Estimating the Demand for Housing Attributes in Chile[1]

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Contents

CONTEXT

- Chile and its *good* Housing reputation in Latin America
  - Leader in reducing Housing Deficit in Latin America by direct aid (construction).
  - Leader in implementing a Demand-lead Subsidy Financing System in Latin America. Ruprah, (2007)
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  - What are those attributes that consumers value the most?

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Circunvalación Padre Alberto Hurtado
Antofagasta, Antofagasta Region
Street View - Aug 2012


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THE PROBLEM

A. Find out what housing attributes consumers need and how these contribute to consumer welfare
   - Let us estimate the Demand for Housing Attributes to provide information about:
     - *Price Elasticities*: Attribute's perception as either substitutes or complementary good
     - *Income Elasticities*: Attribute's classification as inferior, normal or luxury goods.

B. Would this economic valuation of housing attributes be homogeneous across the territory?
   - Chile has very different economic and geographic conditions varying in space.
   - This will impose different scenarios depending of the geographical context creating different housing markets

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HOUSING DEMAND ESTIMATION

First wave: *Restrictive assumptions and data*

- Pioneers articles proposing two step procedures suggest that housing attributes are both inferior and complimentary.

  King (1976) and McMillan (1979).
- Data from London to show Housing Space as the component with highest relevance.

  Awan, Odling-Smee, & Whitehead (1982)

Second wave: *Flexible functional forms and more detailed data*

- *Turning point*: Almost Ideal Demand System (AIDS) and AIDS for Housing attributes (AIDS-HA)

  Deaton & Muellbauer (1980) and Parsons (1986)
- Linear version of AIDS to show how estimations vary along income levels Cheshire & Sheppard (1998)
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1. Demand system representation of the spatial heterogeneity of preferences between regional housing markets
   - Many others either do for only one specific market or aggregate (and generalize for the whole country)

2. Estimation of Confidence Intervals for Elasticity estimates
   - First time in this literature, to our knowledge.

3. First estimation of Housing Demand for Attributes in Chile under this body of Literature
   - This would serve not only for Chile, but for other countries that have follow its path.

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ECONOMIC MODEL

$$\textbf{Maximize } U(Z, X) \textbf{ s.t. } Y = P(Z) + X,$$

where:

- $Z = (z_1, z_2, \ldots, z_n)$ is a composite good of housing attributes
- X is a composite good of all other goods besides housing (numeraire)
- $Y = P(Z) + X$ is a non-linear budget constraint dependent of prices of housing attributes (w.l.o.g)

Assumptions:

- $U(Z, X)$ is weakly separable
- Households are price takers and housing supply is an exogenous factor
- $Y = P(Z) + X$ is the budget constraint dependent of prices of housing attributes (w.l.o.g)

Yielding a demand function such as:

$$Z = f(P_{z1}, P_{z2}, \ldots, P_{zn}; Y)$$

Based on the AIDS functional form properties gives the demand system in the budget-share form:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \text{ Log } p_i + (\beta_i + \theta_i' d_i) \text{ Log } (\frac{x}{H(1+\rho_i' d_i)})$$

where: $H = \alpha_0 + \sum_k \alpha_k \text{ Log } p_k + 0.5 \sum_k \sum_j \text{ Log } p_k \text{ Log } p_j$ and $\gamma_{ij} = 0.5(\gamma_{ij}^* + \gamma_{ji}^*)$, and $x = \sum_i = p_{zi} z_i$, and $w_i = \frac{p_{zi} z_i}{x}$

From which the elasticities can be recovered:

- *Income*: $\eta_{ie} = [(\beta_i + \theta_i' d_i)/w_i] + 1$
- *Price (uncomp)*: $\eta_{ii} = \frac{1}{w_i}[(\beta_i + \theta_i' d_i)(\alpha_i + \sum_k \gamma_{ik} \text{ Log } p_k)] - 1$
- *Price (comp)*: $\eta_{ii}^* = \eta_{ii} + \eta_{ie} * w_i$

EMPIRICAL STRATEGY

Step 1. *Hedonic Regressions*: $Ln(P) = f(Z, D)$

- *Aggregation:* Regional Level & Demographics
- *Output:* $\frac{\partial P}{\partial Z_j} = exp(\widehat{Ln(P)} \times \hat{\beta}_j) = \hat{p}_j$

Step 2. *AIDS-HA*: $w_i = f(\hat{p}(z), D)$

- *Aggregation:* National Level & Demographics (micro-level)
- *Output:* AIDS-HA demand equation parameters

Step 3. *Elasticities*: η_{ie}, η_{ii}, *and* η^*_{ii}

- *Aggregation:* National and Regional level
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CROS-SECTIONAL CHILEAN HOUSEHOLD SURVEY CASEN (2000-2009)

- Renters micro-level data for the 13 Chilean regions.
- House characteristics: Renting Price, Housing Size (HS), Housing Quality (HQ), Housing Features (HF), Housing Location (HL)
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A. Estimate Housing Quality Index (HQ)

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B. Estimate Housing Features Index (HF)

- Option 1: Factor Analysis of several house features variables.
- Option 2: Composite index as the sum of the Housing Features attributes times their fitted values. Parsons (1986)

$$Ln(P) = \alpha_0 + \sum_{j=1}^{J} \alpha_j A_j + \sum_{s=1}^{S} \beta_s F_s + \epsilon$$

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DESCRIPTIVE STATISTICS: HEDONICS

Variable	Description	min	mean	p50	max	sd
Ln(Rent Price)	Natural Logaritm of Monthly Rent Prices in CLP	9.21	11.17	11.16	12.90	0.67
HS	Housing Size: Total number of Rooms in the house	1.00	5.25	5.00	36.00	1.60
HQ	Housing Quality: Index based on floor, walls and ceilings	0.01	0.75	0.79	1.00	0.23
HL	Housing Location: Proxy by years of schooling	1.00	11.44	12.00	23.00	3.70
WasherD	Dummy for Washer Yes=1, No=0	0.00	0.72	1.00	1.00	0.45
RefrigeratorD	Dummy for Refrigerator Yes=1, No=0	0.00	0.92	1.00	1.00	0.27
LandlineD	Dummy for Landline Yes=1, No=0	0.00	0.31	0.00	1.00	0.46
WaterHeaterD	Dummy for Water Heater Yes=1, No=0	0.00	0.66	1.00	1.00	0.47
ComputerD	Dummy for Computer Yes=1, No=0	0.00	0.39	0.00	1.00	0.49
Year2003D	Dummy for Year 2003=1, otherwise=0	0.00	0.18	0.00	1.00	0.39
_Iyear_2006	Dummy for Year 2006=1, otherwise=0	0.00	0.20	0.00	1.00	0.40
_Iyear_2009	Dummy for Year 2009=1, otherwise=0	0.00	0.21	0.00	1.00	0.40
_Iyear_2011	Dummy for Year 2011=1, otherwise=0	0.00	0.25	0.00	1.00	0.43
_Iv_tipo3_2	Dummy for Apartment=1, otherwise=0	0.00	0.12	0.00	1.00	0.33
_Iv_tipo3_3	Dummy for Other house type=1, otherwise=0	0.00	0.02	0.00	1.00	0.14
zona	Dummy for Zone, Urban=1, Rural=0	0.00	0.91	1.00	1.00	0.29

Note: 33,733 Observations

DESCRIPTIVE STATISTICS: AIDS

Variable	Description	min	mean	p50	max	sd
HS	Housing Size	1.00	5.25	5.00	36.00	1.60
HQ	Housing Quality	0.01	0.75	0.79	1.00	0.23
HF	Housing Features	0.44	1.66	1.73	2.66	0.67
HL	Housing Location	1.00	11.44	12.00	23.00	3.70
z1	Household Size	1.00	3.51	3.00	15.00	1.55
s_HS	Share of expenditure in HS	0.01	0.26	0.25	0.71	0.10
s_HQ	Share of expenditure in HL	0.01	0.33	0.33	0.84	0.13
s_HF	Share of expenditure in HF	0.04	0.18	0.19	0.54	0.06
s_HL	Share of expenditure in HL	0.01	0.22	0.23	0.67	0.07
lnp1	log(Hedonic price for HS)	6.97	8.87	8.89	11.30	0.50
lnp2	log(Hedonic price for HQ)	8.84	11.08	11.09	13.69	0.67
lnp3	log(Hedonic price for HF)	7.79	9.74	9.76	11.54	0.50
lnp4	log(Hedonic price for HL)	5.93	7.97	7.99	10.06	0.54
lnw	log(Total expenditure in 4 Attributes)	8.23	11.90	11.96	14.70	0.76

Note: 33,733 Observations

ELASTICITIES WITH AND WITHOUT DEMOGRAPHICS

AIDS-HA without Demographics

Elasticity	HS	HQ	HF	HL
Income	*0.7955*	*1.2324*	*1.1498*	*0.7620*
	(0.0004)	(0.0005)	(0.0002)	(0.0005)
Price				
Uncompensated				
HS	***-0.5809***	*-1.4216*	*-1.2770*	*-1.3325*
	(0.0016)	(0.0001)	(0.0004)	(0.0003)
HQ	*-1.8116*	***-0.7183***	*-1.6553*	*-1.7699*
	(0.0001)	(0.0026)	(0.0003)	(0)
HF	*-1.4911*	*-1.5203*	***-0.5239***	*-1.4348*
	(0.0001)	(0.0002)	(0.0015)	(0)
HL	*-1.3173*	*-1.3784*	*-1.2234*	***-0.5437***
	(0.0002)	(0.0001)	(0.0003)	(0.0012)
Compensated				
HS	***-0.4279***	*-1.2686*	*-1.1240*	*-1.1795*
	(0.0009)	(0.0004)	(0.0002)	(0.0003)
HQ	*-1.3228*	***-0.2296***	*-1.1665*	*-1.2811*
	(0.0009)	(0.0019)	(0.0004)	(0.0007)
HF	*-1.2486*	*-1.2778*	***-0.2814***	*-1.1922*
	(0.0004)	(0.0005)	(0.0013)	(0.0003)
HL	*-1.2016*	*-1.2627*	*-1.1077*	***-0.4280***
	(0.0003)	(0.0003)	(0.0001)	(0.0007)

AIDS-HA with Demographics

Household Head = 3

Elasticity	HS	HQ	HF	HL
Income	*0.8081*	*1.2245*	*1.1502*	*0.7566*
	(0.0004)	(0.0005)	(0.0002)	(0.0005)
Price				
Uncompensated				
HS	***-0.2422***	*-0.2394*	*-0.1069*	*-0.2196*
	(0.0017)	(0.0005)	(0.0003)	(0.0005)
HQ	*-0.2876*	***-0.4989***	*-0.1923*	*-0.2457*
	(0.0007)	(0.0013)	(0.0005)	(0.0006)
HF	*-0.2336*	*-0.3226*	***-0.4118***	*-0.1822*
	(0.0003)	(0.0005)	(0.001)	(0.0003)
HL	*-0.2370*	*-0.2118*	*-0.0782*	***-0.2296***
	(0.0005)	(0.0004)	(0.0002)	(0.0014)
Compensated				
HS	***-0.0364***	*-0.0336*	*0.0990*	*-0.0138*
	(-0.0384)	(-0.0353)	(0.0974)	(-0.0158)
HQ	*0.1236*	***-0.0877***	*0.2190*	*0.1655*
	(0.1211)	(-0.0886)	(0.2165)	(0.1631)
HF	*-0.0199*	*-0.1089*	***-0.1981***	*0.0315*
	(-0.0211)	(-0.1103)	(-0.1995)	(0.0304)
HL	*-0.0677*	*-0.0426*	*0.0910*	***-0.0604***
	(-0.0695)	(-0.044)	(0.0901)	(-0.0621)

Technical Note:

Variable Housing Features (HF) was here calculated as the estimated Factor from a Factor/Principal Components Analysis between four housing features available as Dummy variables: Wather heater, Whasher, Landline, Refrigerator, Computer

- HS & HL: Basic Necessities (Normal goods), and Price Inelastic
- HQ & HF: Non-Affordable (Luxury goods), and Price Elastic

ELASTICITIES WITH DEMOGRAPHICS

AIDS-HA with Demographics

Household Head = 2

Elasticity	HS	HQ	HF	HL
Income	*0.8376*	*1.2032*	*1.1548*	*0.7448*
	[0.83612,0.83909]	[1.20126,1.20523]	[1.15382,1.15579]	[0.74262,0.74689]
Price				
Uncompensated				
HS	***-0.2188***	*-0.2648*	*-0.1192*	*-0.2348*
	[-0.22674,-0.21079]	[-0.26717,-0.26252]	[-0.12044,-0.11804]	[-0.23731,-0.2322]
HQ	*-0.2792*	***-0.5003***	*-0.1853*	*-0.2384*
	[-0.28234,-0.27598]	[-0.50591,-0.49475]	[-0.18704,-0.18362]	[-0.24094,-0.2359]
HF	*-0.2354*	*-0.3258*	***-0.4102***	*-0.1834*
	[-0.23691,-0.23383]	[-0.32813,-0.32342]	[-0.41403,-0.40647]	[-0.18464,-0.1822]
HL	*-0.2286*	*-0.1997*	*-0.0726*	***-0.2438***
	[-0.23048,-0.22674]	[-0.20123,-0.19826]	[-0.07323,-0.07194]	[-0.24944,-0.23819]
Compensated				
HS	***-0.0138***	*-0.0599*	*0.0857*	*-0.0298*
	[-0.01865,-0.00892]	[-0.0642,-0.05552]	[0.08191,0.08957]	[-0.03438,-0.02517]
HQ	*0.1320*	***-0.0892***	*0.2258*	*0.1727*
	[0.12596,0.13802]	[-0.09133,-0.08704]	[0.22115,0.23049]	[0.16743,0.17803]
HF	*-0.0217*	*-0.1121*	***-0.1966***	*0.0302*
	[-0.02445,-0.01903]	[-0.11563,-0.10865]	[-0.19931,-0.19393]	[0.02776,0.03266]
HL	*-0.0584*	*-0.0295*	*0.0977*	***-0.0736***
	[-0.06226,-0.05448]	[-0.03267,-0.02634]	[0.09509,0.10022]	[-0.07738,-0.06977]

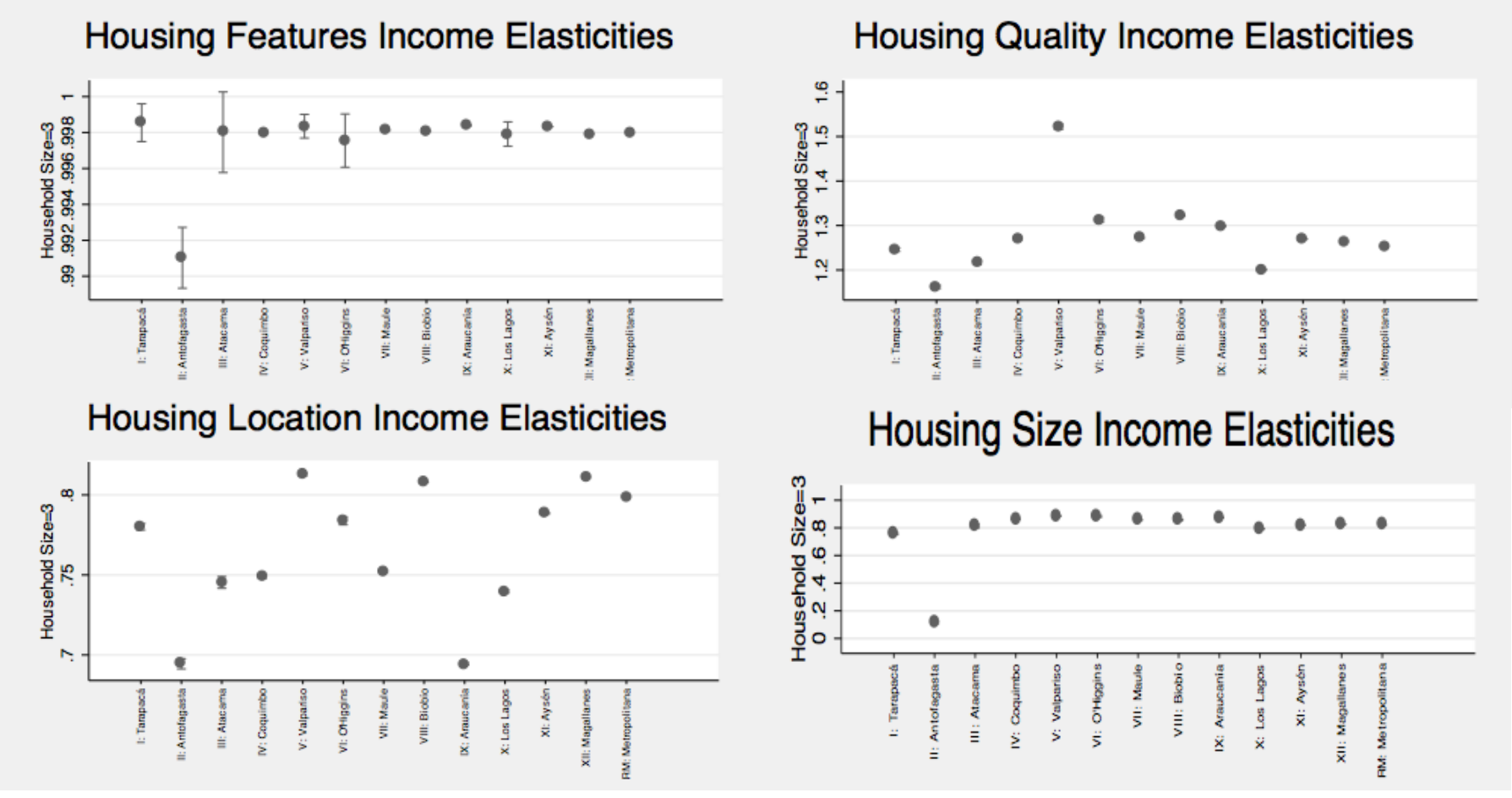
ELASTICITIES WITH DEMOGRAPHICS

AIDS-HA with Demographics

Household Head = 4

Elasticity	HS	HQ	HF	HL
Income	*0.7803*	*1.2459*	*1.1453*	*0.7684*
	[0.77917,0.78143]	[1.24493,1.24694]	[1.14489,1.1458]	[0.76738,0.7694]
Price				
Uncompensated				
HS	***-0.2623***	*-0.2162*	*-0.0956*	*-0.2062*
	[-0.2656,-0.25892]	[-0.21709,-0.21539]	[-0.09609,-0.09507]	[-0.20732,-0.20511]
HQ	*-0.2956*	***-0.4988***	*-0.1991*	*-0.2524*
	[-0.29712,-0.29406]	[-0.50184,-0.49586]	[-0.20007,-0.19804]	[-0.25365,-0.25124]
HF	*-0.2313*	*-0.3187*	***-0.4148***	*-0.1804*
	[-0.2321,-0.23056]	[-0.31993,-0.31752]	[-0.41687,-0.41282]	[-0.18104,-0.17986]
HL	*-0.2465*	*-0.2249*	*-0.0842*	***-0.2128***
	[-0.24759,-0.24542]	[-0.22568,-0.22404]	[-0.08464,-0.08383]	[-0.21606,-0.20953]
Compensated				
HS	***-0.0562***	*-0.0102*	*0.1105*	*-0.0002*
	[-0.05812,-0.0543]	[-0.01211,-0.00827]	[0.10873,0.11221]	[-0.00242,0.00208]
HQ	*0.1165*	***-0.0867***	*0.2131*	*0.1597*
	[0.11337,0.11967]	[-0.08796,-0.0855]	[0.21068,0.21545]	[0.15704,0.1623]
HF	*-0.0171*	*-0.1045*	***-0.2006***	*0.0338*
	[-0.01866,-0.01554]	[-0.10623,-0.10275]	[-0.20205,-0.19917]	[0.03251,0.03506]
HL	*-0.0789*	*-0.0573*	*0.0834*	***-0.0452***
	[-0.08082,-0.077]	[-0.05905,-0.05546]	[0.08213,0.08461]	[-0.04741,-0.04297]

ELASTICITIES WITH HHS=3, AT THE REGIONAL LEVEL



INITIAL INSIGHTS

- Demand Elasticities are crucial to understand consumer preferences
- HS and HL are basic necessities and people will be less willing to trade them.
- HQ and HF are seen as luxuries and they are easily given up to price changes.
- This results are robust and consistent across Household Sizes, with small but significant differences
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WHAT POLICY ANALYSIS CAN WE GET FROM HERE?

Policy should be focus in characteristics with high price elasticity (HS and HL)

- Households identify this two attributes as still a concern in Chile $\rightsquigarrow$ Larger Houses, even if this means less quantity.
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- We need more studies that expand our understanding of regional housing markets and its dynamics with labor markets.

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Estimating the Demand for Housing Attributes in Chile[2]

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[2]Lincoln Institute of Land Policy 2014 Research Seminar: *Land Policy and Urban Development in Latin America*