiency, and, second, there is no guarantee that the predicted value of the dependent variable will lie in the (0,1) interval. Besides, these sort of categorical dependent variable models, namely Logit and Probit, have been already used in literature to deal with similar problems such as land use or land development (McMillen 1989; Wu and Yeh 1997; and Ding 2001).

However, given the nature of our sample, we have had to face an extra problem, namely, a very small quantity of positive cases, i.e. the probability of a lot being vacant is very low. The main implication is that the distribution of errors is asymmetric; hence it cannot be a normal distribution, violating one of the main assumptions of Probit model. An alternative way to deal with this problem is using a complementary log-log model which function unlike Logit and Probit models is asymmetric (McCullagh and Nelder 1989). For comparison in the "Results" section we have reported the results from Probit and complementary log-log models.

We define a set of N landowners that are assumed to be rational and utility-maximizers. The landowner i chooses between holding the land undeveloped or developing it. The observed decisions of keeping the land undeveloped will depend on the land's characteristics. Equation 1 represents the indirect utility function:

$$U_{ij} = V_{ij}(X_i; \beta) + \varepsilon_{ij} \tag{1}$$

where j represents the decision alternatives, $j = 1$ if the decision is not to develop and $j = 0$ if the decision is to develop a project. V_{ij} is the deterministic component of the indirect utility function and depends on the vector of land characteristics, X, and on a vector of unknown parameters, β, which has to be estimated. The term ε represents the random component of the utility function, and landowners' heterogeneity. Although U_{ij} cannot be observed, the revealed preference theorem tells us that if the landowner i is selecting "1" it is because by making this choice he will maximize his utility. If we define Y_i as a discrete variable that represents landowner i's decision, we know that if $Y_i = 1$ then $U_{i1} > U_{i0}$, and if $Y_i = 0$ then $U_{i1} < U_{i0}$. Therefore the probability of $Y_i = 1$ can be written as:

$$Pr(Y_i = 1) = Pr(U_{i1} > U_{i0}) = F(X; \beta) \tag{2}$$

Equation 2 is the one we have used to run our estimations (depending upon the errors' distribution this model will be either a Probit model or a log-log model).

Results

As it was mentioned, we have run a Probit and a complementary log-log model. These two models' parameters are estimated with the maximum likelihood approach. Marginal effects of the complementary log-log model are shown in Table 3 meanwhile Table 4 presents marginal effects for the Probit model for those variables that were significant. The results obtained from the both models are very similar and the goodness of fit too, as it is possible to see in Table 5.

As we can see, regulation variables have different impacts on the probability of a site being vacant. If the site is either in a conservation area or with listed houses neighbouring it this likelihood is lower. The explanation is straightforward: the site cannot be vacant otherwise it would have been not declared under conservation because of historical or architectural reasons. Nevertheless it would be possible the existence of derelict buildings, that cannot be demolished and with a high cost of maintenance. Although this can be an interesting issue to study, it is beyond the scope of this paper. Besides,

Table 3 Variables marginal effects of cloglog model

Variable	dy/dx	Std. Error	z	$P > \|z\|$	[95%	C.I.]	X
mt_metro	−.0000313	.00002	−1.74	0.082	−.000067	3.9e-06	877.848
mt_vias	.0000557	.00003	2.05	0.040	2.5e-06	.000109	72.0474
mt_salud	−2.39e-06	.00001	−0.18	0.856	−.000028	.000023	416.131
mt_educa	.0000133	.00002	0.70	0.486	−.000024	.000051	157.823
mt_averde	.0000171	.00001	1.29	0.197	−8.9e-06	.000043	248.085
calida_ed	.0175679	.00702	2.50	0.012	.003809	.031327	.541143
hab_ha	.0000675	.00004	1.89	0.059	−2.5e-06	.000138	254.949
prom_spminn	−4.71e-06	.00001	−0.38	0.706	−.000029	.00002	462.744
prom_cc	−.0024956	.00665	−0.38	0.707	−.015525	.010534	2.58963
prom_alt	.0004393	.0011	0.40	0.689	−.001712	.002591	15.8759
sup_exp	.2798421	.10382	2.70	0.007	.07635	.483334	.002134
mt_hitosco	−.0000135	.00001	−1.38	0.167	−.000033	5.6e-06	1288.69
p_e_02	.0013969	.00477	0.29	0.769	−.007943	.010737	8.81543
p_d_02	−.0001325	.00132	−0.10	0.920	−.002728	.002463	28.2933
p_c3_02	−.0008899	.00124	−0.72	0.472	−.003316	.001537	26.8916
p_c2_02	.0003989	.00116	0.34	0.730	−.001868	.002665	29.1706
p_abc1_02	−.0000892	.00223	−0.04	0.968	−.004465	.004286	6.83157
delitos	.0031563	.00148	2.13	0.033	.000253	.00606	.526363
conser_d	−.0124992	.00285	−4.38	0.000	−.018088	−.006911	.028943
inmue	−.0128415	.00292	−4.40	0.000	−.018557	−.007126	.087278
frente	.0002472	.00008	3.27	0.001	.000099	.000395	12.8587
largo	.3985236	.13994	2.85	0.004	.124244	.672803	.002926
mt_met2	2.05e-08	.00000	2.16	0.031	1.9e-09	3.9e-08	1.0e+06
hab_ha2	−1.76e-07	.00000	−2.78	0.005	−3.0e-07	−5.2e-08	100185

Table 4 Significant variables marginal effects of Probit model

Variable	dy/dx	Std. Error	z	$P > \|z\|$	[95%	C.I.]	X
mt_metro	−.0000315	.00002	−1.59	0.112	−.00007	7.3e-06	877.848
mt_vias	.0000599	.00003	2.03	0.042	2.2e-06	.000118	72.0474
calida_ed	.0200075	.00758	2.64	0.008	.005155	.03486	.541143
hab_ha	.0000809	.00004	2.16	0.031	7.6e-06	.000154	254.949
sup_exp	.4021536	.13842	2.91	0.004	.130848	.673459	.002134
delitos	.0034094	.00171	2.00	0.046	.000067	.006752	.526363
conser_d	−.0123274	.00276	−4.46	0.000	−.01774	−.006915	.028943
frente	.0003579	.0001	3.51	0.000	.000158	.000558	12.8587
largo	.6847052	.24337	2.81	0.005	.207702	1.16171	.002926
inmue	−.0132985	.00283	−4.70	0.000	−.018841	−.007756	.087278
mt_met2	2.06e-08	.00000	2.02	0.044	5.7e-10	4.1e-08	1.0e+06
hab_ha2	−2.01e-07	.00000	−3.12	0.002	−3.3e-07	−7.5e-08	100185

being either a conservation area or a listed houses area may improve the neighborhood quality and hence houses prices will be higher, making more attractive to develop a project.

On the other hand, regulation concerning expropriation rights (SUP_EXP) has an opposite effect. Such a regulation norm means that some sites (or parts of them) are subject to eventual expropriation by the State, in order to expand the city infrastructure (streets, roads) in the future. However, many of these potential expropriations never are materialized. The problem about this regulation is the uncertainty that it generates with regard to the effective size of the sites that are affected by and the exact time in which the expropriation will take place, if ever. This uncertainty has an obvious implication on the profitability of an investment project to be undertaken to develop the vacant site and may delay building activity. Accordingly, we would expect that SUP_EXP would have a positive impact on the probability of a site being vacant. The positive sign of the estimated parameter indicates that our result is consistent with intuition. The high value of the marginal effect and its high level of significance reveals that this regulatory factor is very important in determining the amount of vacant land that exists in the County of Santiago. This result has important policy implications. Vacant land in the County of Santiago would be mainly caused by this strict regulation and could be classify as structural vacant land. This sort of vacant land could have been prevented if this particular regulation were not in place.

Several of the variables corresponding to the urban environment where the site is located are also statistically significant. They are: distance to the nearest underground station (MT_METRO); distance to the nearest structural road (MT_VIAS); an index of quality of edification in the block where the site is (CALIDAD_ED), this index goes from 0 to 1; the density of the block where the site is located (HAB_HA); and the crime index in the block where the site is (DELITOS). Regards the latter it can be argued that vacant land generates higher levels of crime and not vice verse, however we think that is not true,

Table 5 Measures of fit

Measure	Value
Cloglog of Eriazo	
Log-Lik intercept only:	−508.452
D(4432):	920.193
McFadden's R2:	0.095
Maximum Likelihood R2:	0.021
Efron's R2:	0.025
Count R2:	0.976
AIC:	0.218
BIC:	−36318.496
Log-Lik full model:	−460.096
LR(24):	96.711
Prob > LR:	0.000
McFadden's Adj R2:	0.046
Cragg& Uhler's R2:	0.105
AIC*n:	970.193
BIC':	104.943
Probit of eriazo	
Log-Lik intercept only:	−508.452
D(4435):	925.042
McFadden's R2:	0.090
Maximum likelihood R2:	0.020
McKelvey and Zavoina's R2:	0.148
Variance of y*:	1.174
Count R2:	0.975
AIC:	0.217
BIC:	−36338.853
Log-Lik full model:	−462.521
LR(21):	91.861
Prob > LR:	0.000
McFadden's Adj R2:	0.047
Cragg& Uhler's R2:	0.100
Efron's R2:	0.025
Variance of error:	1.000
Adj Count R2:	−0.019
AIC*n:	969.042
BIC':	84.586

because a vacant lot that is properly fenced and clean must not imply the presence of crime.

Concerning the distance to nearest underground station (MT_METRO) we expect that a greater distance of a site to the nearest underground station would imply a higher probability that the site stays vacant, because the site would be less attractive since its access to the rest of the city decreases. However, if we consider the effect of this variable by using MT_METRO and MT_METRO2 we can see that within a radius of 1,100 m. the closer the site is to the subway station, the higher the probability of being vacant. Nevertheless this situation changes when the sites is farther than 1,100 m. In this case it is exactly the opposite (see Fig. 1). The explanation to this phenomenon could rest on the fact that subway stations have some negative externalities such as

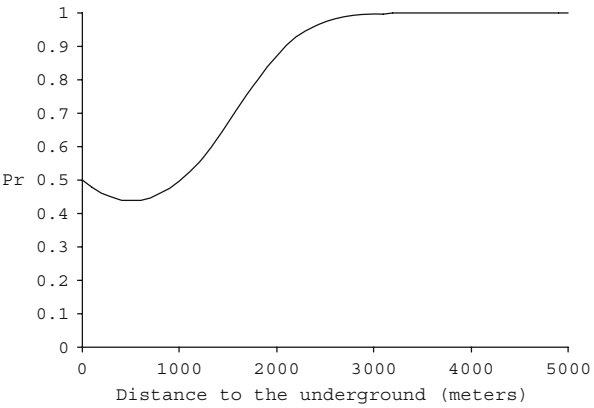

Fig. 1 Impact of the distance from underground on the probability that a site stays vacant

congestion and noise. Therefore, the benchmark distance of 500 meters could be interpreted as some sort of optimal distance to the subway.

In order to analyze the impact of the block's density on the probability that a site stays vacant we use HAB_HA and HAB_HA2. A high density should be related to a high level of demand in this area. Therefore we could expect an inversely proportional relationship. We observe this result for densities greater than 224 inhabitants per hectare (see Fig. 2). Before 224 the slope is slightly positive, almost flat, meaning no impact for small densities.

With respect to the quality of edification one possible interpretation of the regression result is that the higher the quality of edification, the higher the demolition cost. Hence the impact on the probability of being vacant is positive, because it is difficult to incorporate in a particular project adjacent sites.

The intuition explaining the positive impact of the index of criminality upon the probability of a site staying vacant is quite straight. A high level of delinquency implies that the area is not going to be attractive to develop any sort of project due to dwellings' prices are going to be affected negatively and hence the present value too.

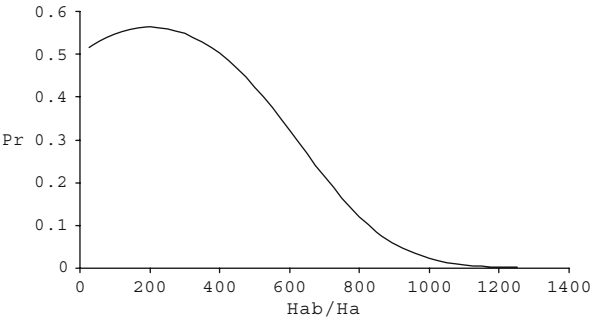

Fig. 2 Impact of the block's density on the probability that a site stays vacant

In the case of the site's surface variables, width (FRENTE) and length (LARGO), they have a positive impact upon the probability. The explanation of this phenomenon can rest on the fact that a greater surface implies that the site has no subdivisions. In general a site has no subdivisions if the demand for land in that area is low. Consequently there are no incentives to develop projects there and the landowner prefers to keep the site vacant. Similar results have been found previously in literature (Ding 2001).

Conclusions and Policy Implications

The objective of this paper has been to cast light on the causes of vacant land inside an important and populous county part of a large Latin American capital city, Santiago of Chile. In order to achieve this we have employed the categorical dependent variable approach and we have used a rich database. Our results indicate that the variables that have impacts on the probability of land being vacant are: the distance to nearest underground station, the surface that could be expropriated, if the site is in a conservation area or surrounded by listed houses, the block's density, the quality of edification, the neighborhood level of criminality and the site's width and length. In general we found that those variables that could increase the site value have a negative impact on the probability of land being vacant. On the other hand those variables that could reduce the profit of an investment project or that could increase the uncertainty of profitability of an investment project have a positive impact. Our results are consistent with the theoretical literature. Besides, we found that in the County of Santiago the variables that explain vacant land are mainly connected with regulations. This suggests that the authority should be careful with the implementation of regulations and policies that may increase uncertainty about the profitability of an investment project, because this could diminish building activity and increase the amount of vacant land in a city. Additionally, the authority must be aware about the kind of vacant land that it wants to confront, structural or frictional, if it is willing to take the correct measures about it. As theory has explained, if the vacant land is frictional or held for future use, to force it into use quickly could push it into uses which in the long run are undesirable, but if it is structural then some intervention may be required. However, not every intervention is adequate in this case. It should be in the form of going directly to solve the problem that is impeding the land market to function well. For example, in the case of land uses that imply negative externalities on the surrounding area and a consequent delay in the development of it, like suburban trains or a rubbish dump, the policy implemented by the government should go in the direction of making this land uses to internalize the negative externalities that they generate and this will increase development in the surrounding area without the necessity of additional measures.

The policy implemented in Santiago has been to charge an extra-tax to the sites that are vacant in order to penalize the delay in their development.

However, this policy treats all of them in the same way, without distinguishing the source of vacant land or the possible negative externalities that it may generate. Instead, a more adequate policy would be to leave frictional vacant land as it is, to solve directly the problems that may be causing the existence of structural vacant land and to impose a fine to those vacant sites that effectively generate negative externalities with an amount proportional to it.

Finally, it is important to mention some still open questions that would be interesting for future research. The first one is about the possible existence of a "natural" or "normal" rate of vacant land inside cities, in the sense that its existence can be considered a natural component of efficient urban growth rendering government intervention unnecessary. Second, it is important to build a panel to take into account dynamic aspects of development process. Also, it could be interesting to research upon the impacts of the special subsidies that have been implemented in Santiago, in order to quantify and isolate them.

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