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Determinants of Housing Demand and its Interaction with Public Policies

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Abstract[1]

This paper analyzes the determinants of housing demand for Uruguay and the extent to which housing policies have an impact on their target population. The paper first analyzes the determinants of housing demand, following an approach based on Rosen's (1974) two-step procedure consisting of fitting a hedonic price regression in 34 different geographical units (or markets) to estimate a housing demand function. The determinants of formality and ownership choices were examined using a multinomial logit framework. Determinants of these choices include both household demographic attributes and access to and use of public housing programs and other social programs. Policy recommendations are offered on the basis of the finding that a price and income-inelastic formal housing market greatly contrasts with a rather price and income-elastic informal housing market.

JEL classifications: G21, I38, O54, R21, R28, R38
Keywords: Housing demand, Housing policies, Hedonic pricing, Uruguay

[1] At the time of writing the authors were affiliated with the Group for the Study of Economics, Organization and Social Policies (GEOPS).

1. Introduction

The Inter-American Development Bank (IDB, 2004) has emphasized the importance of the housing sector for countries' economic and social development and the well-being of citizens. Many studies have identified and documented the importance of this sector for economic growth and stability (Leamer, 2007; Bostic et al., 2009).

The importance of the housing sector can be analyzed in three key dimensions—social, legal and economic (IDB, 2004). The social dimension is linked to the population's need for shelter. The legal dimension of housing is related to property rights and to the way in which housing impacts the development of well-functioning institutions. The economic dimension encompasses housing as a source of wealth, investment, and economic growth. Any effective housing policy needs to consider these three aspects. However, too often governments in developing countries tend to consider housing only from a welfare perspective, transferring resources that do not produce adequate housing.

Besides the need to account for these three aspects when looking at the way in which housing policies are implemented, it is also necessary to do a thorough analysis of the environment in which housing policies are implemented. Latin America faces major challenges in this area, and any attempt to develop the sector should take into account its unique characteristics, as well as the enabling environment in which these economies operate.

In most Latin American countries, a large segment of the population is low-income. The IDB (2004) has highlighted the link between poverty and inadequate housing conditions. On the one hand, poverty hampers the demand for housing and thus the size and efficiency of private housing markets, leading to low investment and inadequate housing conditions. On the other hand, poor housing conditions make it more difficult for poor people to lift themselves out of poverty. Moreover, many Latin American economies have weak legal and institutional frameworks and underdeveloped capital markets, although this is not the case in Uruguay. The combination of these elements favors the growth of informal housing arrangements, with the consequent lack of formal investment in housing.

Recently it has been noted that public housing policies can be reinforcing this vicious circle. By addressing the housing problem through a supply-side perspective, they provide inadequate housing solutions for the poor and they do not take their housing demand into

account, and hence fail to meet their needs when providing housing. This appears to have been the case of housing policies in Uruguay in the past decade (MVOTMA, 2005).

Few studies have looked at the housing market in the Latin American context. A pioneering work in this field is that of Samuel Ruiz (1965). The author concluded that the Latin American housing problem is markedly different from that of developed countries and that, given its severity, governments should devote adequate resources and coordinate the different housing policies effectively. The author identifies housing cooperatives as a viable tool to overcome the housing problem. More recently, Dowall (2006) assessed the efficiency and maturity of housing markets in Brazil, recommending a package of measures to improve housing affordability and production. Clavijo et al. (2005) analyzed the socioeconomic and financial determinants of Colombian housing markets, finding high housing demand elasticities with respect to household disposable income and to real mortgage interest rates. Fontenla et al. (2009) analyzed the components of housing demand in Mexico and found much lower price elasticity than in developed countries, once more highlighting the differences between housing demand in developed and in developing countries.

Few studies on Latin American countries have looked at the interaction of the implementation of housing policies and the development of formal housing markets. Among those studies, Conthe and García (2007) described government initiatives to develop primary housing markets and concluded that some of these programs have been successful in attracting private sector capital to middle and low-income housing markets. Zanforlin and Espinosa (2008) looked at the regulatory framework fostering the creation of primary and secondary mortgage markets in Mexico as a tool to overcome the shortcomings of poorly governed public housing finance programs.

In the case of Uruguay, even fewer attempts have been made to explain the characteristics and dynamics of housing markets and their policy implications. Exceptions are Gandelman and Gandelman (2004), who looked at the mortgage market in Uruguay and focused on the operations of the National Mortgage Bank (Banco Hipotecario del Uruguay, BHU), and Casacuberta (2006), who provided a preliminary descriptive analysis of the data gathered through the Extended Household Survey conducted in 2006. More recently, Garabato and Ramada-Sarasola (2011) provided a detailed description of the Uruguayan housing market and a descriptive assessment of the effectiveness of Uruguayan housing policies.

This paper was prompted by the dearth of studies analyzing the determinants of housing demand in Uruguay, as well as the clear need to better understand to the extent to which housing policies are having an impact on their target population. We conducted an assessment of the Uruguayan housing market, looking at the determinants of housing demand, as well as at its interaction with public housing policies.

The paper is structured in three parts. In the first part, we analyze the determinants of housing demand following an approach based on Rosen's (1974) two-step procedure, by firstly fitting a hedonic price regression in 34 different geographical units (or markets) to estimate a housing demand function. The second part looks at the determinants of formality and ownership choices in a multinomial logit framework. As part of the determinants of these choices, we not only include household demographic attributes, but also access and usage of public housing programs and other social policies, aiming to understand the impact of public policies on the development of formal and informal housing markets, and to evaluate their interaction with other social policies. The third part of this study presents some policy recommendations, based on the main conclusions stemming from the quantitative results of the first two parts.

The first part comprises Sections 2 and 3. Section 2 briefly summarizes the literature, describes the data and defines the theoretical framework behind the empirical approach. Section 3 describes the implementation of the econometric model and analyzes its results. The second part consists of Sections 4 and 5, which describe a decision tree approach for the choices of formality and ownership. The determinants of these choices are then estimated by means of binomial and/or multinomial logits at each node of the tree. This part also attempts to capture the effect of housing and social programs in these two choices. Finally, the conclusions are laid out in Sections 6 and 7, summarizing the study's main findings and offering some key policy recommendations.

2. Determinants of Housing Demand

Among the most recent literature reviews on the estimation of housing demand are the studies by Malpezzi (1999) and by Ermisch et al. (1996). Malpezzi (1999) summarizes the results found in studies dealing with developing countries, and Ermisch et al. (1996) look at estimates and methodologies used in papers on housing demand in developed countries. As was also the case in Follain and Jiménez (1983), results on income and price elasticities vary greatly, depending both

on the empirical framework used and on the specificities of the data. Most of the variation can be found in the price elasticities, which reflects the high degree of variation in the estimates depending either on the method to derive prices (Mayo, 1981), or on the different ways in which the same approach can be implemented, e.g. the number of markets defined when estimating hedonic prices and deriving a price index.

As a general rule, price elasticities tend to be less robust to model specification and implementation, and they usually seem to indicate that housing demand is price inelastic and are lower (in absolute terms) than income elasticities. Also, price elasticities are usually lower for owners than for renters. According to Ermisch et al. (1996), price elasticities are between 0.5 and 0.8. When comparing previous studies to ours—taking into account similar empirical approaches—price elasticity tends to be around 0.5. For instance, Fontenla et al. (2009) find a price elasticity of 0.3, which is considerably below the elasticities reported in the literature. They suggest that this can be explained by the size of the housing deficit and the lack of alternatives to ownership in Mexico, where rental markets are underdeveloped. With respect to income elasticities, Mayo (1981) found a range going from 0.36 to 0.87 for owners when using micro data, while Ermisch et al. (1996) reported overall income elasticities between 0.8 and 1. When income is divided into permanent and temporary, permanent income elasticities are somewhat lower, between 0.7 and 0.9, while temporary income elasticities have been found to be between 0.04 and 0.8.

In any case, the lack of robustness of estimated elasticities in the literature can be attributed to changes in the estimation method, in the type of data, and in the proxy used for the variables involved, making it difficult to establish a benchmark against which our estimates can be compared. We therefore checked the robustness of our estimates by varying the ways in which our empirical implementation was done—number of markets, aggregation of neighborhoods—and by segmenting demand to various sub-markets by geographic location, degree of formality, and age. We also distinguish between tenants and owners. For all estimated models, we find a low income elasticity of housing demand, and our results are robust to changes in specification and in the sub-samples analyzed.

The empirical analysis uses data stemming from the Uruguayan Expanded National Household Survey (ENHA)[2] 2006. This cross-sectional micro-dataset is put together by the

[2] Encuesta Nacional de Hogares Ampliada.

National Statistical Institute (INE) on an annual basis, and it uses a sample that is representative of the entire Uruguayan population. It includes rural areas and urban centers of less than 5,000 inhabitants. The survey also collects data on a number of personal attributes of the household and its members, such as demographics, educational attainment, income, occupation, and health, among others, as well as information on housing arrangements, characteristics of the housing unit, its conservation, how it was accessed, and informal housing arrangements.

The sample used has 21,310 observations, of which 35 percent are located in Montevideo, 45.1 percent are households in other cities, and 19.9 percent are rural households. The sample includes a split of owners, tenants and occupiers of 55.3, 18.9 and 25.8 percent, respectively. In all three categories, both legal and illegal forms of housing are included. In fact, when distinguishing among the formal and the informal housing market, we follow the definition by Garabato and Ramada-Sarasola (2011), which defines three categories—formal, semi-formal and informal—although in this paper we take into account only formal and informal markets, due to the residual character of the semi-formal category. This yields a sample of 16,868. The sample used to run the regressions excludes households in rural areas. It also excludes 284 observations in which data seemed to be erroneous or misleading. The final sample thus includes 14,193 households, of which 7.4 percent are part of the informal housing market, and the other 92.6 percent within the formal housing market is composed of 18.5 percent tenants and 81.5 percent owners. A detailed description of the data used in this paper, looking specifically at housing markets, can be found in Garabato and Ramada-Sarasola (2011). They describe the main attributes of Uruguayan housing demand and provide a thorough assessment of how public housing policies are addressing the housing deficit and the existence of informal housing markets.

2.1 Theoretical Framework

Rosen's (1974) seminal work on the determinants of housing demand defines the theoretical basis upon which most literature on housing is based. Household decision making stems from a utility function $U = U(\mathbf{z}, C)$ in which $\mathbf{z} = (z_1, \ldots, z_j, \ldots, z_n)$ is a vector of housing attributes and C is a composite good consumed by households. The price of C is set to be the numeraire and the price for housing is noted as $p(\mathbf{z})$. The value of housing $v(\mathbf{z})$ can be hence decomposed into

price and quantity as $v(\mathbf{z}) = p(\mathbf{z}) \cdot q(\mathbf{z})$. The maximization of the households' utility is subject to a budget constraint that is nonlinear in the housing component,

$$y = v(\mathbf{z}) + C$$

In other words, each household i faces the following maximization problem

$$\begin{cases} \max\limits_{q_i(\mathbf{z}),C_i} U_i(q_i(\mathbf{z}), C_i, X_{1i}) \\ \text{s.t.} C_i + p(\mathbf{z})q_i(\mathbf{z}) = y_i \end{cases}$$

where X_{1i} is a vector with household characteristics. Note that $p(\mathbf{z})$ is a hedonic price function determined in the market and taken as given by households in an atomized and competitive market. Following Rosen (1974) we define a bid-rent function $\theta(\mathbf{z}, U, y, \alpha)$ to be the money amount a household is ready to pay for different values of housing, as captured by the housing characteristics vector $\mathbf{z}$, for a given level of utility and income.

The consumption of the composite good C will hence be the non-housing expenditure, $y - \theta$ which is observed to be $y - v(\mathbf{z})$. The parameter α captures non-modelable characteristics of household housing preferences that are stemming from taste or private reasons (near to family, ancestors' house, etc.). Solving the maximum for U yields a demand function for housing, $q(\mathbf{z}) = q(p(\mathbf{z}), y, X_1)$.

For each housing characteristic z_j the partial derivative θ_j will be the amount of money a household is willing to pay for an extra unit of z_j for unchanged levels of utility and income.[3] Since that additional expenditure stems from a decrease in its consumption in C, θ_j will be $\theta_j = \frac{u_{z_j}}{u_C}$.

2.2 Econometric Model for the Determinants of Housing Demand

Since households face exogenous prices $p(\mathbf{z})$, in the optimum they will pay $\theta_j(z_j^*, U^*, y, \alpha) = p_j(\mathbf{z}^*)$ for each attribute j and hence for the overall value of housing $\theta(\mathbf{z}^*, U^*, y, \alpha) = p(\mathbf{z}^*)$. Since q is non-observable, but instead we can only observe $v_i(\mathbf{z})$ the

[3] $y = p(\mathbf{z}) + C$ and hence F.O.C. yield $p_j \equiv \frac{\partial p}{\partial z_j} = \frac{u_{z_j}}{u_C}$

value of the housing unit paid by household i, both quantity and price of housing will have to be estimated. This is done through a hedonic regression following Rosen's (1974) two-step-procedure.

First we estimate the price of housing through a hedonic regression. In a second step, we use the estimated hedonic price $\hat{p}_j(\mathbf{z})$ for each attribute to determine the price of housing units. The estimated price for housing is then used to estimate the housing demand function:

$$q(\mathbf{z}) = q(\hat{p}(\mathbf{z}), y, X_1)$$

2.2.1 Decomposition of Income into Permanent and Temporary Income

In a first step, we decompose the observed income into a permanent income, defined as the fitted value of income in a regression predicting a household's income from its demographic attributes, and temporary income, calculated as the residual:

$$y_i = y_i^P + y_i^T$$

where $\hat{y}_i^P = f(X_{2i})$ and X_{2i} is a vector of the household's characteristics affecting income.

To determine the most likely functional form of f we perform Box-Cox regressions,[4] testing against other functional forms, e.g. linear and log-linear. As part of X_2 we include the head of household's age, gender, race, level of education, and marital status, as well as their source of income. In order to account for differences in salary levels at the capital and the upcountry, we include dummies for three geographical regions defined as Montevideo and urban centers with more than 5,000 inhabitants (other than Montevideo).

2.2.2 Hedonic Regression for $p(z_j)$

To determine the price for housing, we estimate a hedonic price regression fitting its functional form through Box-Cox. We estimate the hedonic price for 34 different markets, distinguishing among 14 regions in the upcountry and 20 groups of neighborhoods within Montevideo. For all these geographical units, we estimate hedonic prices accounting for different types of housing (house, apartment) and distinguishing among construction quality (poor, average, good/very

[4] See, for example, Quigley (1982) and Follain and Jiménez (1983).

good) as further controlling attributes. Garabato and Ramada-Sarasola (2011) provide a detailed description of the way in which a housing unit's construction quality was estimated.

The housing attributes z_j included to estimate the hedonic price regression

$$v = v(\mathbf{z}, X_3)$$

are directly related to the housing unit's characteristics—number of bedrooms, number of bathrooms, existence of basic services (Water, Electricity, Sewerage, WES), construction materials, existence of structural problems (of severe, medium or low importance), housing unit's age—or to its neighborhood characteristics, such as the existence of certain types of services meeting certain standards: paved streets, lighting, and sanitation, among others. To further characterize neighborhood attributes beyond those included as part of the survey, we also include a categorical variable distinguishing among different socioeconomic types of neighborhoods. In addition, we follow Zabel (2004) and include some characteristics of the household, noted as X_3 in which the household head's age, education, and permanent income are included, as well as other characteristics associated household equipment (a wealth proxy accounting for the existence of superior durable goods such as dishwasher, washer-dryer and/or automobile) and the existence of maid service. For the 62 neighborhoods in Montevideo, we also include the average price of a constructed squared meter to capture neighborhood unobservables that may be affecting a housing unit's price.

By defining a standard housing unit z^{std} and using the estimates of the hedonic regression to determine its value $v(z^{\text{std}})$, we construct a price index that differentiates among the different geographic units. We define the group of neighborhoods in Montevideo which account for the highest share of the population—Malvín, Buceo, Parque Battle, Parque Rodó, and Prado—as the market in which the price index is 100. This yields the following formulation for the price index p_j in each market j:

$$p_j = 100 \frac{v(z_j^{\text{std}})}{v(z_1^{\text{std}})}$$

Once the price indices have been constructed, the quantity of housing can be calculated as the ratio between observed housing value and the region-specific estimated hedonic price. Since p_j defines the price of a standard—average—housing unit within a market j, we derive the

quantity of housing demanded by a household i in market j by dividing the rent (or equivalent rent) value paid by the household for its housing unit v_{ij} through the price index in that market:

$$q_{ij} = \frac{v_{ij}}{p_j}$$

The above-demanded quantity of housing is then used to estimate the determinants of housing demand.

2.2.3 Regression on Housing Demand

We estimate the determinants of housing demand, taking into account three dimensions. First we include the household's income—in its estimated decomposition in y^T and y^P. Second, we include the hedonic price as estimated in the previous step. Finally we include household demographic characteristics in X_1. Vectors X_1, X_2 and X_3 may share most attributes, but are each defined as the attributes determining different things, namely housing demand, income, and housing prices, respectively.

Similar to what is implemented by Fontenla et al. (2009) for Mexico, we let permanent income and housing prices enter the equation non-linearly by specifying the functional form through a Box-Cox transformation.

$$\frac{q_z^\theta - 1}{\theta} = \alpha + \beta_1 \frac{p_z^\lambda}{\lambda} + \beta_2 \frac{y^{P^\lambda}}{\lambda} + \delta y^T + X_1\gamma + \pi PP + \varepsilon$$

As part of X_1 we include the household head's age, gender, race, and marital status, the household's permanent income, the number of young children (defined as less than 14 years of age), the number of teenagers and adults (older than 14 years of age), its access to private sources of housing financing, and its use of social programs (other than housing). Finally, we also include a variable PP that accounts for the use or access to public housing. For a description of the used variables please refer to Garabato and Ramada-Sarasola (2011) and to Tables 11 and 12 in the Appendix.

3. Empirical Implementation and Estimation Results

In this section, the results obtained for the regressions outlined above are analyzed. Since the regressions estimated follow a Box-Cox specification and are hence non-linear, besides the estimated coefficients we present the variables elasticities so as to allow a better interpretation of the results and allow comparability between different types of specifications. For dummy variables instead of elasticities, the effect of the dummy's discrete change from zero to one is presented.

3.1 Estimation of Permanent and Temporary Income

We estimate an equation following a Box-Cox specification in which age enters the equation non-linearly and the remaining variables are not transformed:

$$\frac{y^{\theta}-1}{\theta} = \alpha + \beta\frac{age^{\lambda}-1}{\lambda} + \delta_1 male + \delta_2 caucas + \sum_{l=3}^{8}\delta_l educ_level_l + \sum_{j=9}^{13}\delta_j source_inc_j$$
$$+ \delta_{14} mvdeo + \delta_{15} partner + \delta_{16} div_wid \qquad (1)$$

where y is the declared household income. The educational level variables are implemented as dummy variables accounting for completed primary, completed secondary, completed technical, completed tertiary, and completed postgraduate studies. The omitted category is less than completed primary studies. For marital status, we decided to include a variable that accounts for the existence of a life partner, instead of the formal status of being married, since we have 15 percent of the population that although not married are in stable relationships with a life partner.[5] In addition, for those households that are currently monoparental, we include a dummy variable that accounts for divorced or widowed heads of household, since these may receive a pension stemming from a previous (formal) relationship. The omitted categories are unmarried heads of household who are neither in a stable life-partnership, divorced, nor widowed. The dummy variables distinguishing among the head of household's main source of income do it according to the categories: public salary, private salary, own business, informal, pensioner and/or retiree and other. In the regression, the other omitted categories are female, not Caucasian, business owners, and cities other than Montevideo.

[5] Further, under current Uruguayan law, so-called *civil unions* are practically legally equivalent.

Table 1. Determinants of Income: Box-Cox Regression

	Coef.	P> $\chi^2(df)$	Elasticity
Transformed			
Age	279.851***	0.000	0.228
Not Transformed			
Male	0.001	0.002	0.001
Caucasian	0.127***	26.103	0.078
Primary	0.495***	459.675	0.304
Secondary	1.084***	1197.778	0.667
Technical	1.303***	925.828	0.801
Tertiary	2.162***	1750.546	1.329
Postgraduate	2.939***	546.598	1.806
Inc. Retiree	-0.688***	305.375	-0.423
Inc. Informal	-1.304***	1109.138	-0.802
Inc. Private	-0.329***	72.744	-0.202
Inc. Public	-0.257***	38.080	-0.158
Inc. Other	-0.996***	112.402	-0.612
MVD	0.391***	483.331	0.241
With Partner	0.815***	848.897	0.501
Divorced/Widower	0.196***	44.223	0.120
Constant	-157.161		
	Coef.	P>|z|	
λ	-1.66***	0.000	
θ	0.053***	0.000	
N	17,030		
LR χ^2	8,259.95		
P> χ^2	0.000		
Test HO:			
		P> χ^2	
$\theta = \lambda = -1$		0.000	
$\theta = \lambda = 0$		0.000	
$\theta = \lambda = 1$		0.000	

*p<0.1, **p<0.05, ***p<0.001

As can be seen in Table 1, likelihood-ratio tests reject the linear, log-linear and inverse-multiplicative specifications at the 1 percent significance level, being θ and λ 0.053 and -1.66, respectively, and hence supporting the choice of a Box-Cox specification. Given the obtained coefficient for λ income relates to age in an inverse U-shape, as expected. Transformed age has a positive elasticity of 0.228, a result that is slightly lower than the one obtained by Fontenla et al. (2009) for Mexico. Further, we obtain a positive effect on the household's total disposable

income when the head of household head is male and Caucasian. The percentage changes on a household's total income for a male head of household (as opposed to a female one) and from having a Caucasian head of household (as opposed to another race) are 0.1 percent and 7.8 percent, respectively. The effect stemming from gender is so little since gender refers to the head of household, while income includes the whole household's income, i.e. the income received by each household member, plus the entire household's income from other sources such as remittances.

Further, we obtain increasing elasticities for each consecutive completed education level, with an impact of almost tripling income for finished postgraduates. The impact of completing primary education is 30.4 percent, and a secondary degree generates an income premium of 66.7 percent with respect to households in which heads have not completed primary education.

The results for variables capturing the type of source of income are also aligned with economic intuition. An informal source of income has a negative impact of income when compared to owning a business (omitted case), while public and private salaried are those displaying the smallest difference in permanent income when compared to business owners. Owning a business as the main source of income earns a premium of over 80 percent over having an informal source of income, while households headed by retirees and pensioners have 42 percent less total disposable income.

As expected, cities in the upcountry display smaller permanent income levels than Montevideo. The income premium of living in the capital is 24 percent. Finally, biparental households have an income premium of almost 50.1 percent, while monoparental households with a divorced or widowed household head earn 12 percent more income than those led by singles not engaged in a stable life-partnership.

The highly significant results obtained, as well as their correctly predicted direction, support the approach of estimating permanent income through the above regression, while temporary income is defined as the residual. The estimated permanent income, noted as y, is used in the next estimation stages.

3.2 Estimation of Hedonic Prices

For all 34 geographic units defined above, we estimate hedonic price regressions testing among different specifications of the Box-Cox transformation. In all regressions the household head's

age, a categorical variable for his/her level of education and the household's estimated permanent income enter the specification non-linearly, while the rest of the variables are not transformed. For 25 regressions we find evidence of a functional form that transforms both the dependent and the transformed independent variables by the same parameter, i.e., following the form:

$$\frac{v^{\lambda}-1}{\lambda} = \alpha + \beta_1 \frac{age^{\lambda}-1}{\lambda} + \beta_2 \frac{y^{\lambda}-1}{\lambda} + \beta_3 \frac{educ^{\lambda}-1}{\lambda} + \gamma_1 num_bedr + \gamma_2 num_bathr$$
$$+ \gamma_3 hous_age + \gamma_4 constr + \gamma_5 neigh_servs + \gamma_6 neigh_type + \gamma_7 avg_p2$$
$$+ \delta_1 WES + \delta_2 lux + \sum_{l=3}^{5} \delta_l probl + \delta_6 house + \delta_7 domest \qquad (2)$$

where v is the value paid by households for their housing, measured as the actual monthly rent for tenants or its equivalent estimated amount for non-tenants. For the dummies looking at construction problems, the omitted category is not having any construction problems.

For the regressions of geographic units (11), (21), (22), (24), (26), (31), (34), (37) and (38), we found evidence of θ and λ not being significantly different from zero, hence yielding a log-linear specification. Those areas are thus estimated as log-linear regressions.

The independent variables accounting for the housing unit's characteristics are the number of bedrooms, the number of (full) bathrooms, a dummy variable accounting for the existence of WES, three dummies accounting for the existence of construction problems of different degrees of severity, them being defined as before as severe problems, average problems and small problems. A further differentiator in prices is the unit being a house or an apartment; this is the reason why a dummy for the unit being a house was included. Additionally, units differ in terms of their construction quality—defined as previously as poor (1), medium (2), and good/very good (3)—so that an ordinal qualitative variable ranking the construction quality is included. Two further dummies control for the existence of superior durable goods or domestic service.

As control variables at the neighborhood level, we include two ordinal categorical variables that rank the existence of services in a neighborhood and its socioeconomic characteristics. The *neigh_servs* variable is an index that ranges from one to ten, adding up the existence of any of the following attributes in a neighborhood: access to general electricity net, access to general water net, access to general sanitation net, access to gas net, waste collection,

waste bins, paved street, paved sidewalks, public lighting, and rain drainage. The *neigh_type* variable classifies neighborhoods from 1 to 8, 1 being those of better socioeconomic and safety conditions and those placed in irregular settlements classified as 8.

The results of the regressions are displayed in Tables 18 to 22 in Appendix B. Several interesting results can be highlighted here. With respect to the elasticities of direct attributes of the housing unit, we find that on average—across all 34 regressions—an additional bedroom increases the value of housing by 0.120, while a bathroom impacts it by 0.130. The highest impact on housing value stems from the housing unit's type of construction, which on average displays an elasticity of 0.458. In addition, medium to severe construction problems are found to be significant in most regressions, impacting the value of housing with a percentage change of 22.3 percent for severe problems and 12.5 percent for average ones. Minor problems impact housing value by 7 percent on average, although the results are only significant in regressions for neighborhoods with solid construction. Results also display a value premium of 11.7 percent on average for houses over apartments, as a housing unit, and neighborhoods with more services or better socioeconomic conditions also impact favorably on a housing unit's value.

It is also interesting to note the differences in the determinants of housing values for different geographic areas and types of neighborhoods. As expected, within Montevideo WES has no impact on the value of housing in higher-income neighborhoods, classified as (1), (2) and (3), while the elasticities for additional rooms and bathrooms are higher than in other neighborhoods. Small problems have a large impact on the value of housing, while the ownership of superior durable goods or the existence of maid service are strong differentiators in these neighborhoods.

In very poor Montevideo neighborhoods—(16), (17), (18) and (19)—the existence of WES plays a larger role in housing value, with an impact on value of around 18 percent. According to our results, even in these very poor neighborhoods, where overall construction is poor and housing units display major qualitative deficits and constructions problems, the market is able to differentiate units' value with respect to the existence of those problems, with severe problems and average problems significantly impacting housing value.

In terms of the determinants of housing value, there are no recognizable patterns differentiating the upcountry from Montevideo, although elasticities can vary greatly from one region to another. For example, while the existence of medium problems has impacts of a

maximum of 30 percent in the better neighborhoods of Montevideo, in the upcountry it reaches a maximum of only 17 percent.

The calculated price index displays a high variability—as is to be expected—varying from 164.2 for the most expensive neighborhoods—Carrasco, Punta Gorda, Pocitos and Punta Carretas—to 21.7 for minor urban centers in the northeast of the country. The poorest neighborhoods in Montevideo share a price index ranging from 33 to 35, while the most expensive housing units outside Montevideo are found in Punta del Este, Piriapolis and Colonia del Sacramento—highly touristic areas. Table 2 displays the index per defined geographic area.

Table 2. Price Index per Geographic Unit

Geographic unit	Price Index	Geographic unit	Price Index
21	21.66527	15	46.35277
31	22.22923	10	46.94619
28	23.96944	12	47.62147
24	24.57396	14	49.79442
19	33.10717	38	53.51966
17	34.98606	13	53.53538
18	35.9001	9	54.42764
36	36.85075	11	61.3203
26	37.37452	8	65.15956
22	38.93307	7	67.32248
39	39.15928	6	70.71945
20	40.26341	4	73.38694
35	40.39213	34	75.91908
16	41.07972	5	79.57543
37	42.12924	3	80.55163
29	43.8167	2	100
32	45.95634	1	164.1628

3.3 Estimation of the Determinants of Housing Demand

Here too, a Box-Cox specification was tested to determine functional form yielding an equation of the type:

$$\frac{q^{\lambda}-1}{\lambda} = \alpha + \beta_1 \frac{age^{\lambda}-1}{\lambda} + \beta_2 \frac{y^{\lambda}-1}{\lambda} + \beta_3 \frac{p^{\lambda}-1}{\lambda} + \delta_1 male + \delta_2 caucas + \delta_3 partner$$
$$+ \delta_4 hou_pol + \delta_5 fin_access + \delta_6 soc_pol + \gamma_1 y^T$$
$$+ \gamma_2 num_childr + \gamma_3 num_adults + \gamma_4 educ_level \qquad (3)$$

with q the estimated demanded quantity of housing, y estimated permanent income, y^T temporary income, and p the estimated hedonic price. In addition to household demographic attributes, we added three more independent variables that capture the extent to which the household has access or makes use of housing policies (hou_pol), social policies (soc_pol), and/or private financing sources for housing (fin_access).

We estimated housing demand for different segments of demand as a way of testing for the robustness of the estimated income and price elasticities. We therefore estimated the above regression for the whole sample, as well as for the formal and the informal housing markets separately. We also repeated the estimation for housing demand in Montevideo only. In addition, within the formal housing market we estimated the housing demand separately for owners and for tenants. Finally, we estimated housing demand for four age cohorts, which included households with heads under the age of 30, heads ages 30 to 50, those between 50 and 65, and heads over 65. The results and their interpretation are summarized below.

3.3.1 Housing Demand in the Formal and Informal Housing Markets

Here, too, our results strongly support the choice of a Box-Cox specification with a single parameter, since linear, log linear and inverse multiplicative specifications are rejected at the 1 percent significance level.

When not distinguishing between formal and informal markets, we find a price elasticity of housing demand of -0.372, which is low compared to developed countries but higher than what was found by Fontenla et al. (2009) for Mexico. This may reflect the fact that there is less supply than demand of housing units, which narrows Uruguayan households' reaction ability in terms of adjusting their housing demand to prices. In addition, and since the results rely on the full sample, this may also be mirroring the low degree of mobility within the country. The price elasticity goes up significantly up—to 0.792—when looking only at the informal market, which lies within the acceptable range of 0.5 to 0.8 proposed by Ermisch et al. (1996). This difference

between the formal and the informal market can be explained by the fact that a higher price elasticity is to be expected for low-income households, and it also mirrors the higher degree of mobility in informal markets. In these markets, supply seems to match better the quantity of demand since it is more flexible as it is not regulated. Given Malpezzi (1999) and Zabel's (2004) results on the high degree of variation of price elasticities and its sensitivity to model design, our results are in line with expectations, and it can be argued that the informal market behaves as a more homogeneous market in the sense that households in informal markets are more prone to relocate to other informal housing arrangements irrespective of neighborhood or area. In the formal market, where there is less supply than demand and where less housing substitutes are available, demand becomes price inelastic.

Table 3. Housing Demand: Box-Cox Regression

	Total sample		Formal		Informal	
	Coef.	Elasticity	Coef.	Elasticity	Coef.	Elasticity
			Not Transformed			
Temporary Income	0.000***	0.032	0.000***	0.038	0.000***	-0.023
Male	-0.209***	-0.087	-0.155***	-0.063	-0.364**	-0.132
With Partner	0.019	0.008	0.011	0.004	-0.102	-0.037
Children<14	-0.046***	-0.013	-0.006	-0.001	-0.119***	-0.060
# adults in HH	0.007	0.007	0.014	0.013	0.062	0.057
Education HH head	0.125***	0.113	0.137***	0.123	-0.028	-0.018
Caucasian	0.255***	0.106	0.243***	0.098	0.067	0.024
Use Housing Policies	-0.011	-0.004	-0.117***	-0.047	-	-
Financial Access	0.243***	0.101	0.179***	0.072	-0.283	-0.102
Social assistance	-0.355***	-0.147	-0.346***	-0.140	-0.109	-0.039
Const.	3.472		3.92		7.299	
			Transformed			
Price Index	-0.368***	**-0.372**	-0.368***	**-0.368**	-0.728***	**-0.792**
Permanent Income	0.106***	**0.373**	0.091***	**0.325**	0.105***	**0.570**
Age	0.194***	0.200	0.2***	0.205	-0.12**	-0.134
	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|
λ	0.228	0.000	0.231	0.000	0.297	0.000
σ	1.183	0.000	1.178	0.000	1.417	0.000
N	16,939		13139		1054	
LR χ^2	5375.7		3661.77		359.33	
P> χ^2	0.000		0.000		0.000	
Test HO:		P> χ^2		P> χ^2		P> χ^2
λ =1		0.000		0.000		0.000
λ =0		0.000		0.000		0.000
λ =1		0.000		0.000		0.000

*p<0.1, **p<0.05, ***p<0.001

For the overall market, income elasticities obtained for temporary and permanent income are in line with those found in the literature. In fact, while temporary income is found to have an elasticity of 0.032, permanent income shows an elasticity of 0.373, which, although being smaller than the usually expected 0.6 to 0.8 income elasticities, is at least above the minimum income elasticities reported in literature for developed countries, which are around 0.36 (Mayo, 1981). Here again, the informal market yields an income elasticity that is higher and closer to what is expected—0.57—pointing again to the fact that the informal market seems to be working as a more consolidated housing market. These results seem to be robust to changes in the definition of neighborhoods and proper housing markets[6], as well as to different ways of segmenting housing demand according to income strata or geographic areas.

In addition, our results seems to be consistent with the findings from Garabato and Ramada-Sarasola (2011) on the types of qualitative deficits faced by households in Uruguay and the lack of use of housing programs by the eligible population. In this sense, Uruguayan households seem to display a certain inertia with respect to improving their housing conditions, and this may be also reflected in the low elasticity found with respect to income. Given that the regression displays a static relationship between income and housing, this may be also the result of neglecting a time lag or taking into account income evolution, rather than income levels.

When looking at household composition in terms of its members, we find that the larger the number of children, the less housing is demanded—and less income is available to demand housing given the costs children entail. This result seems to be highly driven by the informal market, where the elasticity is more than double the one found in the whole sample. In the formal market, no significant effect is found. In addition, the usual negative impact on housing demand of being married, reported in the literature, is being captured by the presence of the variable accounting for the number of children. Once that has variable been controlled for, as well as total income (which implicitly includes the number of earning adults in the household), neither the partnership variable nor the number of adults in the household yields significant results.

In the overall sample, male heads of household demand 8.7 percent less housing than their female peers, Caucasian heads of household demand 13 percent more housing, and bi-parental households demand 10.6 percent more housing than their single counterparts. Further, we find that age has a positive impact on housing demand, with an elasticity of almost 0.20, both

[6] Results are available upon request.

in the overall sample and in the formal market. Further, given λ is 0.228, age displays an inverse U-shaped relationship with housing demand in the overall sample. This is aligned with what can be expected, since housing needs initially increase with age. Once a certain threshold is met, those needs start declining when the household size gets smaller as children move out and found their own households. In the informal market, surprisingly, age is found to have a negative elasticity. This may be mirroring the fact that among the poorest strata, age is not correlated with a more stable economic status and hence the possibility of demanding more housing, or, as argued by Fontenla et al. (2009), it may just reflect taste once income is accounted for. Still, among low-income households, the older the head of household, the more fragile its overall economic situation, since age implies higher health care costs and lower labor productivity.[7] It is also in this stratum where retirees and pensioners, who rely only on government pensions, suffer the most in terms of needing to downscale their overall living standards. In addition, these households usually do not have access to other indirect sources of income (e.g., the support of their immediate family), since they are also struggling with poverty. Thus, despite the fact that income is being controlled for, the effect of a "forced" taste to downscale may be present here, driven by an increased need to reduce housing demand in higher ages, stemming from unobservables related to older households' more fragile economic status in general—in terms of both level and uncertainty.

We also find a very strong effect of education of housing demand. According to our results, the more educated the head of household, the more housing is demanded. Since income is being controlled for, this may mirror differences in taste, in which more educated heads of household demand a larger extent of housing, all other things being equal. In fact, the effect disappears within the informal market, where the major differences in education affecting demand are already accounted for by its effect through permanent income.

Finally, the interaction of housing demand and housing programs can be examined. According to our findings, in the formal housing market, those who accessed their housing through private sources of financing demanded 18 percent more housing than those who did not. Households making use of social programs demand 35 percent less housing, while the fact that households have used housing programs to access has an impact of almost 12 percent less in

[7] Although the functional form obtained is U-shaped, due to the magnitude of the coefficients it is extremely flat in the region of ages between 0 and 100 and mimics a linear negative relationship in that range, since the minimum is reached far beyond livable ages.

housing demand. None of these effects can be observed among informal housing markets. The fact that the use of housing programs has a significantly negative impact on the amount of housing demanded, even after controlling for the effect stemming from the household's socioeconomic attributes, may imply that housing programs grant access to housing solutions with fewer attributes than those that would have been demanded if the housing unit had been acquired by other means, all other things being equal.

3.3.2 Housing Demand in Montevideo

Given the low price elasticities found for housing demand when taking into account all Uruguayan cities with more than 5,000 inhabitants, the question arises whether the result is driven by low mobility from one urban area to the other across the country. We looked at the results of a much more homogeneous market, in which analogous housing units should behave as substitutes irrespective of them being in different neighborhoods.

Table 4. Housing Demand: Box-Cox Regression for Montevideo

	Montevideo		Montevideo Formal		Montevideo Informal	
	Coef.	Elasticity	Coef.	Elasticity	Coef.	Elasticity
			Not Transformed			
Temporary Income	0.000***	0.030	0.000***	0.038	0.000***	-0.033
Male	-0.137**	-0.037	-0.038	-0.011	-0.31*	-0.094
With Partner	-0.035	-0.010	0.006	0.002	-0.043	-0.013
Children<14	-0.049**	-0.008	0.031	0.004	-0.129**	-0.053
# people in household	0.057**	0.036	0.075***	0.053	0.092	0.073
Education HH head	0.092**	0.059	0.124**	0.092	-0.011	-0.006
Race White	0.328***	0.089	0.330***	0.099	-0.073	-0.022
Use Housing Policies	-0.034	-0.009	-0.189***	-0.057		
Financial Access	0.340***	0.092	0.187**	0.056	-0.41	-0.125
Social assistance	-0.432***	-0.117	-0.359***	-0.108	0.034	0.010
Const.	5.078		5.421		9.814	

Table 4., continued

	Montevideo		Montevideo Formal		Montevideo Informal	
	Coef.	Elasticity	Coef.	Elasticity	Coef.	Elasticity
	Transformed					
Price Index	-0.291***	-0.319	-0.322***	-0.350	-0.843***	-0.897
Permanent Income	0.047***	0.321	0.042***	0.239	0.072***	0.498
Age	0.200***	0.208	0.217***	0.223	-0.139**	-0.153
	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|
λ	0.337	0.000	0.305	0.000	0.340	0.000
σ	1.638		1.399		1.642	
N	7,129		5,410		775	
LR χ^2	1,980.21		1,423.59		251.05	
P> χ^2	0.000		0.000		0.000	
Test HO:		P> χ^2		P> χ^2		P> χ^2
λ =1		0.000		0.000		0.000
λ =0		0.000		0.000		0.000
λ =-1		0.000		0.000		0.000

*p<0.1, **p<0.05, ***p<0.001

Although the elasticities for the overall market and for the formal market seem to decrease, i.e., become more inelastic, the difference between them is not significant. In the case of the informal market, where mobility across the country is even more difficult than for the formal market, the change goes in the expected direction, with elasticities becoming significantly larger in absolute terms. In other words, within the informal market results taking into account the whole country were downward, biasing price elasticity. For the formal Montevideo housing market, no difference can be found and price elasticity remains low. Still another difference is the effect of male heads of household demanding less housing, which becomes less pronounced in Montevideo.

3.3.3 Housing Demand by Owners and Tenants

Arguably, income elasticity should be greater for tenants, who can adapt their housing solutions to changes in income faster and face fewer transaction costs than homeowners. In fact, in Uruguayan homeowners incur transaction costs both for selling and for buying a new housing unit, among them income taxes, notary costs, and real estate brokerage fees. Coordinating the timing of selling and buying simultaneously to transfer the value of one housing unit to the next

also should increase the difficulty faced by owners in adapting their housing solution to both their needs and changes in income. On the other hand, owners could refurbish and renovate their housing units as a reaction to an increase in income. This could offset the effect of transaction costs for improving their housing conditions in the case of owners, provided they have access to credit. If there is no working lending market, it may be difficult for owners to borrow a large amount of money to adapt their housing unit, despite their current income having increased. This reasoning warrants estimating the demand separately for owners and tenants to see whether and how their price and income elasticities differ.

As can be seen in Table 5, the housing demand of tenants is more elastic to changes in housing price, which supports the inference that tenants have more ability to react to changes in prices given they are the only ones who actually act as real economic agents in the market. While for owners there is a so-called imputed rent, if prices go up, the odds of an owner moving due to the movement in prices are rather small.

In addition, our results support the inference that tenants are more income elastic than homeowners. Both elasticities are around 0.3, i.e., aligned with the previous results presented above. The difference, although not large, is significant. Given that the elasticities are similarly, one could also conclude that for owners, the lack of a well-functioning mortgage market may be keeping the income elasticity low. For tenants—where this situation does not apply—restrictions on the supply side, inertia, and other types of transaction costs, such as finding proper rental guarantees, may explain the low elasticity.

Further differences become apparent between owners and tenants. First, while for owners neither the fact of having a partner, nor the number of grown-ups in the households affects housing demand, it does so for tenants. According to our results, couples that rent demand less housing, other things being equal, than single people. Given that the variable on the number of children is non-significant,[8] this may be capturing the effect of couples demanding less housing given that they have to spend on other items, such as schooling and health care for their children. The interesting fact is that this is not observable for owners, who do not appear to reduce their demand for housing in order to account for family-related expenses when the housing demand is felt to be related to a more permanent type of housing, i.e., when buying. Older heads of

[8] This result is probably related to the high correlation between the two variables and a smaller number of observations in the subsample for tenants.

household also tend to demand more housing when buying than when renting, displaying an elasticity to age that almost doubles the one for tenants.

Table 5. Housing Demand: Box-Cox Regression for Homeowners and Tenants

	Homeowners		Tenants	
	Coef.	Elasticity	Coef.	Elasticity
Not Transformed				
Temporary Income	0.000***	0.037	0.000***	0.038
Male	-0.164***	-0.064	-0.076	-0.034
With Partner	0.02	0.008	-0.136**	-0.061
Children<14	-0.009	-0.002	-0.004	-0.001
# people in household	-0.014	-0.013	0.106***	0.101
Education HH head	0.143***	0.121	0.108**	0.115
Race White	0.249***	0.097	0.197***	0.088
Use Housing Policies	-0.209***	-0.081	0.212***	0.095
Financial Access	0.097**	0.038		
Social assistance	-0.381***	-0.148	-0.276***	-0.123
Const.	4.434		4.103	
Transformed				
Price Index	-0.351***	-0.346	-0.384***	-0.410
Permanent Income	0.087***	0.318	0.101***	0.345
Age	0.151***	0.154	0.077**	0.080
	Coef.	P>|z|	Coef.	P>|z|
λ	0.238	0.000	0.216	0.000
σ	1.240		0.93835	
N	10,714		2,425	
LR χ^2	2714.87		895.05	
P> χ^2	0.000		0.000	
Test HO:		P> χ^2		P> χ^2
λ =1		0.000		0.000
λ =0		0.000		0.000
λ =-1		0.000		0.000

*p<0.1, **p<0.05, ***p<0.001
Note: Only the formal housing market was considered for the regression above.

Finally, while, *ceteris paribus*, access to housing through housing programs reduces the amount of housing demanded for households becoming owners of a housing unit, the result is also significant, in the other direction, for tenants. In other words, tenants that make use of the rental guarantee fund are able to demand more housing.

3.3.4 Housing Demand by Age Cohorts

Segmented housing demand can further analyzed. Given the high degree of inertia present in Uruguayan households, which appears to be preventing them from adjusting their housing needs to changes in income, coupled with the aging of the Uruguayan population, it seems natural to ask if inertia may be related to heads of household overconsuming housing at older ages and not changing their housing solution after a certain age—say, 50—when they reach the maximum amount of housing they can demand.

Table 6. Housing Demand: Box-Cox Regression by Age Cohorts

	Age <=30		Age 31-50		Age 51-65		Age 66+	
	Coef.	Elasticity	Coef.	Elasticity	Coef.	Elasticity	Coef.	Elasticity
Not Transformed								
Temporary Income	0.000***	0.029	0.000***	0.038	0***	0.045	0***	0.033
Male	-0.144**	-0.094	-0.041	-0.026	-0.325***	-0.099	-0.225**	-0.074
With Partner	-0.179**	-0.117	-0.038	-0.024	0.113	0.034	0.103	0.034
Children<14	-0.021	-0.013	0.002	0.001	-0.121**	-0.012	0.012	0.000
# people in household	0.182***	0.228	0.017	0.028	0.01	0.008	-0.006	-0.004
Education HH head	0.077*	0.128	0.066**	0.107	0.204***	0.140	0.188**	0.112
Race White	0.099	0.065	0.163***	0.104	0.297***	0.091	0.312***	0.103
Use Housing Policies	0.07	0.046	-0.106***	-0.068	-0.18**	-0.055	-0.113*	-0.037
Financial Access	0.288**	0.188	0.139**	0.089	0.156	0.048	0.162*	0.053
Social assistance	-0.132**	-0.086	-0.213***	-0.136	-0.421***	-0.128	-0.74***	-0.243
Const.	2.553		2.846		5.429		4.863	
Transformed								
Price Index	-0.32***	-0.333	-0.369***	-0.370	-0.397***	-0.390	-0.364***	-0.363
Permanent Income	0.112***	0.215	0.183***	0.349	0.063***	0.325	0.068***	0.298
Age	0.339**	0.325	0.111*	0.109	0.155	0.160	0.17**	0.189
	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|
λ	0.118	0.000	0.114	0.000	0.299	0.000	0.281	0.000
σ	0.662		0.725		1.582		1.437	
N	873		4,306		3,829		4,131	
LR χ^2	194.660		1113.880		1113.880		885.280	
P> χ^2	0.000		0.000		0.000		0.000	
Test HO:		P> χ^2		P> χ^2		P> χ^2		P> χ^2
λ =1		0.000		0.000		0.000		0.000
λ =0		0.004		0.000		0.000		0.000
λ =-1		0.000		0.000		0.000		0.000

*p<0.1, **p<0.05, ***p<0.001

We estimated the housing demand regression for four age cohorts that should proxy four different stages of a household. In the first stage—heads under 30 years of age—households are new and have to face several sources of costs, e.g., access to durable goods, which may reduce

their income elasticity. In the second stage—heads of household between 30 and 50 years of age—households are stabilizing their housing situation and accessing something permanent. It is also the stage in which income varies the most and where expenses related to children are the highest. In the third stage, households should have a smoother income pattern, and while income varies less, housing needs should decrease since in this stage children leave home. Finally, in the fourth stage—heads of household 65 or older—income may be reduced due to retirement. This should be coupled with a reduction in housing demand.

The regression results support most of these inferences. According to our results, the function of income elasticity depending on age displays a clear inverse U pattern, with a maximum elasticity found in stage 2, the stage in which income has more variation, decreasing both for the earlier and the later stages. The results also point towards higher elasticities for households in the fourth age cohort than for those in the first one. This does not support the idea of households overconsuming housing in older ages. In a country like Uruguay, this is an important policy issue. According to our results, households are less income elastic in their constitution stage. This is because in this stage, income is also used to access other goods—automobiles, durable goods—and housing may not be the first priority to adapt, once a minimum amount of housing has been provided for. In the next stage, income elasticity increases by 60 percent, coupled with the fact that income increases during this stage, given that this is the most productive age cohort. Housing needs also increase, as this is the stage in which households grow the most. After that, income elasticity decreases, although not as much as expected. This may imply that households continue to reduce their housing consumption in older ages, although clearly not as much as needed, since elasticity decreases for the last two cohorts, where housing needs also decline and income is rather stable.

Finally, it also appears that access to financing is most important in terms of increasing housing demand for younger households. The importance of access to financing decreases as households age. In addition, while access through housing programs is not significant for the youngest households, it also has elasticities which in absolute terms decrease with age. This is interesting since it implies that housing programs seem to improve for older age cohorts, in terms of restricting less the housing demand of households, other things being equal.

4. Household Formality and Ownership Choices

This section looks at the determinants of the choice of formality and ownership status, and how these two choices interact with public policies. Given the highly definition-driven and residual character of the category semi-formal, regressions were done only on the formal and informal housing markets, as defined in Garabato and Ramada-Sarasola (2011).

4.1 Decision Tree Approach for Formality and Ownership Choices

The rationale laid out above leads to the following decision tree:

$$\begin{cases} \text{Formal} \begin{cases} \text{To own} \\ \text{To rent} \end{cases} \\ \text{Informal} \begin{cases} \text{Permanent solution} \\ \text{Transitory solution} \end{cases} \end{cases}$$

4.2 Estimation through a Multinomial Logit

This section presents the models used to estimate the determinants of the probability of a household ending in any of the five final nodes of the decision tree above. Since households' decisions can be catalogued as discrete choices, we model this behavior using a multinomial logit approach that fits the decision tree described above.

For this purpose we start by analyzing the **formality decision,** which can be modeled as a binomial decision:

$$Pr\left[H = h \middle| X_4\right] = \frac{\exp X_4 \beta_h}{\left[1 + \sum_{l=1}^{2} \exp X_4 \beta_l\right]}, h = 1,2$$

with $h = 1$ for formal housing and $h = 2$ for informal housing conditions and X_4 a vector of household treats. The variables included in X_4 are the head of household's age, gender, race, marital status, number of children, educational level, years of tenure, main source of income, whether the household receives remittances or other type of transfers from abroad, whether it receives social assistance, whether it has access to external financing, and whether it is located in Montevideo.

After this, and within each of the two formality states, we analyze the specific **ownership decisions** of households. In particular, and within those households that have chosen formal housing, we analyze the determinants of the choice to own or to rent the housing unit. Using a further logit approach, we estimate the determinants of the choice of renting or ownership to understand which demographic characteristics and which target groups of people are more inclined to own houses and will thus be more responsive to public housing programs aimed at increasing home ownership. The specification is thus formulated as:

$$Pr\left[OL = o \middle| X_5; h = 1\right] = \frac{\exp X_5 \beta_o}{\left[1 + \sum_{l=1}^{2} \exp X_5 \beta_l\right]}, o = 1,2$$

with $o = 1$ for renting, $o = 2$ for ownership and X_5 a vector of household treats.

Analogously, once a household has chosen to seek housing in the informal housing market, we analyze the determinants of engaging in a permanent housing solution within the informal market—by purchasing—or through a transitory solution—by renting or occupying an informal housing unit:

$$Pr\left[OI = o \middle| X_6; h = 2\right] = \frac{\exp X_6 \beta_o}{\left[1 + \sum_{l=1}^{2} \exp X_6 \beta_l\right]}, o = 1,2$$

with $o = 1$ for permanent, $o = 2$ for transitory and X_6 a vector of household treats.

The estimation of these models yield insights about which target groups may be directly affected through policies impacting the housing financing market, as well as how to target housing programs and complement them with other programs to affect those groups that are more prone to demand final housing or whose odds of being interested in owning a housing solution are greater.

As for the demographic factors that explain the choice of housing situation and/or ownership status, X_5 includes permanent income and main source of income, the head of household's gender, age, race, marital status, education level, and length of tenure, whether the household receives remittances or other type of transfers from abroad, and its composition in terms of family members. To assess the effects of public policies in the ownership decision, we include variables accounting for the household's involvement in public housing programs and

other social assistance. X_6 also incorporates a variable accounting for the use of an illegal access to a power supply. This factor not only controls for the propensity to pay for other essential services/assets, but also allows us to control for the possibility that having this good for "free" can influence the choice of housing ownership in this market (though this is not a reasonable assumption in the other two markets).

As for the exact variables to include in each of the three models, we tested a number of different specifications for each of them and found that the model that provided a better fit in the informal market differed slightly from the ones selected for the formal market[9] (see Section 5 for further details). This finding should not be surprising since decision determinants in these two very different markets are expected to differ.

5. Do Housing and Social Programs Affect Ownership and Formality Choices?

This section presents the estimation results of the three regressions described in the previous section. A fourth regression is presented in which the decision to own or rent housing units of different construction quality is analyzed within a multinomial logit over the four options.

As for formality choices, Table 7 shows the estimated marginal effects, standard errors and p-values for choosing to be in the formal market (as opposed to the informal one). Marginal effects have been calculated at the sample mean, i.e., $ME = \frac{\delta F(\overline{X}\beta)}{\delta x_i}$.

5.1 Proneness to Enter the Illegal or Informal Housing Market

A household's proneness to leave the formal market is not necessarily based on an explicit decision, but it can be modeled as such. In the same way a firm's proneness to innovate or to outsource can be modeled through a binomial logit approach, we decided to assess the (probably unconscious) choice of living in an irregular settlement or housing situation. According to surveys conducted on households in irregular settlements, the main reasons for leaving the formal housing market are related to the costs of formality. Around 30 percent declared that they

[9] Criteria of better fit (through the comparison of adjusted R^2 and log-likelihood information) were used to decide among different specifications. In addition, a sensitivity analysis of coefficient estimates was performed to ensure that their sign and significance was not greatly affected by the inclusion or exclusion of any of the variables initially chosen as determinants of ownership choice.

decided to enter the informal market because they had no economic means to stay in the formal market, while another 50 percent says that the trigger was the need to leave their parents' household (Amarante and Caffera, 2003). In that sense, it could be argued that entering informality can be modeled as a decision in which demographic attributes play an important role.

Most of the variables display the expected sign and are highly significant in explaining formality choices. In particular, the older and more educated the head of household, the more likely he/she is to be in the formal market. An increment of ten years in age increases the probability of being in the formal market by 0.01, and escalating one educational category (for example from primary to secondary) increases the likelihood of choosing the formal market by 0.023. The coefficient for the male dummy shows that women are 0.014 more likely to be a part of the formal market. Finally, although years of tenure significantly increases the odds of formality, the size of that effect is not great.

Table 7. Formality Choices: Logit Estimation

	ME for Formal Market/ (se)
Age	0.001***
	(0.000)
Male	-0.014***
	(0.003)
Caucasian (d)	0.021***
	(0.004)
Education level	0.023***
	(0.002)
Inc. Retiree	-0.032**
	(0.012)
Inc. Informal	-0.123***
	(0.029)
Inc. Private	-0.053**
	(0.018)
Inc. Public	-0.045**
	(0.020)
Inc. Other	0.001
	(0.022)
MVD	-0.063***
	(0.004)
With Partner (d)	0.006**
	(0.003)
# children under 14	-0.006***
	(0.001)
Fin. Access	0.026***
	(0.003)

Table 7., continued

	ME for Formal Market/ (se)
Transfers	0.005**
	(0.003)
Social assistance (d)	-0.022***
	(0.004)
Years of Tenure	0.000***
	(0.000)
Pred. Prob. at mean	.971
Log Likelihood	-2753.259
Pseudo R^2	0.2667
N	14,193

*p<0.1, **p<0.05, ***p<0.001
ME: Marginal Effects. Marginal effects are calculated for the formal market

With respect to sources of income, all categories decrease the odds of being in the formal housing market, when compared to owning a business. As expected, those that are more prone to be in the informal housing market are the ones with informal sources of income. In fact, having an informal source of income increases the odds of informality by 0.123. Surprisingly, private and public salaried workers are more prone to be in the informal market than retirees and pensioners, despite the latter being a group with a smaller average income. This can be reflecting the fact that older people are less prone to enter an irregular housing market. Indeed, most households in irregular settlements are headed by very young people, who see their irregular situation as transitory. Still, as Garabato and Ramada-Sarasola (2011) have shown, for half the population in irregular housing settlements, informality is not transitory.

Household composition also has an influence over formality decisions. Every additional child under the age of 14 increases the probability of choosing the informal market by 0.006, and monoparental households are more likely to be found in informal markets. Finally, those households receiving social assistance are 0.022 more likely to be part of informal housing markets, which is expected, as these households are probably in a vulnerable financial situation that hampers their ability to access the formal market.

Households receiving income through transfers or remittances are 0.005 more likely to be in the formal market than those who do not, and the impact of having access to external financing sources is significantly positive, increasing the likelihood of formality by 0.026. This

again supports the inference that there is a formality premium that households may not be willing or able to pay.

5.2 The Ownership Choice

Table 8 shows the marginal effects estimates and standard errors for the two ownership models presented in the previous section. In the case of the formal market, households only have a dichotomous choice to make (to rent or to own) and hence the fitted model is simply a binomial logit regression in which the decision to own is taken as the base case. In the case of the informal market, households can choose to own, rent, or occupy, and therefore a multinomial logit model could be fitted. Still, given the scant number of households renting within the informal market, we decided to pool renting and occupying together in a category that accounts for a less permanent status within the informal market, against ownership, which is inherently a more permanent situation of housing informality. The marginal effects of choosing between a somewhat permanent and a less permanent housing solution within the informal market are presented in Table 10.

5.2.1 Ownership in Formal Housing Markets

In the case of the formal market, age has a positive impact on the odds of owning the housing solution, suggesting that older heads of household—even after controlling for income—are more prone to owning a housing solution. This reflects the tendency of households in Uruguay of preferring ownership to renting, and for households with older heads, the need to achieve the goal of owning a home seems to get more pronounced. We also find that men are less likely than women to own than to rent, which can be related to women's increased need of a more permanent housing solution as a safe haven. In fact, the predicted probability of renting increases by 0.024 if the head of household is a man.

With respect to the source of income, public employees are more likely to rent compared to wage earners in the private sector (base case), and the income source most increasing the odds of ownership is owning a business. Given that these results hold even after controlling for income, they may reflect differences in taste, e.g., business owners like more to "own" than others, and in the predictability of income: public sector wage earners have more job security since public employees cannot be terminated in Uruguay. As tenure increases, so does the probability of owning a housing solution (at the mean, the ME of more than 10 years of tenure

on ownership is 0.046). This may be related to the fact that the longer the tenure, the more likely it is that the household will access credit in the financial market. Households where the head has a partner and those with small children are more likely to own a housing unit in the formal market than to rent. Indeed, being in a partnership increases the probability of owning the housing solution by 0.087, and each additional child under the age of 14 adds 0.01 to the probability. The explanation for this may be that non-traditional families need more stable housing arrangements. Finally, households in the formal housing market who are receiving social assistance are more prone to own, while those receiving remittances are more likely to rent.

Table 8. Ownership Choices: Logit and Multinomial Logit Estimation

	Formal+
	Own
	ME/se
Perm Inc.	-0.000
	(0.000)
Age	0.006***
	(0.000)
Male (d)	-0.024**
	(0.009)
Caucasian (d)	0.014
	(0.010)
Education	0.003
	(0.006)
Inc. Retiree	0.015
	(0.013)
Inc. Informal	0.020*
	(0.010)
Inc. Own business	0.044***
	(0.011)
Inc. Public	-0.038**
	(0.013)
Inc. Other	0.110***
	(0.016)
With Partner	0.087***
	(0.011)
Divorced/Widower	-
	-
# people <14	0.010**
	(0.004)
# people >14	-
	-
Reg. House. Policy (d)	-
	-
illegal electricity (d)	-
	-
Transf. (d)	-0.062***
	(0.011)
Social assistance (d)	0.033***
	(0.008)

Table 8., continued

	Formal+
	Own
	ME/se
Tenure< 1Y (d)	-
	-
Tenure 1-5 Y(d)	-0.025**
	(0.011)
Tenure 5-10 Y(d)	-0.003
	(0.012)
Tenure>10 Y (d)	0.046***
	(0.009)
Predicted Prob. at mean	0.841
N	13139
Log Likelihood	-5,682.583
Pseudo R^2	0.096

*p<0.1, **p<0.05, ***p<0.001

ME: Marginal Effects.

+As per definition, formal housing arrangements only offer two choices (to rent or to buy). Therefore, the estimated model is a simple logit where owning is the base outcome.

Another decision within the formal market can also be assessed. Indeed, it is interesting to find out whether households are ownership-biased and hence prefer to own an average or bad quality housing solution that does not necessarily meet their needs rather than to rent a good quality housing solution. Table 9 depicts the results of that decision.

At the mean, the choice with the highest predicted probability within the formal market is to own a good quality housing solution, followed by owning a bad or average quality housing unit. To assess if owning a bad quality solution is preferred over renting a good quality one, all other things being equal, we present the results having the latter as the base outcome. As can be concluded from estimation results, both owning and renting bad quality solutions are less probable than renting a good quality one the higher the household's permanent income. There is no significant difference stemming from income with respect to the odds of owning vs. renting high quality housing units.

Older heads of household are more prone to own than to rent a good quality housing unit, confirming the results found earlier. Given the age structure of Uruguay's population, this confirms the earlier results regarding a certain bias toward ownership. With respect to gender, the results again seem to confirm that households headed by women are more likely to own than to rent given the same quality. The odds of owning a bad quality solution vs. renting a good quality one are not significantly affected by gender or race.

Table 9. Ownership Choices: Multinomial Logit Estimation

	Estimated Coefficients			Marginal Effects			
	Own good quality	Own bad quality	Rent bad quality	Own good quality	Own bad quality	Rent good quality	Rent bad quality
Perm. Income	-0.000	-0.000***	-0.000***	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)				
Age	0.052***	0.063***	0.026***	0.003	0.003	-0.006	-0.001
	(0.003)	(0.003)	(0.005)				
male (d)	-0.214***	0.106	0.282**	-0.066	0.041	0.014	0.011
	(0.079)	(0.091)	(0.134)				
race_w (d)	0.202**	0.092	0.155	0.032	-0.012	-0.021	0.000
	(0.085)	(0.092)	(0.132)				
education_level	0.026	0.366***	0.355***	-0.047	0.052	-0.013	0.008
	(0.052)	(0.072)	(0.120)				
Inc. Retiree	0.077	-0.574***	-0.844***	0.104	-0.092	0.011	-0.022
	(0.111)	(0.131)	(0.203)				
Inc. Informal	0.152	-0.928***	-1.200***	0.147	-0.130	0.008	-0.025
	(0.099)	(0.131)	(0.203)				
Inc. Own business	0.348***	1.074***	0.764***	-0.097	0.141	-0.053	0.008
	(0.113)	(0.147)	(0.243)				
Inc. Public	-0.237**	-0.179	0.072	-0.034	0.001	0.025	0.008
	(0.100)	(0.122)	(0.182)				
Inc. Other	1.199***	0.163	-1.567**	0.210	-0.104	-0.078	-0.028
	(0.358)	(0.393)	(0.797)				
With Partner	0.716***	1.506***	1.194***	-0.037	0.133	-0.108	0.012
	(0.089)	(0.111)	(0.175)				
# people <14	0.083**	0.242***	0.221***	-0.016	0.026	-0.014	0.003
	(0.035)	(0.037)	(0.049)				
Transf. (d)	-0.443***	-0.444***	-0.094	-0.048	-0.015	0.054	0.009
	(0.076)	(0.087)	(0.123)				
Social assistance (d)	0.099	0.801***	0.365***	-0.097	0.124	-0.031	0.003
	(0.078)	(0.086)	(0.122)				
Tenure 1-5 Y(d)	-0.176*	-0.222**	-0.069	-0.012	-0.012	0.021	0.003
	(0.093)	(0.105)	(0.140)				
Tenure 5-10 Y(d)	-0.125	-0.019	-0.257	-0.022	0.014	0.012	-0.005
	(0.103)	(0.117)	(0.168)				
tenure>10 Y (d)	0.360***	0.263***	-0.130	0.050	-0.004	-0.035	-0.012
	(0.087)	(0.098)	(0.148)				
Const.	-1.880***	-1.118***	-0.117				
	(0.210)	(0.236)	(0.344)				
Predicted Prob at mean				0.646	0.196	0.128	0.030
N				13,139			
Log Likelihood				-12,598.675			
Pseudo R2				0.1233			

*p<0.1, **p<0.05, ***p<0.001

Note: Renting a good quality solution is the base outcome.

The more educated the head of household, the more likely he or she will prefer to own a bad/average quality housing unit than to rent a good quality one. For business owners, this pattern is also supported by the results in Table 9, given that the odds of owning a bad quality solution significantly increase over the odds of renting a good quality one for this subsample. Again, non-traditional families, consisting of a stable partner and children—increase the likelihood of preferring to own a worse housing solution than to rent a better one. Finally, less tenure increases the odds of owning. This is to be expected, since tenure should be aligned with an increased savings capacity.

As our model showed, households with certain characteristics would rather own a bad quality housing unit that rent a property in better conditions. This preference is probably also a byproduct of the low income stability of many households. Income uncertainty discourages households that depend on salaries from entering the rental market, since they view ownership as an extra safeguard in the event of a negative income shock.

5.2.2 Ownership in Informal Housing Markets

Within the informal market, we include new variables to understand the choice of engaging in a somewhat permanent housing solution vs. a less permanent one. In fact, according to anecdotal data gathered through interviews of households in the informal housing market, the motivation to enter the informal market seems to be a strong driver of the type of "ownership" chosen. We hence include four dummy variables accounting for the reasons why the household had to leave its previous housing solution. The four reasons included are those in which the household was to some extent forced to leave, namely eviction, restrictions of space, inhabitability of previous solution due to structural problems, and leaving for economic reasons (negative income shock).

Table 10. Ownership Choices: Logit Estimation (Marginal effects presented)

	Permanent Arrangements (illegally own)
Perm Inc.	0.000**
Left - Evicted[§]	-0.184
Left - Econ[§]	-0.261***
Left - Inhabitable[§]	-0.204**
Left - Space[§]	-0.165*
Age	0.000
Male[§]	-0.039
White[§]	-0.059*
Education	-0.084**
Inc. Informal[§]	0.016
With Partner[§]	-0.058
Divorced/Widower[§]	-0.03
# people <14	-0.005
# people >14	0.029**
Reg. House. Policy[§]	0.067
illegal electricity[§]	0.054*
Transf. [§]	-0.015
Social assistance[§]	0.02
Tenure< 1Y [§]	0.036
Predicted Prob at mean	0.639
N	1054
Log Likelihood	-661.167
Pseudo R2	0.047

Note: Occupying or renting is the base outcome.
[§] Dummy variables
*p<0.1, **p<0.05, ***p<0.001

Having been evicted does not significantly affect the type of arrangement chosen, while those households that were indirectly forced into the new housing solution chosen are all less prone to engage in a more permanent illegal housing situation. Being white and having more years of education also significantly lower the odds of a more permanent illegal housing solution. On the contrary, among the households in the informal housing market, income is positively related to more permanent arrangements. The other two variables increasing the likelihood of more permanent illegal housing arrangements are the number of adults in the household and illegal access to electricity.

6. Policy Recommendations

In the previous sections we analyzed the Uruguayan housing market and the determinants of formality choices. We found that unlike the situation in other Latin American countries, quantitative housing deficit is not a major problem, while qualitative deficit is. As described in Garabato and Ramada-Sarasola (2011), one-fourth of all housing units suffer from at least one form of qualitative deficit. This figure jumps to almost 60 percent when we consider households in the informal market. Also, after a thorough investigation of current public housing programs, we found that even though the number of programs is large, take-up for most programs is very low, hampering their potential impact on housing relief. In light of these findings, this section discusses possible policy options to tackle these issues. Based on the model estimated in Section 5, we will examine how certain policy measures could impact household formality choices, especially for the more vulnerable strata.

6.1 Policy Options

Based on the findings by Garabato and Ramada-Sarasola (2011) there seem to be two key issues that need special attention from a policy perspective. The first relates to the sizeable number of people that are found with informal housing arrangements and the poor housing conditions they share (qualitative deficit). The second issue relates to the low mobility and high inertia found in the market, probably driven by the extremely low development of the mortgage and rental markets. Indeed, almost half of the households stay in the same housing unit for more than 15 years and almost half of these remain in the same unit for more than 30 years, irrespective of changes in housing prices, or in household income, as well as of modified household composition. Moreover, this inertia is not restricted to the formal market, since informal housing arrangements also develop into a rather permanent housing solution, with more than 40 percent of households having lived in the same housing unit for more than 10 years. While this inertia can be motivated by unobservables such as idiosyncrasy and cultural elements, there may be mother reasons for it that could be addressed through proper policy measures.

6.1.1 Increasing the Size and Efficiency of the Mortgage Market

There is agreement in the literature[10] on the fact that these issues could be partially explained by some characteristics of the mortgage market. Short repayment periods and stringent guarantees required by most financial institutions meant that large segments of the population were left without the financial capacity to buy or upgrade their housing unit. Recent data from ANV (2010) confirms the small size of the mortgage market. In 2009, only 2,168 new mortgages were granted (out of a total of 15,538 transactions made), and the average amount of these loans was around US$36,000 for inflation-linked credits and US$53,000 for loans in U.S. dollars. These figures are rather low if we consider that the average price per square meter is around US$750 (ANV, 2010).

Another indicator of the size of the housing credit market is the ratio of mortgages to GDP. In Uruguay, this figure is less than 5 percent, which is very low compared to the numbers found for developed countries. In the United States, the figure is near 70 percent, in the United Kingdom it is around 80 percent, and in Germany around 46 percent.[11] It is also rather small when we look at other countries in the region. In Chile, the ratio is around 17 percent, in Brazil around 11 percent, and in Mexico around 13 percent.[12]

In light of the data, there seems to be room for increasing the size of the mortgage market. In addition, lack of credit may explain the low income elasticities found in Section 4, as households cannot translate their increased income into a credit that allows them to move or to improve their housing solution.

As explained in Garabato and Ramada-Sarasola (2011), in Uruguay, the mortgage market was dominated by one key player, the National Mortgage Bank (BHU). This public institution used to account for more than 80 percent of all mortgages granted.[13] Even though the conditions for accessing a loan through BHU are less stringent than in private banks, there is still a vast portion of the population that does not qualify for a loan from this institution.[14] In addition, other housing assistance programs do not have high take-up rates, which means that much of the population is left without any financial capacity to move or upgrade their housing unit and/or to move out of informality. Moreover, the limited development of this market is forcing those

[10] See, for example, Gandelman and Gandelman (2004).
[11] Own calculations based on data from the European Mortgage Federation.
[12] See Tiscornia (2010).
[13] Gandelman and Gandelman (2004).
[14] Less that 40 percent of the population would be eligible. See Table 27 of Garabato and Ramada-Sarasola (2011).

households that cannot afford to buy a property upfront to pay rents that are well above the value of mortgage payments (relative to income). According to Casacuberta (2006), on average, mortgage payments are around 15 percent of household income, while rents account for 22 percent of income. This difference is even more pronounced for the lowest income quartile.

In this sense, we believe that the government should take a more active role in fomenting the development of the mortgage market. Among other things, it should encourage private banks to shift their offer downwards in order to reach medium and low-income households. It should also design policies that provide targeted assistance and subsidies to those families that cannot meet the conditions set by private banks and financial institutions. The ease of use of these programs and access to them, as well as the way they are promoted among the target population, should also be improved. We believe that the provision of better financial access will stimulate housing demand, increase income elasticity, and remove some of the inertia in the Uruguayan real estate market. Moreover, more accessible credit may also provide the necessary incentives for households to leave the informal market.

The project under consideration to create a guarantee fund for the purchase of property falls into this category. Currently, local banks only issue credits for amounts less than 70 percent of the value of the property and guarantee the credit. Clearly, this is highly restrictive for young households with no savings and/or low saving capacity. The project that is now under consideration in Congress would create a fund to act as guarantor and absorb the extra risk that banks take on when lending amounts that surpass the 70 percent threshold. This program would mean that families would need to provide less of their own capital when applying for loans, facilitating access to housing finance.

Projects like this have the potential to make the private mortgage market more dynamic by facilitating the demand for credit. However, it does not directly tackle the shortage of credit. According to ANV (2009), around 80 percent of bank funding is in sight deposits, which clearly hampers the ability of banks to issue long-term credits. To tackle this issue, the ANV introduced an instrument called *notas de crédito hipotecario,* which allows private and public financial institutions to issue mortgage-backed debt. These instruments aim to expand private credit by providing banks with additional tools to manage term mismatch between assets and liabilities. Unfortunately, these instruments were launched in September 2009, and to date their use has been limited.

A further measure to expand the mortgage market is legal reform. Legal reform should aim at decreasing the costs and risks associated with enforcing contracts. There appears to be plenty of room for improving current laws and regulations to create a new regulatory framework that is more enabling of private initiative. As Gandelman and Gandelman (2004) point out, one of the main issues hampering the private supply of credit is the high cost (both in terms of time and money) of enforcing contracts. According to the authors, the cost of recovering a debt can range between a fourth and a half of the value of the guarantee. The World Bank's *Doing Business* report states that it takes an average of 720 days to resolve a dispute (the OECD reports that it takes 500 days), and the number of procedures that need to be undertaken is on average 41 (OECD average 31.2).[15] Uruguay also ranks poorly in the U.S. Department of State's Doing Business report, where the execution of guarantees is described as a slow process.[16] In this sense, we think a reform of the legal setting for enforcing contracts and executing guarantees needs to take place, so that the private sector can feel more comfortable issuing credits with longer terms and better conditions.

6.1.2 Increasing the Size and Efficiency of the Rental Market

Regardless of the fact that households seem to be a biased toward the choice of owning instead of renting, policy makers should think about whether it is desirable to design policies aimed at increasing access to housing mainly through ownership, or if they should try to stimulate the rental market. In fact, while in Uruguay 82.9 percent of households in the formal market own their homes, in other countries less than half the population are homeowners (e.g., 42 percent in Germany[17]). This raises the question of whether ownership is desirable per se. Both in old age and when income is volatile, home ownership provides a certain degree of economic security and acts as an emotional safe haven. It is also a way to promote forced savings that allows inter-generational transfer of wealth. Moreover, given that it almost acts as an alternative to social security and a source of income in old age (Castles, 1988), it can be attractive for countries like Uruguay, in which the public social security system fails to deliver adequate levels of income to the elderly.

[15]See The World Bank and the International Finance Corporation (2011).
[16]Please see U.S. Foreign Commercial Services (2004).
[17] See Statistisches Bundesamt Deutschland, accessed January 10, 2011. http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/EN/Content/Statistics/BauenWohnen/Wohnsituation/Tabellen/Content75/EntwicklungEigent_C3_BCmerquote,templateId=renderPrint.psml

On the other hand, attempting to access housing via ownership may be an irrational choice for lower-income households with that lack the capacity to save or to repay a loan within 20 years (the current maximum term for a mortgage loan in Uruguay), or for households with stable and guaranteed income, such as public employees, who could decide to rent for a smaller proportion of their permanent income rather than repay a mortgage and thus sacrifice current consumption.

In any case, a differentiated, sufficiently large, and efficient rental market would push rents downward and allow households to find housing solutions that fit their current needs and to adapt their housing consumption to reflect changes in permanent income. Three different types of measures can be proposed to increase the rental market's size and efficiency.

First, it would be desirable to foster the take-up of the housing programs facilitating access to rental guarantees for those households in the lower income quartile. The program not only provides less well-off households with the opportunity to access houses in the formal market (reducing informality and also qualitative deficit), but it also grants landlords additional safety. State-sponsored guarantees may hence increase the willingness of landlords to offer housing solutions in the rental market to serve the low-income segment, which is currently the most risky in terms of default and property damage.

Second, and considering the limited supply of rental properties, the public sector should consider the design of policies that incentivize the private sector to build housing solutions for the middle- to lower-income segments of the population.[18] These incentives could come in the form of tax exemptions or tax credits, as well as in form of cost subsidies. This would differ from the government providing housing solutions in that it would still be regulated through the open market. It would be expected to increase the efficiency of resource allocation.

Third, it should address the imbalance in the relationship between the rights of tenants and landlords. The legal reform suggested in the previous section should thus also consider changes in leasing regulations.

In our opinion, there are two main problems with the current regulatory framework. First, current regulation is quite inflexible in the sense that it does not allow tenants and landlords to design contracts that adequately fit their needs. For example, in the case of guarantees, the only

[18] Currently, the ANV is considering the implementation of a project that provides very generous tax incentives for the construction and/or repair of properties that target the low-income market.

two types of valid guarantees are either a deposit of a maximum of five months' rent in the BHU (denominated in UR) or the use of a guarantor. Additionally, contracts are to be set for a minimum of two years,[19] and rent adjustments are also regulated. Besides this inflexibility, the main problem within this market has to do with the time it takes for landlords to evict tenants that fail to comply with the contract or whose contracts have expired. According to Uruguayan law, if the tenants have complied with payments, landlords have to wait one year after the expiration of the contract to be able to initiate the eviction procedures, which in the best-case scenario take around 330 days from the moment the lawsuit is filed until the eviction actually occurs.[20] In those cases where tenants have not complied with the contract, e.g., failed to pay the rent, the eviction petition can be filed immediately, but it still takes at least one year to execute. In addition, in cases where the tenant partly or fully destroys the rental property, in most cases the landlord must initially bear the costs of repair if it wants to rent the unit again or use it privately, since litigation on property damage is not only costly and lengthy, but the outcome is uncertain.

These are clear reasons why the current legal framework is hampering the development of the rental housing market. On the demand side, stringent guarantees and high rents discourage households from considering the rental market a viable option. Indeed, as Viera (2010) notes, for low income deciles, the expenditure in rent can add up to 33 percent of household income. From a supply-side perspective, the legal and economic risks involved in renting a property lowers the number of properties offered to lease and at the same time pushes the value of rents upward as landlords demand higher rates of return.

Once again, low-income families are the most affected by the underdevelopment of the rental market. First, low income households have the least saving capacity and are therefore more likely to benefit from a larger rental market, since they are not likely to have the necessary funds to buy a property outright or to qualify for a mortgage. Moreover, these households find it very hard to find guarantees that comply with current regulations, which leads them to seek options in the informal market. In this sense, we believe that the development of the rental market has the potential not only to reduce the inertia of the market by allowing people to change

[19] Seasonal contracts and those in which the property has been declared as "casa de familia" are not included.
[20] See Djankov et al. (2002).

housing solutions as their housing needs change, but also to lower informality if regulatory changes provide the right incentives.

6.1.3 Aligning and Coordinating Social and Housing Programs

Finally, it should be possible to better coordinate housing programs with other social programs to induce households to seek solutions in the formal housing market. If the housing supply for low-income households is increased through the measures proposed above, access to this type of housing, whether through purchase or renting, could be coupled with or channeled through the use of non-housing social programs. Given the low take-up of housing programs—which could be related to lack of information—other social programs could be used as a platform to gather information on housing conditions and to provide information on housing programs among target households. In fact, low-income households living in informal housing have shown to be more prone to ask for help in the form of PANES than to avail themselves of housing assistance programs. These households' interaction with formal markets and with government institutions in general is usually very limited. Having access and reaching out to low-income households living in informal housing conditions is hence difficult. By coordinating other social programs with housing programs, the government could leverage the initial contact with these households to engage them to use housing programs and improve their housing conditions. This would require closer interaction between the MVOTMA and the MIDES. One possible way of increasing households' usage of housing programs could be to condition the use of certain social programs, such as income subsidies like PANES, on the formalization of housing arrangements within a certain period of time for all household that are eligible for a housing program.

6.2 Impact of Increasing Financial Access

There is a clear need to increase housing credit, specifically to enhance access to financing by those segments of the population living in less favorable housing conditions. To provide a preliminary estimate of the potential impact of such a policy, this section presents the results of a simulation exercise that estimates the impact of increasing the proportion of people with access to housing finance on the probability of being part of the informal housing market.

Based on the model presented in Section 5, we have recalculated the predicted probabilities of choosing the formal market for target groups of individuals under different

scenarios of access to housing finance. The results of this exercise can be found in Figure 1 and Figure 2.

Case 1 looks at the effect of having financial access on heads of household aged 30, with an average level of education, who work in the formal sector, with an average tenure, and who live in Montevideo. The assumed family structure is two children and two adults. The household is assumed not to receive transfers or social assistance. Cases 2 and 3 keep all these characteristics with the exception of age. Case 2 simulates the effects of changes in financial access for households with heads that are 45 years old, and Case 3 for heads of household age 60.

Figure 1. Scope of Increasing Financial Access on Formality (females)

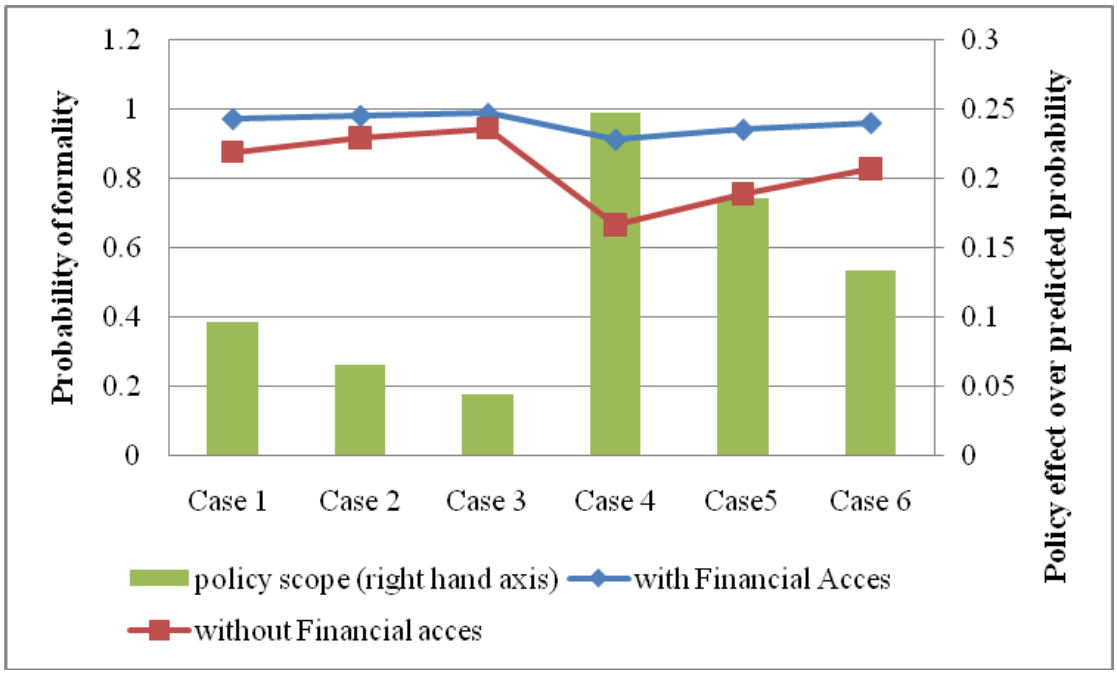
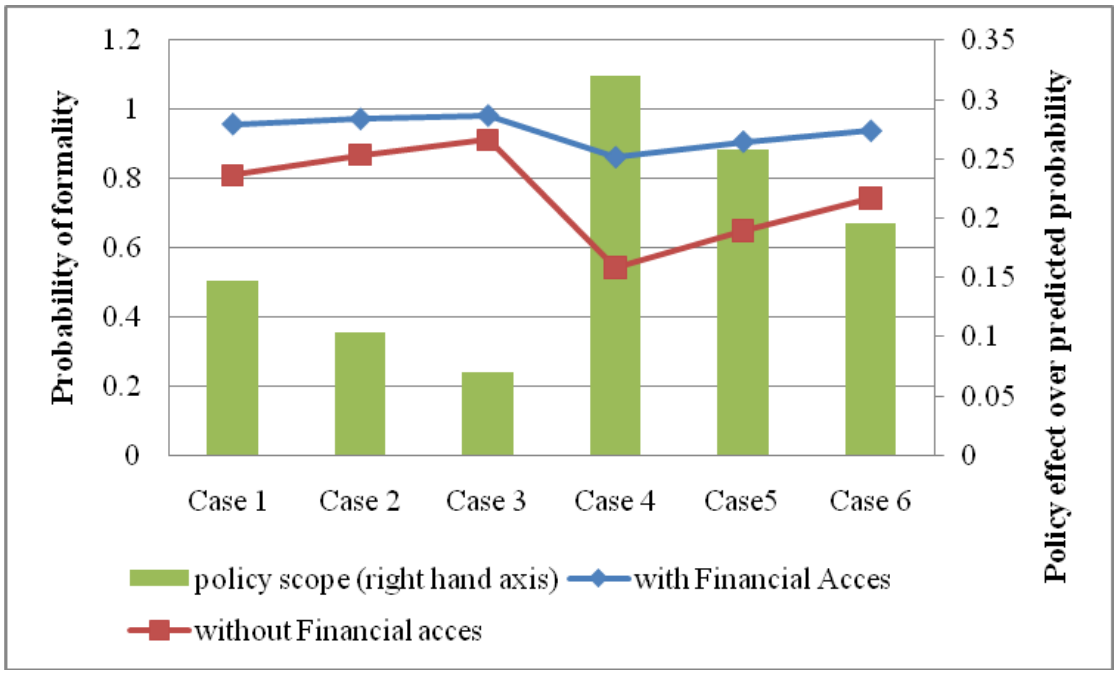


Figure 2. Scope of Increasing Financial Access over Formality (males)



The simulation results show that the impact of obtaining financial access on formality diminishes with age and that it is stronger in households headed by males. Granting financial access to female heads of household has the potential to increase the probability of choosing the formal housing market by almost 10 percent for younger women, though this increment more than halves at later ages. In the case of males, the potential effect of increasing financial access over formality is much stronger, making it almost 15 percent more likely that a male household would choose a formal housing arrangement. Once again, this improvement drops to around 7 percent for older males. These results are in line with the findings of Section 5. Since informality is more common among younger, male-run households, it is not surprising to find that improvements in housing finance have a stronger effect on households with these characteristics.

After this exercise, and considering that those households living in informality are more likely to have lower levels of education, to be employed in the informal market, and to be single, we performed a similar exercise restricting the household to mono-parental, with an education level of less than high school completion and with income stemming from the informal sector. Cases 4 to 6 depict this scenario for heads of household ages 30, 45, and 60 respectively. As in the first three cases, the effect on informality diminishes with age; however, quantitatively, the effect on this type of households is larger. The potential policy impact of increasing financial

access on the probability of choosing the formal housing market is almost 25 percent for young women and more than 30 percent for young males. This effect fades with age, but women aged 60 would be 13.3 percent more likely to choose the formal sector if access to finance were available, and this figure jumps to 19.6 percent for males.

Since these simulations assume that all of the relevant population is granted financial access, we decided to perform a similar exercise for the more vulnerable groups, varying the degree of penetration of access to finance over the target population. Currently, in urban areas only around 6 percent of the population has access to housing finance. This figure drops to around 2 percent for the group of people described in cases 4 to 6. Table 11 shows the results for the different simulation exercises. With an average current penetration of around 6 percent, the predicted probabilities of choosing the formal sector vary from 69 to 84 percent for women of different ages and from 57 to 76 percent for males. With a penetration of 20 percent, young women would be 4.8 percentage points more likely to choose the formal sector, while the effect on young men would be a little higher, reaching 5.6 percentage points. If the proportion of people with access to financing grows to 50 percent, then the change in the probability of choosing the formal sector would rise between 7.5 and 13.3 percent among women and between 10.8 and 16.5 among men.

Table 11. Predicted Probabilities of Formality

	Female			Male		
	Case 4	Case 5	Case 6	Case 4	Case 5	Case 6
Penetration of fin. access	Pred. prob.	Pred. prob.	Pred. prob.	Pred. prob.	Pred. prob.	Pred. prob.
Actual penetration (6%)	0.69	0.77	0.84	0.57	0.67	0.76
20% penetration	0.74	0.81	0.87	0.62	0.72	0.80
50% penetration	0.82	0.88	0.92	0.73	0.81	0.87

Though preliminary and merely illustrative, these numbers show the potential impact that certain new housing policy measures could have if they achieved their goal of facilitating access to financing by low-income households.

7. Conclusion and Further Policy Recommendations

Even though current housing policies include programs that target less well-off households, our findings are showing that these program are not being entirely successful in the sense that they have very low take-up rates, and a vast number of households still maintains informal housing arrangements and/or lives with quite severe qualitative housing deficits.

In fact, even those programs that are specifically designed to tackle housing deficit issues and aim at renovating, refurbishing, or expanding housing units are largely not being used by the very high number of households with qualitative housing deficit. This highlights the need for more efficient design as well as promotion of programs that aim at improving the habitability of existing housing units. Since the incidence of deficit is not only qualitatively different but more pronounced upcountry than in Montevideo, geographic considerations should be taken into account when improving these housing programs' design.

When not distinguishing between formal and informal markets, we find a price elasticity of housing demand, which is low compared to developed countries but higher to what was found by Fontenla et al. (2009) for Mexico. This may imply that there is less supply than demand of housing units, which narrows the reaction ability of Uruguayan households in terms of adjusting their housing demand to prices. The price elasticity rises significantly—up to 0.792—when looking only at the informal market. This mirrors the higher degree of mobility in informal markets, where supply seems to better match the quantity of demand, since it is more flexible as it is not regulated. It can be argued that the informal market behaves as a more homogeneous market in the sense that households in informal markets are more prone to relocate to other informal housing arrangements regardless of neighborhoods or areas. In the formal market where there is less supply than demand and where fewer housing substitutes are available, the demand becomes price inelastic. This has important policy implications since it reveals that the informal housing market is able to better match demand and supply and to provide a wider array of housing substitute solutions than the formal market. This may imply that the currently lax policy in terms of restricting the growth and creation of new, irregular settlements may be encouraging the creation of an apparently black market in housing, which has increasingly become attractive to young families of low income strata.

For the overall market, income elasticities obtained for temporary and permanent income are, although low, still in line with the ones found by the literature. In fact, while temporary

income is found to have an elasticity of 0.032, permanent income shows an elasticity of 0.373, which although smaller than the usually expected 0.6 to 0.8 income elasticities, is at least above the minimum income elasticities reported in the literature for developed countries, which are around 0.36 (Mayo, 1981). Here again, the informal market yields an income elasticity that is higher and closer to what is expected—0.57–pointing again at the fact that the informal market seems to be working as a more consolidated housing market. These results seem to be robust to changes in the definition of neighborhoods and proper housing markets, as well as to different ways of segmenting formal housing demand according to income strata or geographic zones. This result seems to be consistent with the findings on the type of qualitative deficits faced by households in Uruguay and the lack of use of housing policies by the eligible population. In this sense, Uruguayan households seem to display a certain inertia with respect to improving their housing conditions. This may also be reflected in the low elasticity found with respect to income. In addition, low income elasticity also reflects an underdeveloped mortgage market, in which households cannot translate positive income changes into new or better housing conditions due to lack of credit.

Further, our estimation of formality choices provides interesting insights to help policy makers design public programs. As an example, since households tend to grow out of informality, the efficiency of programs that tackle informality could be enhanced by specifically targeting young families, especially those that are larger and mono-parental. Many households in informal housing situations are already receiving some type of social assistance. Still, it seems that this assistance is not effective at getting households out of informality. This implies that the design of more comprehensive social programs linking housing aid with other social programs could leverage the impact of individual policies targeting these vulnerable households through better program coordination and even through conditional policy design.

The high proportion of households within the informal housing market, as well as those with informal sources of income, makes it difficult for current housing policies to reach the neediest, since eligibility criteria are based on a declaration of income that needs to have a formal source of income as a prerequisite. New policies taking this into account need to be designed to be able to target the wealthier within the informal markets in order to help them enter the formal housing market.

Finally, despite PIAI, the number of households in irregular settlements has been increasing in the past 10 years. Future research should try to determine the extent to which social assistance programs such as PANES or the regularization of irregular settlements has not increased the propensity of households to remain informal both with respect to income sources and to their housing solutions. In fact, the signal sent out by regularizing irregular settlements may as well have been interpreted as a green light to occupy state-owned land in the hope of regularization in the future, generating some kind of moral hazard. The high elasticities found within informal markets also support this inference, since they reflect a mature informal housing market that is more efficient and flexible to match housing supply and demand than the formal one.

In summary, our results describe a dynamic low-tail market, contrasted with a very static upper-tail market. Within the middle segment, elasticities are also found to be low, but rather than being due to idiosyncratically driven inertia, this relates to a little developed mortgage market and to insufficient housing supply. Inertia seems also to be related to the age of heads of household and can be further explained by high transaction costs associated with changing from one housing solution to another.

Given the differences found in the elasticities for formal and informal housing markets, our results suggest a dysfunctional formal housing market and to some extent an efficient informal one. To address this situation, two types of solutions can be sought. One is to increase the efficiency of the formal housing market through lower transaction costs and a larger and more varied housing supply for middle income strata. Another could be to reduce the incentives for entering the informal market.

Based on this analysis, our policy recommendations can be structured around three main principles. First, current housing policies should be adapted to the needs of low income strata, taking their characteristics into account to redesign the promotion of and access to housing programs. Second, the legal framework should provide better guarantees for landlords and private financial institutions with respect to contract enforcement, as well as to decrease the degree of tolerance shown with respect to informal housing solutions. Third, policies should address the lack of a functioning mortgage market by providing guarantees for credit differentials above the current threshold of 70 percent, so as to allow young families and households with low saving capacity to own a home. Finally, policies should try to boost housing

supply for low and middle income strata, not through government housing solutions, but instead by incentivizing private construction firms to serve the low- and middle-income market.

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Appendix

Appendix A. Variables and Descriptive Statistics

Table 12. Descriptive Statistics

Variable	# of Observations	Mean	Std. Dev.	Min	Max
hage	21,310	53.861	16.780	17	98
gender	21,310	1.297	0.457	1	2
race_b	21,310	0.071	0.257	0	1
race_other	21,310	0.065	0.246	0	1
race_w	21,310	0.864	0.343	0	1
e_primaria	21,310	0.507	0.500	0	1
e_sec	21,310	0.262	0.440	0	1
e_tec	21,310	0.100	0.300	0	1
e_prof	21,310	0.018	0.135	0	1
e_univer	21,310	0.059	0.235	0	1
e_terciario	21,310	0.011	0.103	0	1
civilstatus_2	21,310	0.108	0.310	0	1
civilstatus_3	21,310	0.529	0.499	0	1
civilstatus_4	21,310	0.153	0.360	0	1
civilstatus_5	21,310	0.210	0.407	0	1
n_peopl_house	21,310	3.025	1.699	1	19
n_peopl_income	21,310	1.898	1.030	0	13
asent	21,310	0.055	0.227	0	1
legal	21,310	0.945	0.227	0	1
rural	21,310	0.199	0.399	0	1
transf	21,310	0.135	0.342	0	1
num_jobs	21,310	0.728	0.611	0	11
one_job	21,310	0.583	0.493	0	1
two_jobs	21,310	0.063	0.243	0	1
multiple_job	21,310	0.006	0.076	0	1
no_job	21,310	0.348	0.476	0	1
aporta	21,310	0.436	0.496	0	1
no_aporta	21,310	0.216	0.412	0	1
rent_recibidas	21,310	0.090	0.286	0	1
cambio_trabajo	21,310	0.015	0.120	0	1
acc_fin	21,310	0.045	0.208	0	1
acc_fin_publico	21,310	0.125	0.330	0	1
ayuda_social	21,310	0.036	0.187	0	1
demanda_housingpolicy	21,310	0.024	0.153	0	1
tenure	21,310	7.893	11.270	0	91
edadvivienda_1	21,310	0.071	0.256	0	1
edadvivienda_2	21,310	0.136	0.343	0	1
edadvivienda_3	21,310	0.163	0.369	0	1
edadvivienda_4	21,310	0.131	0.337	0	1
edadvivienda_5	21,310	0.500	0.500	0	1
num_dorm	21,310	1.917	0.981	1	40
num_ambien s	21,310	3.395	1.652	1	80
num_banos	21,310	1.161	0.776	0	21
sanitation	21,310	0.875	0.331	0	1
tipovivienda_1	21,310	0.834	0.372	0	1
tipovivienda_2	21,310	0.058	0.235	0	1
tipovivienda_3	21,310	0.062	0.242	0	1
tipovivienda_4	21,310	0.041	0.198	0	1
tipovivienda_5	21,310	0.004	0.062	0	1
tipo_construccion	21,312	2.496	0.645	1	3
problemas	21,312	0.656	0.475	0	1
problemas_gravess	21,312	0.573	0.495	0	1
calidad_barrio	21,312	1.543	0.498	1	2
ingtotalhogar	21,310	10,566	13,252	0	335,000
owner	21,312	0.677	0.468	0	1
tenant	21,312	0.128	0.334	0	1
occupant	21,312	0.195	0.396	0	1

Table 13. Description of Variables

Variable name	Variable label	Description
hage	Age of Household Head	Age of household head in years
gender	Gender	Gender of Household head
race_b	Black	Dummy variable that takes the value of 1 when HofH = Black
race_other	Race Other	Dummy variable that takes the value of 1 when HofH = Other
race_w	White	Dummy variable that takes the value of 1 when HofH = White
e_primaria	Primary Education	Dummy variable that takes the value of 1 when education of HofH = Primary
e_sec	Secondary Education	Dummy variable that takes the value of 1 when education of HofH = Secondary
e_tec	Technical Education	Dummy variable that takes the value of 1 when education of HofH = Technical
e_prof	Teacher	Dummy variable that takes the value of 1 when education of HofH = Teacher
e_univer	University or above	Dummy variable that takes the value of 1 when education of HofH = University or above
e_terciario	Tertiary Education	Dummy variable that takes the value of 1 when education of HofH = Tertiary non University
civilstatus_2	Divorced	Dummy variable that takes the value of 1 when HofH is divorced
civilstatus_3	Married	Dummy variable that takes the value of 1 when HofH is Married
civilstatus_4	Widower	Dummy variable that takes the value of 1 when HofH is Widower
civilstatus_5	Single	Dummy variable that takes the value of 1 when HofH is Single
n_peopl_house	# of people in household	# of people living in same household
n_peopl_income	# of people perceiving income	# of people perceiving income in household
asent	Illegal housing (irregular settlement)	Dummy variable that takes the value of 1 when Household is part of an irregular settlement
legal	Legal Housing	Dummy variable that takes the value of 1 when Household is in a legal housing situation
rural	Rural Areas	Dummy variable that takes the value of 1 when Household is located in a rural area
transf	Household Receives Transfers	Dummy variable that takes the value of 1 when Household receives transfers
num_jobs	# of jobs of head	# of jobs of HofH
one_job	One Job	Dummy variable that takes the value of 1 when HofH has one job
two_jobs	Two Jobs	Dummy variable that takes the value of 1 when HofH has two jobs
multiple_job	+ than 2 jobs	Dummy variable that takes the value of 1 when HofH has more than 2 jobs
no_job	No job	Dummy variable that takes the value of 1 when HofH is not employed
aporta	Contribute to SS	Dummy variable that takes the value of 1 when HofH is contributing to SS
rent_recibidas	Rents perceived by household	Dummy variable that takes the value of 1 when Household receives Rents

Table 14. Description of Variables (continued)

Variable name	Variable label	Description
cambio_trabajo	Change Jobs	Dummy variable that takes the value of 1 if HofH has had more than 5 jobs in last 3 years
acc_fin	Access to Private Financing	Dummy variable that takes the value of 1 if household has access to private housing finance
acc_fin_publico	Use of Housing Policies	Dummy variable that takes the value of 1 if household is using Public housing programs
ayuda_social	Use of Social Polices	Dummy variable that takes the value of 1 if household has social assistance
demanda_housingpolicy	Demand of Housing Policies	Dummy variable that takes the value of 1 if household has applied for public housing policies
tenure	Tenure	Years that HofH has been working for the same employer
edadvivienda_1	Housing unit age <5 years	Age of construction of the housing unit is less than 5 years
edadvivienda_2	Housing unit age 5-10 years	Age of construction of the housing unit is between 5-10 years
edadvivienda_3	Housing unit age 11-20 years	Age of construction of the housing unit is between 11-20 years
edadvivienda_4	Housing unit age 21-30 years	Age of construction of the housing unit is between 21-30 years
edadvivienda_5	Housing unit age > 30 years	Age of construction of the housing unit is between >30 years
num_dorm	# of bedrooms	# of bedrooms in the house
num_ambientes	# of rooms	# of rooms in the house
num_banos	# of bathrooms	# of bathrooms in house
sanitation	Sanitation (running water in house)	Dummy variable that takes the value of 1 if there is running water inside the house
tipovivienda_1	House	Dummy variable that takes the value of 1 if the housing unit is a house
tipovivienda_2	Apartment in complex	Dummy variable that takes the value of 1 if the housing unit is in an apartment complex
tipovivienda_3	Apartment building	Dummy variable that takes the value of 1 if the housing unit is in an apartment building
tipovivienda_4	one floor apartment	Dummy variable that takes the value of 1 if the housing unit is a 1 floor apartment
tipovivienda_5	Other	Dummy variable that takes the value of 1 if the housing unit is other
tipo_construccion	Quality of Construction	Categorical variable that = 1 if quality of construction is poor, 2 if quality is average and 3 if is good
problemas	Problems with housing	Dummy variable that takes the value of 1 if the housing unit displays (building) problems
problemas_gravess	Severe problems with housing	Dummy variable that takes the value of 1 if the housing unit displays severe (building) problems
calidad_barrio	Neighborhood quality	Categorical variable that equals 1 if neighborhood quality is poor and 2 if is good
ingtotalhogar	Total Household Income	Monthly household income in UYP
owner	Household owns house	Household owns house/land or both
tenant	Household rents house	Household rents house
occupant	Household occupies house	Household occupies house

Table 15. Region Grouping

1	2	3	4	5	6
carrasco carrasco norte pocitos punta carretas punta gorda	buceo malvin parque batlle, villa dolores parque rodo prado, nueva savoña	cordon tres cruces	atahualpa capurro y bella vista paso de las duranas	aguada centro la blanqueada	figurita jacinto vera la comercial larrañaga reducto
7	8	9	10	11	12
barrio sur ciudad vieja palermo	brazo oriental union	castro, castellanos lezica, melilla sayago	colon centro y noroeste colon sureste, abayuba	belvedere mercado modelo y bolivar villa muñoz, retiro	cerro la teja nuevo paris
13	14	15	16	17	18
aires puros cerrito villa española	bañados de carrasco las canteras malvin norte	flor de maroñas ituzaingo jardines del hipodromo maroñas, guarani	manga paso de la arena peñarol, lavalleja	casavalle conciliacion tres ombues, pueblo victoria	manga, toledo chico punta de rieles, bella italia villa garcia, manga rural
19	20	21	22	23	24
casabo, pajas blancas la paloma, tomkinson	las acacias piedras blancas	small cities cerro largo small cities lavalleja small cities treinta y tres	melo and others rio branco jose pedro varela minas and others treinta y tres and others	cerro largo rural lavalleja rural treinta y tres rural	small cities artigas small cities rivera small cities tacuarembo

Table 16. Region Grouping (continued)

25	26	27	28	29	30
artigas rural rivera rural tacuarembo rural	artigas and others bella union and others rivera and others tranqueras paso de los toros tacuarembo and others tacuarembó and others	durazno rural flores rural florida rural	small cities duranzno small cities flores small cities florida	durazno and others sarandi del yi trinidad capilla del sauce and others florida sarandi grande	paysandu rural rio negro rural salto rural soriano rural
31	32	33	34	35	36
small cities paysandu small cities rio negro small cities salto small cities soriano	cardona and others guichon paysandu and others fray bentos and others young belen and others salto and others cardona and others dolores and others mercedes villa de soriano and others	canelones rural	ciudad de la costa costa de oro e costa de oro w	canelones and others periferia canelones san ramon santa lucia and others sauce	small cities Canelones small cities colonia small cities maldonado small cities rocha small cities san jose
37	38	39	40		
carmelo juan lacaze and others nueva helvecia and others nueva palmira rosario and others tarariras ciudad del plata ecilda paullier and others ituzaingó and others libertad and others san jose de mayo and others	colonia del sacramento maldonado and others piriapolis and others punta del este and others castillos and others chuy la paloma and others	pan de azucar and others san carlos and others lascano puimayen and others rocha	colonia rural maldonado rural rocha rural san jose rural		

Table 17. Variable Averages for Subsamples Using or Having Applied for Housing Programs

Variable	Mean if Housing policy=1	Mean if Housing policy=0	Mean if Demand for housing aid=1	Mean if Demand for housing aid=0
head_age	53.894	53.856	46.523	54.042
gender	1.343	1.291	1.335	1.296
race_b	0.080	0.070	0.097	0.071
race_other	0.071	0.064	0.076	0.065
race_w	0.850	0.866	0.827	0.865
e_primaria	0.420	0.520	0.482	0.508
e_sec	0.295	0.257	0.274	0.262
e_tec	0.103	0.100	0.117	0.100
e_prof	0.030	0.017	0.014	0.019
e_univer	0.097	0.053	0.056	0.059
e_terciario	0.014	0.010	0.010	0.011
civilstatus_2	0.126	0.105	0.132	0.107
civilstatus_3	0.561	0.525	0.482	0.530
civilstatus_4	0.150	0.154	0.103	0.154
civilstatus_5	0.162	0.217	0.282	0.208
n_peopl_house	3.152	3.007	3.290	3.018
n_peopl_income	1.974	1.888	1.971	1.897
illegal	0.017	0.060	0.109	0.053
legal	0.983	0.940	0.891	0.947
rural	0.050	0.220	0.222	0.199
transfer	0.124	0.136	0.158	0.134
num_jobs	0.766	0.723	0.895	0.724
one_job	0.570	0.585	0.693	0.581
two_jobs	0.085	0.060	0.078	0.062
multiple_job	0.008	0.006	0.016	0.006
no_job	0.337	0.350	0.214	0.351
aporta	0.495	0.428	0.539	0.433
no_aporta	0.168	0.223	0.247	0.215
rent_recibidas	0.054	0.095	0.043	0.091
cambio_trabajo	0.010	0.015	0.016	0.015
acc_fin	0.000	0.052	0.039	0.045
acc_fin_publico	1.000	0.000	0.216	0.123
ayuda_social	0.028	0.037	0.084	0.035
demanda_housingpolicy	0.042	0.022	1.000	0.000
tenure	8.594	7.793	8.389	7.881
edadvivienda_1	0.070	0.071	0.088	0.070
edadvivienda_2	0.172	0.131	0.144	0.136
edadvivienda_3	0.214	0.156	0.183	0.163
edadvivienda_4	0.164	0.126	0.119	0.131
edadvivienda_5	0.380	0.517	0.467	0.500
num_dorm	2.071	1.895	1.864	1.918
num_ambientes	3.509	3.378	3.224	3.399
num_banos	1.151	1.162	1.115	1.162
sanitation	0.978	0.860	0.842	0.875
tipovivienda_1	0.599	0.868	0.778	0.836
tipovivienda_2	0.199	0.038	0.080	0.058
tipovivienda_3	0.141	0.051	0.076	0.062
tipovivienda_4	0.060	0.038	0.062	0.040
tipovivienda_5	0.000	0.004	0.004	0.004
tipo_construccion	2.701	2.467	2.403	2.498
problemas	0.532	0.673	0.724	0.654
problemas_graves	0.439	0.593	0.646	0.572
calidad_barrio	1.730	1.517	1.531	1.543
ingtotalhogar	13,806	10,104	10,533	10,567
owner	0.861	0.650	0.436	0.683
tenant	0.139	0.127	0.280	0.124
occupant	0.000	0.223	0.284	0.193
N	2,659	18,651	514	20,796

Housing policy =1 (or =0) mean that the current housing unit was accessed (or not) through the use of a public housing program. "Demand for housing aid"' refers to the household having applied or being registered for a public housing program, irrespective of it having been actually selected for it.

Appendix B. Hedonic Price Regressions

Table 18. Hedonic Elasticities

	1		2		3		4		5		6		7	
	Coef	Elast.	Coef	Elast.	Coef	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.
Not transformed														
# Bedrooms	1.062**	0.212	1.065***	0.182	0.604	0.059	0.442*	0.103	1.252***	0.139	0.925***	0.116	0.165**	0.169
# Bathrooms	2.147***	0.412	1.203***	0.156	0.762*	0.061	0.466**	0.077	3.863***	0.335	0.511**	0.048	0.047	0.037
WES	8.101	0.787	-0.452	-0.042	-2.102	-0.122	3.535*	0.44	-6.687**	-0.433	14.109***	1.019	0.889**	0.546
Severe Problems	-2.607	-0.253	-2.36*	-0.217	10.108**	0.587	2.567**	0.32	-1.823	-0.118	1.258	0.091	0.775**	0.476
Medium Problems	-3.108***	-0.302	-1.168**	-0.107	0.441	0.026	-1.229**	-0.153	0.24	0.016	-1.05	-0.076	0.299**	0.184
Small Problems	-2.473**	-0.24	-1.313**	-0.121	-0.03	-0.002	-0.459	-0.057	-0.601	-0.039	-0.706	-0.051	0.043	0.026
Years of construction	0.009	0.004	0.569**	0.226	1.029**	0.262	-0.281	-0.158	0.748**	0.216	-0.475	-0.158	0.061	0.178
house_D	1.244*	0.121	1.234**	0.114	0.666	0.039	1.625***	0.202	0.138	0.009	1.79**	0.129	0.308**	0.189
Construction Type	-1.37	-0.398	4.262***	1.163			1.366	0.501	12.069**	2.34	-1.516	-0.326	0.071	0.13
Neigh. Serv.	0.24	0.223	0.796***	0.651	0.634**	0.37	0.336**	0.355	0.401**	0.251	0.345	0.209	0.074**	0.44
type_neigh r														
Sup. durable goods	1.411**	0.137	1.277**	0.117	2**	0.116	0.228	0.028	2.287***	0.148	2.587***	0.187	0.165*	0.101
Domestic Service	2.872***	0.279	2.3***	0.212	3.64**	0.212	0.979	0.122	3.024***	0.196	3.21***	0.232	0.128	0.079
m2 avg. Price	0.000	0.14	0.001***	0.621	0.000	-0.026	0.000	-0.075	0.000**	-0.164	0.000**	0.187	0.000**	0.501
Cons	16.087		-0.438		33.501		12.656		-4.209		11.782		5.37	
Transformed														
Per. Inc.	0.046	0.062	0.019	0.028	-0.029	-0.047	0.045	0.066	-0.036	-0.058	0.073*	0.118	0.139*	0.153
Age	0.115	0.032	0.63**	0.181	1.092***	0.249	0.268	0.094	0.857***	0.211	0.611**	0.161	0.194*	0.151
Educ.	0.398	0.053	1.217***	0.152	3.1**	0.259	0.593	0.094	1.582**	0.144	0.757	0.075	0.097	0.064
	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|
λ	0.261	0.000	0.282	0.000	0.346	0.000	0.255	0.007	0.329	0.000	0.323	0.000	0.061	0.276
N	443		593		283		244		289		312		233	

	1		2		3		4		5		6		7	
	Coef	Elast.	Coef	Elast.	Coef	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.
LR χ^2	238.14		317.33		92.10		99.00		210.67		156.00		130.53	
Prob> χ^2	0.000		0.000		0.000		0.000		0.000		0.000		0.000	
λ =-1	0.000		0.000		0.000		0.000		0.000		0.000		0.000	
λ =0	0.000		0.000		0.000		0.004		0.000		0.000		0.273	
λ =1	0.000		0.000		0.000		0.000		0.000		0.000		0.000	

*p<0.1, **p<0.05, ***p<0.001

Table 19. Hedonic Elasticities (continued)

	8		9		10		11†		12		13		14	
	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.
Not transformed														
# Bedrooms	1.483**	0.103	2.048	0.068	-0.034	-0.004	0.124**		1.174**	0.242	4.088**	0.177	0.104	0.035
# Bathrooms	2.594**	0.116	1.983**	0.045	5.897***	0.367	0.011		0.652**	0.079	0.683	0.019	0.285**	0.055
WES	9.041**	0.347	20.899***	0.37	3.104**	0.184	0.304**		1.922**	0.209	12.218***	0.296	1.134	0.194
Severe Problems	-6.485**	-0.249	-12.802***	-0.227	-2.678**	-0.159	-0.238**		-1.198**	-0.13	-8.904**	-0.215	-1.49**	-0.255
Medium Problems	-6.609***	-0.254	-8.072**	-0.143	-1.369	-0.081	-0.2***		-1.045**	-0.114	-7.321***	-0.177	-0.58*	-0.099
Small Problems	-2.183**	-0.084	-5.056	-0.09	-0.172	-0.01	-0.095**		-0.087	-0.009	-3.151	-0.076	-0.879**	-0.151
Years of construuction	0.547	0.093	0.11	0.008	-0.403	-0.083	0.001		0.236**	0.105	-0.474	-0.049	0.013	0.009
House	5.034***	0.193	7.615**	0.135	2.334**	0.138	0.128**		1.17***	0.127	4.78***	0.116	-0.081	-0.014
Construction Type	3.945**	0.436	10.989***	0.543	2.323**	0.357	0.421***		1.151**	0.338	6.972**	0.473	2.301***	1.095
Neigh. Serv.	1.445**	0.438	1.916	0.215	1.143***	0.321	0.044**		0.594***	0.401	1.533**	0.279	-0.079	-0.083
Type Neigh.	0.161	0.02	-1.909	-0.141	1.189***	0.332			0.766***	0.443	3.629**	0.45	0.543	0.567
Sup. durable goods	1.301	0.05	9.904***	0.176	0.534	0.032	0.167**		1.085***	0.118	4.888***	0.118	0.446	0.076
Domestic Service	3.608**	0.139	12.844**	0.228	-0.986	-0.058	0.133		1.302	0.142	0.856	0.021	1.428	0.245
m2 avg. Price	-0.006	-1.44	0.003	0.328	8.95E-05	0.118				-0.11	0.002**	0.231		

	8		9		10		11†		12		13		14	
	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.
Cons	41.092		-5.871		19.688		4.331		15.107		13.324		3.668	
						Transformed								
Perm. Inc.	0.046	0.087	0.109**	0.258	0.141***	0.264	0.099		0.056*	0.092	0.063**	0.139	0.168***	0.249
Age	0.886**	0.173	0.532	0.075	-0.008	-0.002	0.092		0.265	0.091	1.486***	0.241	0.345**	0.147
Education	2.536	0.142	-5.761*	-0.155	-0.393	-0.03	0.05		0.466	0.063	1.165	0.042	-0.396	-0.082
	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|
λ	0.405	0.000	0.513	0.000	0.366	0.000			0.287	0.000	0.474	0.000	0.228	0.000
N	295		256		228		211		460		331		248	
LR χ^2	203.85		181.73		162.27		13.31		324.85		199.92		158.4	
Prob> χ^2	0.000		0.000		0.000		0.000		0.000		0.000		0.000	
λ =-1	0.000		0.000		0.000				0.000		0.000		0.000	
λ =0	0.000		0.000		0.000				0.000		0.000		0.000	
λ =1	0.000		0.000		0.000				0.000		0.000		0.000	

*p<0.1, **p<0.05, ***p<0.001. + indicates fitted model is log linear. In these cases, elasticities are estimated coefficients and model significance was tested with and F-test and not a χ^2 distribution

Table 20. Hedonic Elasticities (continued)

	15		16		17		18		19		20		21†	
	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.
							Not transformed							
# Bedrooms	0.775**	0.124	0.27**	0.129	0.441**	0.099	0.356	0.058	2.182**	0.131	1.905*	0.107	0.067**	
# Bathrooms	1.607**	0.152	0.285**	0.08	0.192	0.025	2.993***	0.27	1.049	0.035	1.787*	0.057	0.251**	
WES	1.693**	0.149	0.716**	0.185	1.394**	0.168	2.098**	0.187	5.275**	0.169	2.164	0.066	0.254***	
Severe Problems	-1.859**	-0.164	-1.055**	-0.273	-2.542***	-0.306	-1.967**	-0.175	-5.948**	-0.191	-6.32**	-0.193	-0.099	
Medium Problems	-1.42**	-0.125	-0.574**	-0.148	-1.501***	-0.181	-1.623**	-0.144		-0.08	-3.704*	-0.113	-0.024	
Small Problems	-0.573	-0.051	-0.31*	-0.08	0.954*	0.115	-0.453	-0.04	-2.556	-0.082	-1.245	-0.038	0.055	
Years of Construct-ion	-0.082	-0.03	-0.036	-0.037	-0.158	-0.072	0.157	0.047	-0.573	-0.062	0.721	0.088	0.008	
House	0.896**	0.07	0.635**	0.16	1.742**	0.21	1.537**	0.13	5.428**	0.17	9.651**	0.29	0.144	

	9	*	4	**		*	7	*	4	**	5		
	15		16		17		18		19		20		21†	
	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.
Construc-tion Type	2.585***	0.614	0.613***	0.417	0.819**	0.24	1.131**	0.236	3.207***	0.252	6.114***	0.486	0.214***	
Neigh. Serv.	0.377**	0.194	0.202**	0.246	0.426***	0.268	0.652**	0.248	0.529	0.068	2.712***	0.445	0.065**	
Type Neigh.	-0.942**	-0.513	-0.511**	-0.806	-0.509	-0.442	-1.684**	-1.086	-7.093***	-1.714	-3.835*	-0.838		
Sup. durable goods	2.035***	0.18	0.455**	0.118	1.489***	0.179	0.703	0.063	3.232**	0.104	5.233**	0.16	0.131***	
Domestic Service	1.112	0.098	0.114	0.029	2.271**	0.274	-1.524	-0.136	-5.745	-0.184	24.824***	0.758	-0.192**	
m2 avg. Price	0.001**	0.374	0	0.082	0.001**	0.252	-0.001	-0.306	-0.002	-0.205	0.004	0.383		
Cons	13.408		10.77		15.885		28.418		85.532		23.232		2.473	
							Transformed							
Perm. Inc.	0.037	0.062	0.119**	0.162	0.063*	0.106	0.095**	0.174	0.072**	0.173	0.051*	0.114	0.271***	
Age	0.584**	0.181	0.202*	0.106	0.264	0.097	0.167	0.053	0.594*	0.118	0.483	0.091	0.154*	
Education	0.083	0.009	-0.007	-0.002	0.417	0.061	-0.031	-0.003	1.129	0.049	0.602	0.025	-0.145*	
	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|
λ	0.315	0.000	0.178	0.001	0.285	0.000	0.325	0.000	0.466	0.000	0.461	0.000		
N	527		451		487		441		515		288		472	
LR χ^2	283.91		259.36		270.64		225.69		202.11		193.52		16.17	
Prob> χ^2	0.000		0.000		0.000		0.000		0.000		0.000		0.000	
λ =-1	0.000		0.000		0.000		0.000		0.000		0.000			
λ =0	0.000		0.001		0.000		0.000		0.000		0.000			
λ =1	0.000		0.000		0.000		0.000		0.000		0.000			

*p<0.1, **p<0.05, ***p<0.001

+ indicates fitted model is log linear. In these cases, elasticities are estimated coefficients and model significance was tested with an F-test and not a χ^2 distribution

Table 21. Hedonic Elasticities (continued)

	22†		24†		26†		28		29		31†		32	
	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.
Not transformed														
# Bedrooms	0.075***		0.022		0.092***		0.889**	0.137	0.116***	0.12	0.096**		0.411***	0.167
	22†		24†		26†		28		29		31†		32	
	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.
# Bathrooms	0.277***		0.272**		0.052***		0.241	0.021	0.107***	0.064	0.083*		0.365***	0.085
WES	0.197***		0.297***		0.22***		3.474***	0.284	0.465***	0.244	0.174**		0.991***	0.199
Severe Problems	-0.195***		-0.285**		-0.245***		-0.52	-0.042	-0.371***	-0.195	-0.068		-1.002***	-0.201
Medium Problems	-0.089**		-0.071		-0.081**		-1.066	-0.087	-0.076	-0.04	0.039		-0.686***	-0.138
Small Problems	-0.013		-0.12		-0.024		0.004	0	-0.009	-0.004	0.025		-0.352**	-0.071
Years of Const.	0		0.003		0.022**		0.361	0.118	-0.011	-0.024	-0.012		0.038	0.029
House	0.073		-0.011		0.084**		-4.307	-0.352	0.236**	0.124	0.167*		1.283***	0.258
Construction Type	0.172***		0.177***		0.17***		1.557**	0.27	0.397***	0.535	0.101**		0.604***	0.307
Neigh. Serv.	0.065***		0.016		0.096***		-0.19	-0.062	0.149***	0.442	0.075**		0.364***	0.431
Type Neigh.	-0.066**		-0.009		-0.028**				-0.217***	-0.254			-0.263***	-0.127
Luxury goods	0.18***		0.275***		0.167***		1.677**	0.137	0.292***	0.153	0.224**		0.776***	0.156
Domestic Service	0.178**		0.158		0.332***		4.326**	0.354	0.547***	0.287	0.418**		1.801***	0.362
m2 avg. Price														
Cons	4.181		5.052		3.562		13.42		6.768		3.982		5.742	

	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.
								Transformed						
Perm. Inc.	0.108***		0.065		0.182***		0.079***	0.164	0.04	0.045	0.154**		0.12***	0.167
Age	0.23***		0.101		0.19***		0.886***	0.302	0.183**	0.135	0.097		0.494***	0.23
Education	0.084*		0.045		0.048		1.1	0.111	0.164**	0.091	0.048		0.561**	0.132
	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|
λ							0.355	0.000	0.085	0.000			0.210	0.000
N	925		354		1501		413		882		444		1598	
LR χ^2	68.73		17.3		139.16		140.95		714.8		8.6		1082.32	
Prob> χ^2	0.000		0.000		0.000		0.000		0.000		0.000		0.000	
λ =-1							0.000		0.000				0.000	
λ =0							0.000		0.015				0.000	
λ =1							0.000		0.000				0.000	

*p<0.1, **p<0.05, ***p<0.001
+ indicates fitted model is log linear. In these cases, elasticities are estimated coefficients and model significance was tested with and F-test and not a χ^2 distribution

Table 22. Hedonic Elasticities (continued)

	34†		35		36		37†		38†		39	
	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.	Coef.	Elast.
Not transformed												
# Bedrooms	0.044		6.852**	0.111	0.219**	0.141	0.074***		0.058**		0.449	0.084
# Bathrooms	0.339***		24.946**	0.215	0.514***	0.193	0.126***		0.093***		2.208**	0.245
WES	0.247*		9.928	0.082	0.499**	0.167	0.279***		0.186**		1.913**	0.196
Severe Problems	-0.171		-5.351	-0.044	-1.203***	-0.402	-0.271***		-0.152*		-2.666**	-0.273
Medium Problems	-0.171**		-20.104**	-0.166	-0.342**	-0.114	-0.127***		-0.072		-1.24**	-0.127
Small Problems	0.042		-17.392**	-0.144	-0.262	-0.088	-0.117**		-0.045		-0.835	-0.085
Years of const.	0		4.796**	0.146	0.021	0.024	0.015		0.016		-0.359*	-0.149
House	0.217		1.718	0.014	-0.063	-0.021	0.249***		-0.035		3.468***	0.354
Const.	0.195**					0.5						
Type Neigh. Serv.	0.037		17.097*** 6.963***	0.358 0.248	0.636*** 0.003	0.004	0.104*** 0.039***		0.168*** 0.064***		1.559*** 1.074***	0.388 0.549
Type Neigh.	0.148***		-5.019**	-0.1	0.005		-0.035**		-0.034**		-0.285	
Sup. durable goods	0.11		12.301**	0.102	0.637***	0.213	0.136***		0.143***		0.877*	0.09
Domestic Service	0.259**		-3.014	-0.025	0.192	0.064	0.14**		0.347***		2.877**	0.294
m2 avg. Price												
Cons	4.876		10.882		6.102		4.171		5.408		6.102	
Transformed												
Perm. Inc.	0.235**		0.042**	0.113	0.171***	0.22	0.171***		0.084*		0.029	0.048
Age	-0.096		1.691**	0.172	0.143	0.086	0.17**		0.062		0.841**	0.29
Education	0.054		9.246*	0.118	0.671**	0.246	0.068		0.268***		0.978	0.123
	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|	Coef	P>|z|
λ			0.632	0.000	0.147	0.000					0.303	0.000
N	228		484		719		680		728		376	
LR χ^2	25.15		223.17		323.73		41.25		31.3		224.37	
Prob> χ^2	0.000		0.000		0.000		0.000		0.000		0.000	
λ =-1			0.000		0.000						0.000	
λ =0			0.000		0.000						0.000	
λ =1			0.000		0.000						0.000	

*p<0.1, **p<0.05, ***p<0.001

+ indicates fitted model is log linear. In these cases, elasticities are estimated coefficients and model significance was tested with and F-test and not a χ^2 distribution