

Proceeding Paper



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How much does location determine the market value of a building according to a multiple econometric analysis? *

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Abstract: Multi-parametric valuation techniques, in real estate valuation, are particularly useful to11understand and define all the factors that contribute to the determination of market prices. Even12though a plethora of building features influence the way prices are formed, location is certainly13among the most influential. As such, the goal of this research is the analysis of position and neighbourhood in the process of market value estimation for a building. Particular attention is given to15the comparison of location characteristics versus construction characteristics by means of a multiparametric econometric analysis.17

Keywords: Market value assessment; Buildings; Location; Multiple Regression; Econometric analysis

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1. Introduction

Multi-parametric assessment methods are particularly interesting in property valu-22 ation [1] since they are able to define all the **factors** that contribute to the determination 23 of market prices, while also identifying the marginal influence that each factor has on the 24 price [2]. In this context, we distinguish construction and positional factors. Among the 25 construction characteristics, there are, for instance, features like the dimension of the build-26 ing, the floor level, the state of maintenance, the presence of installations, domotics, bal-27 conies, gardens, or parking spaces. On the other hand, location characteristics refer to the 28 position in a central/semi-central/suburban area of a city, the proximity to commercial 29 facilities and services, the access to public transport, as well as the neighbourhood quality. 30 Such positional factors are also defined as **fixed effects**, since a property, apart from its 31 construction characteristics, cannot be considered separately from the positional context 32 in which it is placed [3]. Such fixed effects may have both a positive [4] or a negative [5] 33 influence on prices depending on the market segment considered. 34

In this study, the scope is to examine the impact that fixed effects produce on prices 35 in comparison to construction characteristics, by means of a multi-parametric econometric 36 analysis [6,7]. 37

An econometric market value assessment application, in fact, is able to determine the relationship that links some features describing the property (the independent variables) 39 and its market value (the dependent variable) [8]. 40

2. Materials and Methods

Presented in Figure 1, the methodological strategy is aimed at producing a reliable 42 hedonic pricing model that includes both construction and location regressors. The methodological approach is as follows: 44

In Phase 1, the independent variables for the econometric model are defined 1 (construction and location characteristics), given the market value as the dependent vari-2 able. 3

In Phase 2 a Random Forest (RF) feature importance analysis is carried out to test the significance of the regressors on the output.

In Phase 3, the econometric model is produced, and the multiple regression is built as in Equation 1:

$$Y = \beta_a + \beta_b X_b + \beta_c X_c + + \beta_k X_k + + \beta_K X_K + \xi$$
(1)

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In the equation above, Y is the market price, X_k are the buildings characteristics, β_a is 10 the constant, β_k are the coefficients, ξ is the error. 11 12



Figure 1. Methodological flow-chart.

3. Results

3.1. Case study

Padova (a City in North-Eastern Italy) is chosen to be an exemplary case study, and 17 the consulted information is from the first half of 2023. 18

The observations collected to produce the forecasting model are limited to residential 19 buildings in Padova, including new and existing apartments, detached houses, villas, 20 lofts, or terraces located in central, semi-central, and suburban areas. 21

Particular attention is given to the selection of the location and construction characteristics of each property that need to be collected. The observations recorded describe 1518 buildings, with an average market value of 2150 €/m².

3.2. Feauture selection

A feature importance and a consequent feature selection analysis is performed with 27 the Random Forest (RF) regressor to calculate the **importance coefficients** that link the 28 regressors to the market price. Such coefficients are summarized in Figure 2 and Figure 3. 29

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		Straight line distance	Actual travel distance by car	Travel time by car	Travel time on foot	Travel time by public transport	N. of POI in 400 m ring buffer	N. of POI in a 1 km ring buffer	TOTAL
Shopping malls Access to public City Center	Unit of measure	Km	Km	minutes	minutes	minutes	number	number	%
Parks and transports Middle School	Access to public transports	0.263%	0.000%	0.083%	0.046%	0.062%	0.146%	0.130%	1%
gardens	City Center	0.573%	2.832%	0.287%	0.281%	0.181%	0.001%	0.000%	4%
Primary School	Middle School	0.603%	1.004%	0.412%	1.587%	1.052%	0.082%	0.066%	5%
Nursery	Pharmacies	1.487%	0.017%	0.218%	1.037%	2.028%	0.427%	1.004%	6%
Homitals	Primary School	0.526%	0.016%	0.261%	0.936%	0.623%	0.482%	1.832%	5%
Hospitals	Nursery	1.721%	0.523%	0.272%	0.648%	1.087%	0.034%	0.624%	5%
Cultural Services	Hospitals	1.598%	0.238%	0.515%	0.357%	0.180%	0.059%	0.138%	3%
	Cultural Services	1.153%	0.020%	0.273%	1.892%	0.600%	0.577%	4.005%	9%
Leisure Services Small-commercial	Small-commercial facilities	2.597%	0.643%	0.418%	0.686%	2.321%	0.027%	0.074%	7%
facilities	Kindergarten	0.831%	0.041%	2.092%	0.661%	1.014%	0.037%	0.072%	5%
Train Station Kindergarten	Train Station	0.945%	1.883%	0.715%	2.153%	3.929%	0.000%	0.035%	10%
	Leisure Services	6.148%	0.000%	0.165%	2.276%	1.388%	4.237%	7.207%	21%
	Medical centres	0.605%	0.003%	1.534%	0.118%	0.534%	0.420%	3.403%	7%
	Parks and gardens	0.746%	0.025%	0.324%	0.294%	0.352%	0.056%	0.151%	2%
	Shopping malls	3.133%	1.560%	0.456%	1.143%	1.131%	0.008%	4.314%	12%





Figure 3. Random Forest importance coefficients: construction features

3.3. Hedonic pricing model

A stepwise analysis is carried out as described in Figure 4 to identify the best regression equation. Simulation "E" leads to the final equation, which is summarized in Equation 2: The R-square is 79,21%, and all the regressors satisfy the significance test with p-value<0.05.

	Stepwise analysis																	
												•••						
			Simulation A			Simulation B			Simulation C			Simulation D			Sim			
	n.of regressors		14		12		9			7			5					
		Unit of measure selected per each regressor	t-studen	Coefficien	Keep	t-studen	Coefficien	Keep	t-studen	Coefficien	keep	t-studen	Coefficien	feet	t-studen	Coefficien	Keep	
	Constant			1997.10			1971.17			2010.66			2180.39			2010.47		
1	Area	Square meters	-5.21	-1.71	х	-5.22	-1.72	х	-7.03	-1.75	х	-6.97	-1.73	х	-6.94	-1.73	x	
2	Number of Rooms	Total number	-0.08	-2.16	х	-0.08	-2.21											
3	Energy Performance	Energy class from A4 to G	22.33	149.47	х	22.45	149.55	х	22.46	149.46	х	22.30	148.12	x	22.14	146.84	×	
4	Hospitals	Straight line distance	-1.18	-99.94	х	-1.17	-98.37											
5	Leisure Services	N. in a 1 km ring buffer	-1.55	-1.80	х	-1.56	-1.79	х	-1.79	-2.03								
6	Cultural Services	N. in a 1 km ring buffer	5.04	12.78	х	5.16	12.67	х	5.30	12.98	х	13.32	8.14	х	13.04	7.58	×	
7	Medical Centers	N. in a 1 km ring buffer	-0.18	-0.57														
8	Pharmacies	Travel time by public transport	1.63	12.87	х	1.64	12.92											
9	Primary School	N. in a 1 km ring buffer	-2.63	-53.31	х	-2.66	-53.62	х	-2.95	-58.75	х	-3.67	-70.00	х				
10	Nursery	Straight line distance	-0.07	-6.07														
11	Shopping Malls	N. in a 1 km ring buffer	-3.48	-45.09	х	-3.53	-45.15	х	-3.28	-39.99	х	-4.61	-50.71	x	-4.75	-52.42	×	
12	Small Commercial facilities	Straight line distance	-2.28	-178.15	х	-2.34	-173.92	х	-2.23	-163.77	х	-2.15	-158.33					
13	City center	Actual travel distance by car	-3.60	-60.70	х	-3.77	-59.80	х	-4.20	-65.34	х	-5.22	-71.20	x	-7.41	-92.52	×	
14	Train Station	Travel time by public transport	1.17	2.94	х	1.27	3.06	х	1.26	3.04								

Figure 4. Regression stepwise analysis

100%

$Unitary \ Price = 2010.47 - (1.73 * Area) + (146.84)$	(2)
<pre>* Energy Performance) + (7.58 * Cultural Services)</pre>	
- (52.42 * Shopping Malls) - (92.52 * City Centre)	

4. Discussion and conclusions

The Random Forest analysis and the hedonic pricing model developed indicate that the most influential factors among the construction features are the area of the premise, the number of rooms, the energy performance level, and the maintenance conditions. As far as the building typologies are concerned, the most appreciated ones result to be the apartments and the multi-family villas. Among the location characteristics, the most impactful factors result to be the access to the train station, the proximity to commercial, cultural and leisure services, as well as to medical centres.

The hedonic pricing model points out that greater proximity to the city centre pro-10 duces greater market values (the higher the distance the lower the price). The number of 11 cultural services increases the market value of a building, producing higher quality of the 12 neighbourhood, and also the higher the energy performance the higher the market price. 13

In conclusion, this study has developed a unified procedure to understand processes 14affecting the demand preferences and price formation mechanisms in a specific Italian real 15 estate market, i.e. the city of Padova. In further development of this research-line, the ap-16 proach could be expanded to other cities in Italy, and also applied at different timings, so 17 as to produce a diachronic comparison spread out over the territory that is able to map 18 the willingness to pay for certain features of the buildings. 19

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