PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE

Compact development and preferences for social integration in location choices: Results from revealed preferences of Santiago, Chile

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Density and externalities

Riyadh TOD (http://www.bartonwillmore.co.uk)

Jersey City Redevelopment Agency

Zonas de Integración Social

December 2019: Law project was sent to congress.

ZIS: Private and-or public entities can propose an area, with good accessibility and urban standards, where real estate developers can build with more density but subject to adding a percentage of social housing.

In a market-driven city development, success of this policy is subject to understanding if households are willing to integrate, in dense areas.

Chile has a long tradition of single family dwellings in low density, and a strong socio spatial segregation.

Objetives and Hypothesis

Objectives:

Infer how valuation of location socioeconomic level may vary in context of Compact Development versus Suburban areas.

Hypothesis:

In CD areas households are less sensitive to socioeconomic levels, in comparison to suburban areas.

Counterhypothesis: but density may harden living with other.

Methodological strategy:

Build a location choice model based on census data, to infer how households value urban attributes in different contexts.

The model [in words]

Variations in preferences can be inferred through an econometric model of competence of households for location [Bid-auction model]

We segment households in different types [according to Educ. Level and Life Cycle].

Each type of household has a Willingness to Pay [WP] for each location, which depends on location attributes, and the valuation that the household has for those attributes.

The real estate market is modelled as dwellings being auctioned;
Households with higher WP for a dwelling have higher probability of winning that dwelling.

How households value location attributes depends on the context of that location [if context is CD, their valuation of attributes is different from being suburban].

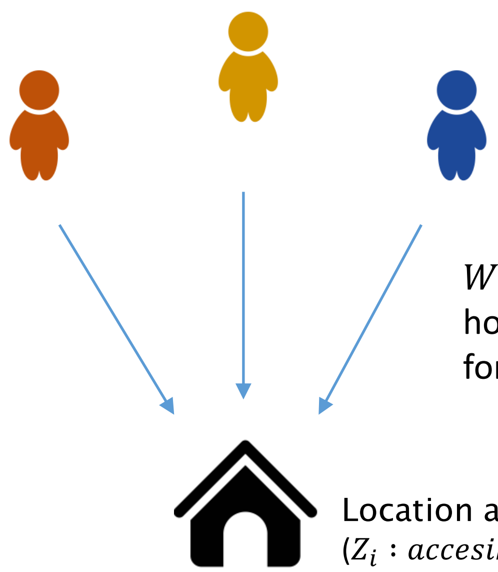
The model [with diagrams and formulas]

- Modelling WP via location choices: *Bid-auction* model (Ellickson, 1981, based on McFadden, 1978).

Different types of Households

Characteristics of Households (X_h)

Preferences of Households (β_h)



WP_{hi} : how much is household *h* willing to pay for location *i*.

Location attributes (Z_i : $accesibility, built\ space. etc$)

Houlseholds bid their WP

$$WP_{hi} = f(X_h, Z_i, \beta_h)$$

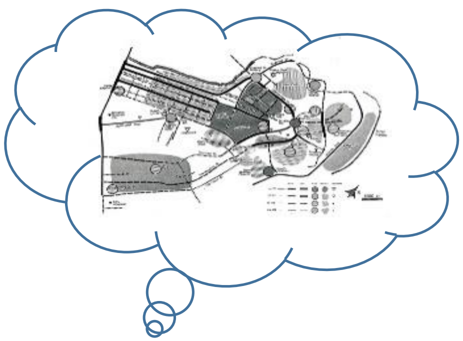
~ Household with max bid gets the location.

Considering an error term (i.i.d. Gumbel), the probability of household *h* winning the auction for location *i* is:

$$P(h|i) = \frac{exp(\varphi WP_{hi})}{\sum_{g \in H} exp(\varphi WP_{gi})}$$

Estimation process: maximize the joint probability that the chosen alternative i for each observation has the highest probability of being chosen in the model.

The model [with diagrams and formulas]



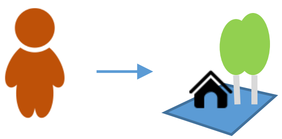
Membership to a class of zone function:

$$W_{si} = f(\hat{Z}_i, \theta_s)$$

Probability that location *i* belongs to a class of zone *s*:

$$P_{si} = \frac{\exp(W_{si})}{\sum_{n \in S} \exp(W_{ni})}$$

As in Latent Class Models



$$WP_{hi}^{s} = f(Z_i, X_h, \beta_h^{s})$$

Agents have different attribute valuation for each context s

$$P_{hi}^{s} = \frac{\exp(WP_{hi}^{s})}{\sum_{g \in H} \exp\left(WP_{gi}^{s}\right)}$$

The probability of being the best bidder changes according to the class of context

Ellickson's bid-auction model

(Conditional to context)

$$P_{hi} = f\left(P_{hi}^{s=1}, P_{hi}^{s=2} \ldots\right) = P_{hi}^{s=1} \cdot P_{is=1} + P_{hi}^{s=2} \cdot P_{is=2} \ldots = \sum_{s \in S} P_{hi}^{s} \cdot P_{si}$$

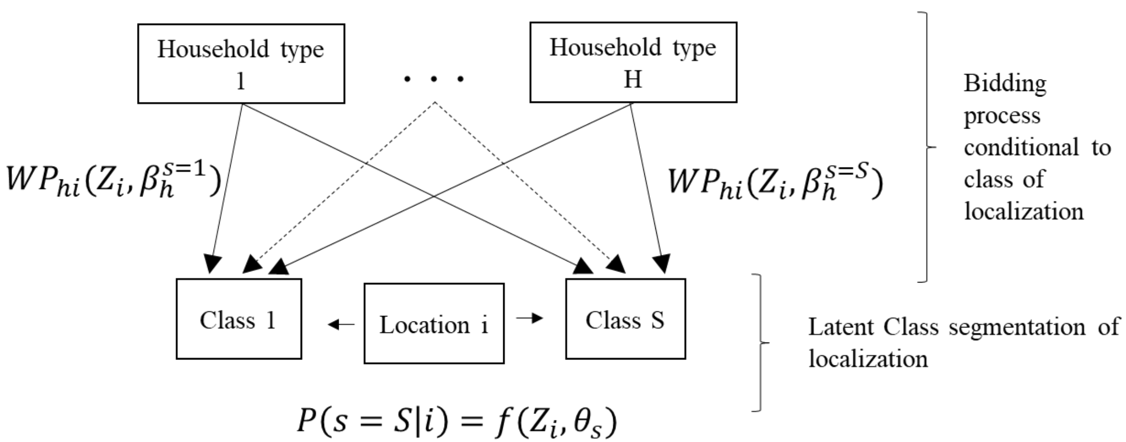
Methodological contribution

Households bidding for location is a model by Ellickson [1981].

Latent classes: Kamakura & Russell [1988]

LCM in location choice models : Walker & Li [2007] : endogenous segmentation of households.

Our methodological contribution: using LCM in a bid model : endogenous segmentation of locations.



Case Study: Santiago de Chile

Case Study: Household segments

SEGMENTATION CRITERIA

Educational Level	
Low-EL	from 1 to 8 years
Mid-EL:	from 9 to 12 years
HI-EL:	more than 13 years

Life Cycle	
Indep:	All between 18 and 65 years
Senior:	No one below 18 years and at least one above 65 years
wChild:	At least one below 18 years

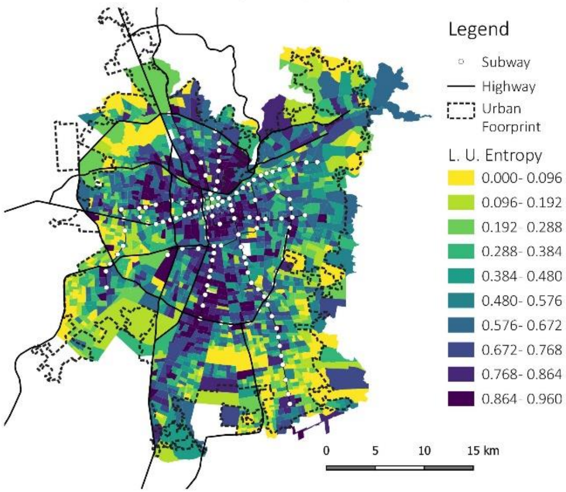
OBSERVED PROPORTIONS, MOVERS

(in parenthesis, proportion in all households of Study Area)

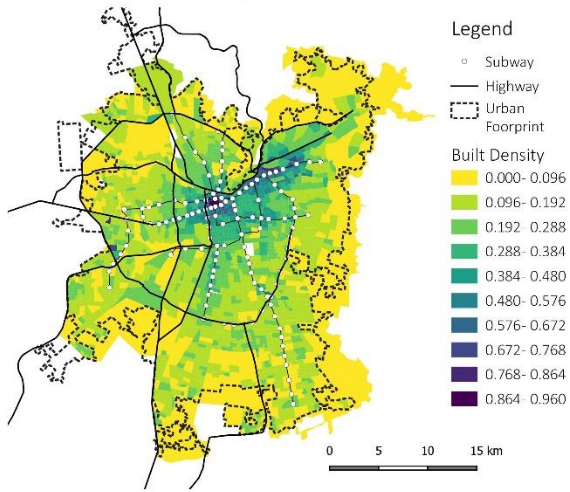
	Indep	Senior	wChild	TOTAL
Low-EL	20218 4% (7%)	10423 2% (8%)	18294 4% (9%)	48935 10% (25%)
Mid-EL	72287 15% (14%)	11445 2% (6%)	72581 15% (20%)	156313 33% (40%)
Hi-EL	162977 34% (16%)	13740 3% (4%)	92605 20% (15%)	269322 57% (36%)
TOTAL	255482 54% (37%)	35608 8% (18%)	183480 39% (44%)	474570 100%

Case Study: location attributes

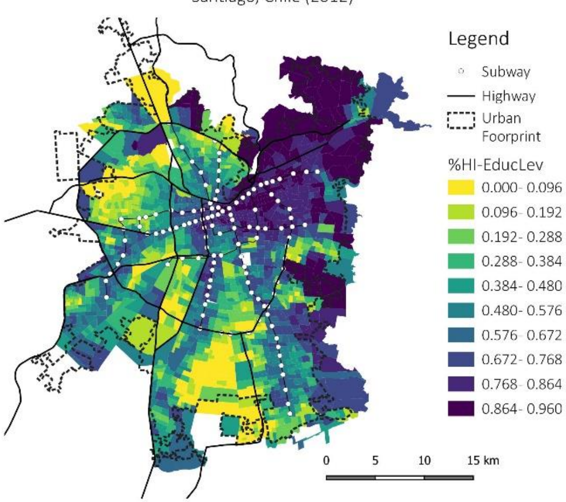
LAND USE ENTROPY
Santiago, Chile (2014)



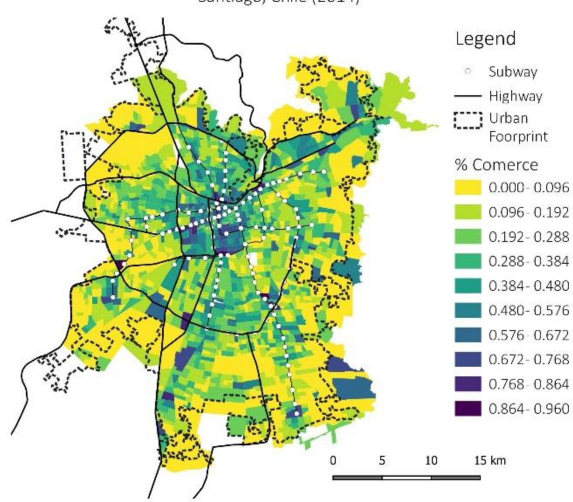
BUILT DENSITY
Santiago, Chile (2014)



% HIGH EDUC LEVEL HOUSEHOLDS
Santiago, Chile (2012)



% COMERCE
Santiago, Chile (2014)



Land Use entropy is a measure of diversity [0 to 1]

Other attributes:

Distance to nearest subway station, distance to city center, Average unit built surface.

Estimation Results

Location Attribute	Household Types: Education Level	Household Types: Life Cycle	Location Probability Elasticity: Compact Development	Location Probability Elasticity: Suburban
Constant	Low-EL	Indep		
		Senior		
		wChild		
	Mid-EL	Indep		
		Senior		
		wChild		
	Hi-EL	Indep		
		Senior		
		wChild		
Distance to City Center (km)	Low-EL	Indep	-0.64	-0.04
		Senior	-0.22	-0.40
		wChild	0.36	-0.38
	Mid-EL	Indep	-0.66	0.07
		Senior	0.30	-0.66
		wChild	-0.63	0.13
	Hi-EL	Indep	-0.18	-0.65
		Senior	0.35	-0.74
		wChild	-0.31	-0.07
% Hi-EL Households	Low-EL	Indep	-0.65	-0.61
		Senior	-0.49	-0.07
		wChild	-0.89	-0.44
	Mid-EL	Indep	-0.53	-0.36
		Senior	-0.16	-0.29
		wChild	-0.58	-0.33
	Hi-EL	Indep	0.61	0.27
		Senior	0.37	0.49
		wChild	-0.12	0.63

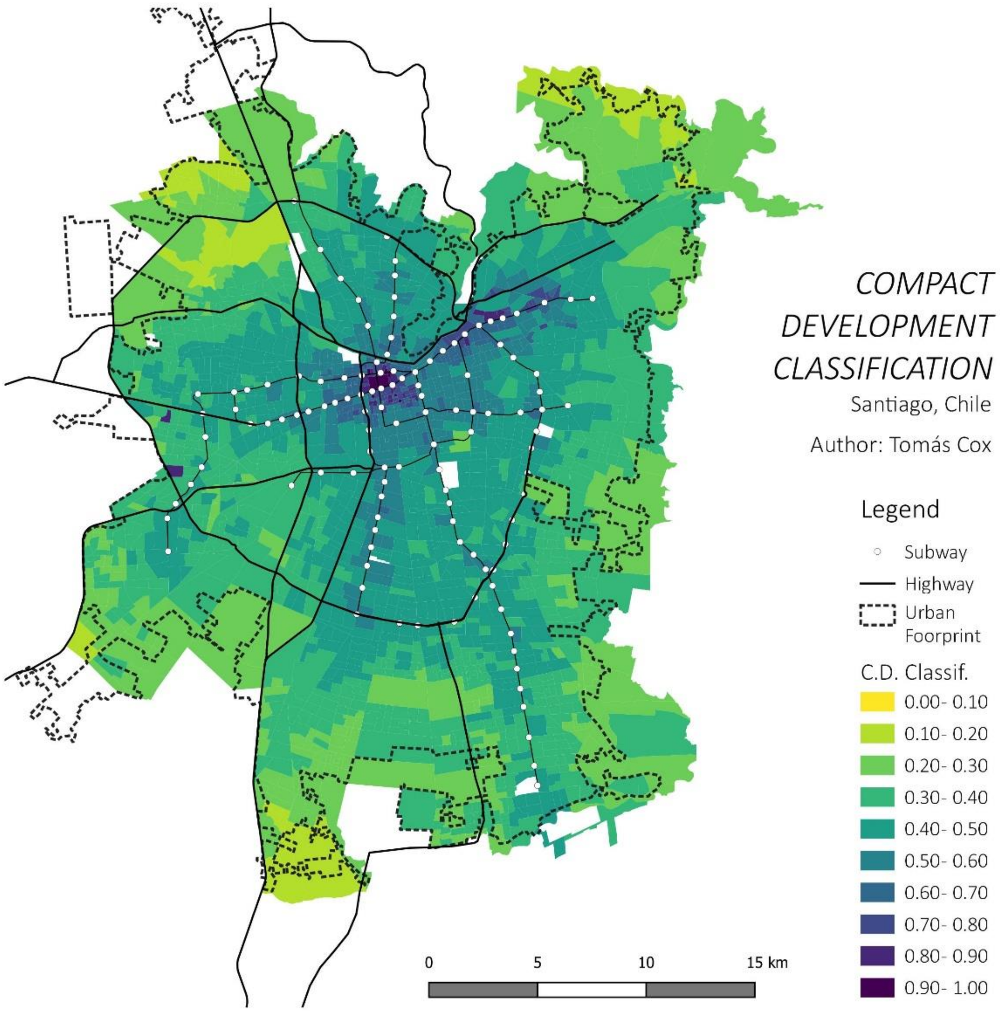
Location Attribute	Household Types: Education Level	Household Types: Life Cycle	Location Probability Elasticity: Compact Development	Location Probability Elasticity: Suburban
% Comerce	Low-EL	Indep	0.08	0.00
		Senior	0.00	-0.05
		wChild	-0.18	0.05
	Mid-EL	Indep	0.05	0.01
		Senior	0.05	-0.17
		wChild	0.06	-0.05
	Hi-EL	Indep	0.04	0.22
		Senior	0.11	-0.22
		wChild	0.03	-0.03
Avg Unit Built Surface (m2)	Low-EL	Indep	-0.08	0.33
		Senior	-0.63	-0.16
		wChild	0.26	-0.52
	Mid-EL	Indep	-0.06	-0.05
		Senior	0.31	0.04
		wChild	-0.32	-0.31
	Hi-EL	Indep	0.06	-0.16
		Senior	0.40	0.84
		wChild	-0.72	0.29

Class Segmentation Attribute		
Intercept		
Built Density	0.26	0.13
Distance to Closest Subway	-0.07	-0.18
Land Use Entropy	0.26	0.27

Location Probabilities

Education Level	Life Cycle	Aggregate Location Probability Compact Development	 Suburban	Relative difference
Low-EL	Indep	3.2%	4.7%	-32%
	Senior	4.0%	0.3%	1059%
	wChild	3.0%	5.0%	-41%
Mid-EL	Indep	16.6%	10.7%	55%
	Senior	3.5%	2.0%	81%
	wChild	8.3%	19.2%	-57%
Hi-EL	Indep	49.8%	24.8%	101%
	Senior	3.9%	2.6%	52%
	wChild	7.6%	30.6%	-75%
		100%	100%	

CD classification probabilities



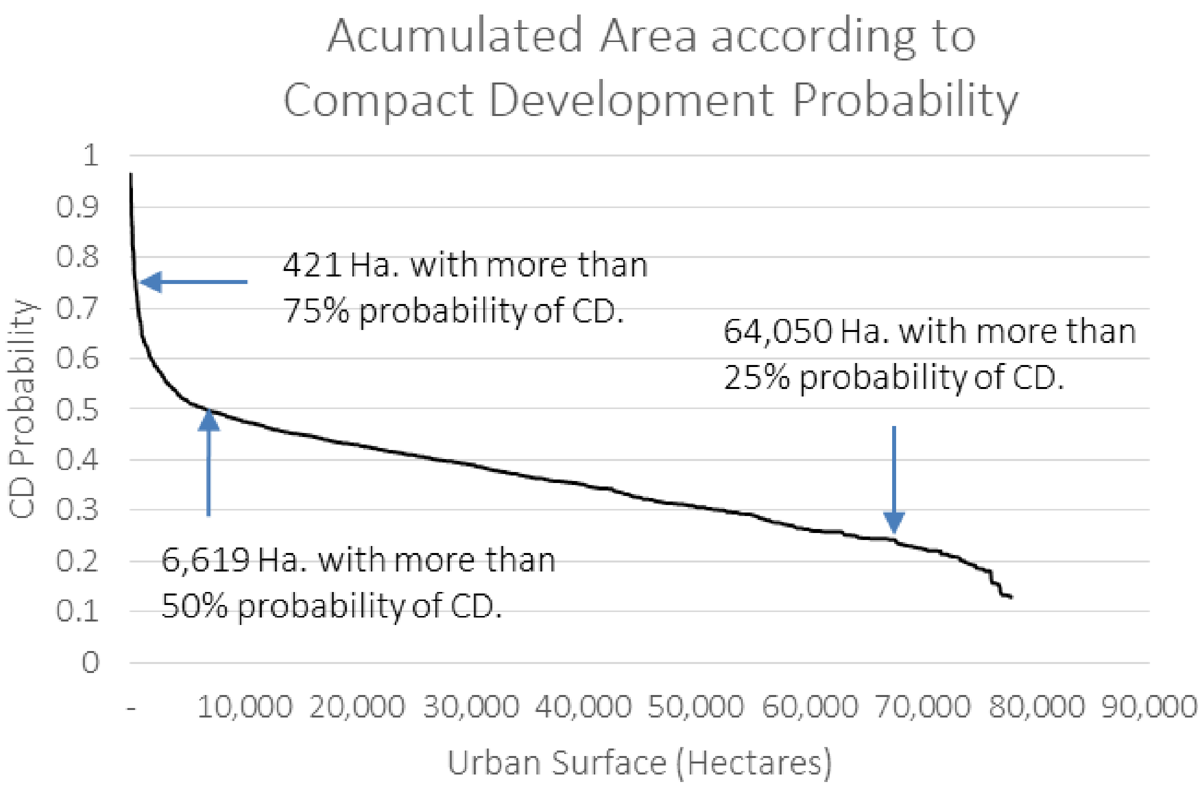
This function can be used as a CD index, which is behaviorally-based.

It represents how much households perceive a zone as CD, considering their shift in preferences due to this perception.

$$P_{si} = \frac{\exp(W_{si})}{\sum_{n \in S} \exp(W_{ni})}$$

$$W_{si} = 0.927 - 0.66 * Density * 0.101 \ * DistSubway - 0.852 * Entropy$$

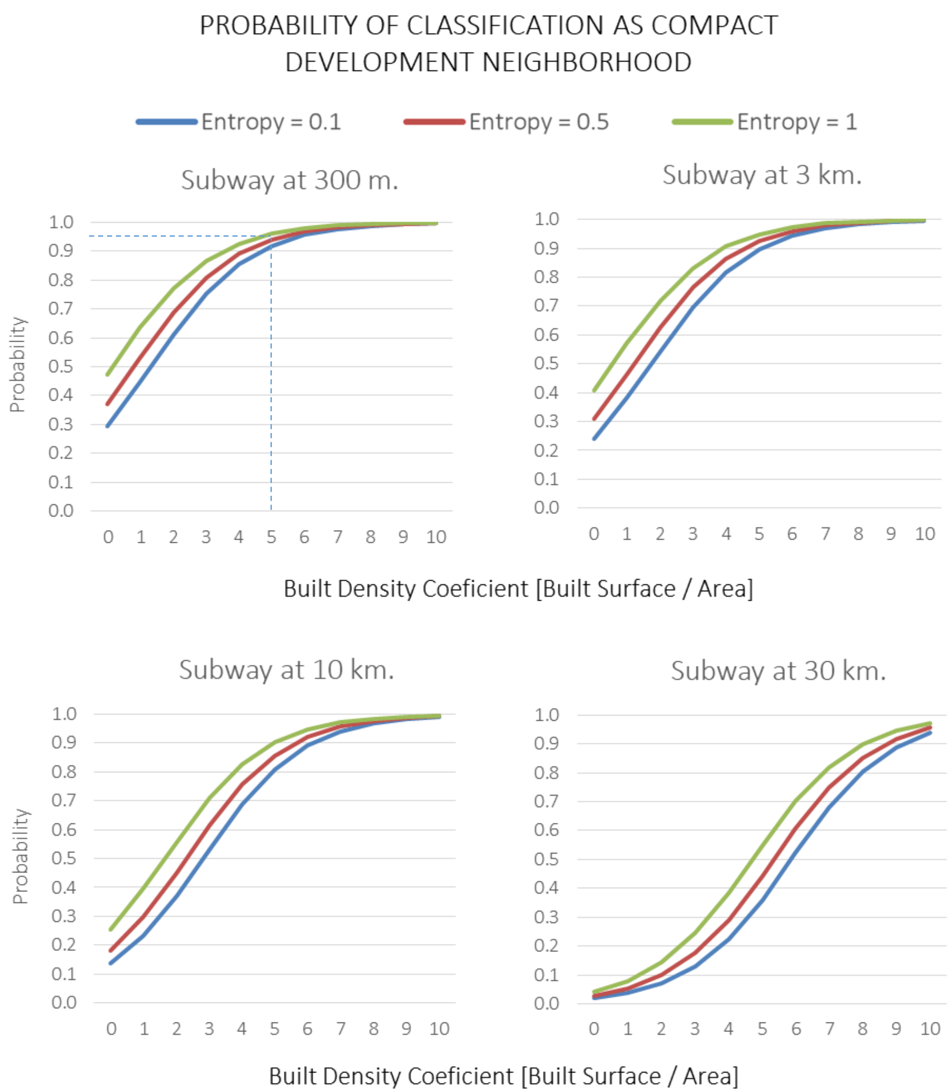
CD classification probabilities



Only 0.54% of the city has a probability above 0.75 of CD.

A clear cut division of the city into two classes, would give only a 8.5% of the urban area as CD [using 0.5 probability as the boundary].

CD classification probabilities



How much density is needed for an area to be perceived as CD?

Example: with subway at 300 m. and land use entropy of 0.5 [mid diverse], to reach a 0.95 CD probability is needed a building coefficient of 5 [that means a building of around 10 floors if its base takes half of the plot surface]

Conclusions

CD is more attractive to independent households, and not to households with children, and this difference is stronger with higher Education Level.

Senior households are more likely to locate in CD.

There is a strong inertia of Households locating in areas with similar Educ. Level, but this inertia is higher in CD.

Therefore, social integration may be harder in density than in suburban.

The classification function W_s and the subsequent logit probability of a zone being Compact Development, can be interpreted as behaviorally-based Compact Development Index, which goes from 0 to 1.

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