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WHAT: ENCOUNTER AND CONFRONTATION

THE URBAN LANDSCAPE AND THE REAL ESTATE MARKET. STRUCTURES AND FRAGMENTS OF THE AXIOLOGICAL TESSITURA IN A WIDE URBAN AREA OF PALERMO

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Abstract. *The proposed study deals with the urban landscape of Palermo and its possible representation from the perspective of the real estate market analysis. Real estate is one of the most significant types of capital asset and the wide range of its possible utilizations makes complex the interpretation of the market phenomena. The multi-layered reality of such a large city (represented through the sample of 500 properties) needs to be articulated into a significant set of sub-markets in order to outline the complexity and to map the distribution of homogeneous groups of properties within the whole city area. The comparison between quality and price within each cluster allows us to elicit the degree of consistency or complexity of each group, especially taking into account the location (spread/concentration) of the properties. The relationship between prices and landscape quality has been traced as well.*

Keywords: *Urban landscape, Real estate market, Data mining, Cluster analysis, Urban regeneration.*

1. Introduction

The methodologies of analysis of the complex socio-economic phenomena as well as those hyper-complex, which concern the formation of the real estate in the multiform and multilevel context of the great cities, move towards applying models of data-mining or big data management. In the last years these tools have achieved a notable impulse especially because of the spreading of a probabilistic and inductive approach to investigate the reality that is found on the idea that the complexity is ungovernable and there are several variable that can contribute to the prices forming, especially where markets are failed and poorly transparent (Breuer and Nadler, 2012).
On the one hand these methodologies - and the approaches or epistemologies subtending them - allow to see what is not clearly evident, and, on the other they make a curious fragmentation and abstraction of the reality, representing it through indexes, and the dematerializing of the connections among its parts towards, however, to achieve a methodological unifying (Gabrielli et al., 2015).

This is the direction followed by this study concerning the urban landscape and the real estate market in Palermo, whose analysis is conducted on a sample of 500 data directly collected in 2014 in ten urban districts.
A cluster analysis technique is applied with the intention of over look, using the standardized analysis of the properties characteristics, the urban landscape with the aim of highlighting its degree of complexity and the qualitative articulation, comparing the most coherent grouping in statistic sense to the subdivision in districts (Giuffrida et al., 2015).
The proposed study holds the heuristic perspective of the knowledge of the city by the point of view of the values, and it consider the real estate market a particularly effective informative source for reading the social behaviours subtended to the real estate investment because they allow to understand to what extend and with which sense the urban landscape can constitute a meaningful component of the urban localization pattern.
In a scenario of complex and different phenomenology of the real estate, that shows messy and impulsive reactions to the long tide of the current economic-financial crisis, this study is inserted in a general approach to the notion of capital that, in its urban real estate declination, always exhibits unexpected aspects oscillating between panic and euphoria in the gap that separates ask-price and bid-price (Giuffrida, 2012).

2. Urban landscape

The landscape is a uni-duality representation/construction of the world that is subjected to continuous transformations under the pressure of the cultural mutations of the social system (Dematteis, 1989; Turri, 1990). The landscape is, therefore, the final result of the way that has a society to live and to modify the reality but, once it is produced it becomes the new symbolic reference for the following modifications that it can contains the extension of undifferentiated places that produce spatial disarray and the destruction of the topophilia resulting from the homologation of the differences (Turri, 1990; Bianchi and Perussia, 1988; Jameson, 1991). This tension between perception and action is manifested with particular intensity in the second half of the nineteenth century when the “Great Transformation” (Polanyi, 1944; Turri, 1990), consequent to the deep social, economic and political changes, has radically modified the urban landscape.
During this period, in the city of Palermo the historical centre has been abandoned and afterwards it has been partially restored through gentrification (Napoli, 2007a; Bonafede and Napoli, 2015), the districts developed on the northern line of expansion become central districts with high urban and architectural quality and, the semi central districts (founded in the nineteenth-century) have been saturated by new buildings, while in the peripheral areas the

pattern texture of the rural villages has been distorted from the construction of high multilevel buildings. The mixture of the location qualities of the places and very diversified architectural and technological characteristics of the buildings has formed a complex and multiform urban landscape. The market values of the real estate, that are readjusted themselves after the sub-prime mortgage crisis in 2007, as key for reading and interpreting the urban landscape quality in ten districts (Fig.1): 1. Settecannoli-Brancaccio, 2. Oreto-Stazione, 3. Tribunali-Castellamare, 5. Montegrappa-S.Rosalia, 6. Cuba-Calatafimi, 7. Zisa-Noce, 8. Politeama, 9. Libertà, 10. Malaspina-Palagonia, 11. Resuttana – S. Lorenzo. The districts 8 and 9 are central; the district 3 is a part of the historical centre; districts 2, 5, 6,7 and 10 are mid-central; districts 1 and 11 are suburbs, although the first one -located in the southern part of the city- is a working-class district whereas the middle-class is outnumbered in the second one.

Figure 1. **Map of the ten analysed districts of Palermo**

3. The sample

The analysed real estate sample includes 500 properties located in ten districts of Palermo and described by $h = e, i, t, a$ features k_h, including 26 characteristics k_{hi} (i varies for each group): k_e *location* (*urban*: centrality k_{e1}; functional complexity k_{e2}; social complexity k_{e3}; facilities k_{e4}; accessibility from the outside by public k_{e5}; and private transportation k_{e6}; internal accessibility k_{e7}; *micro-contextual*: functionality k_{e8}; symbolic quality; settlement quality k_{e9}; societal mix k_{e10}); k_i *intrinsic* (view k_{i1}; overlooking k_{i2}, brightness k_{i3}, exposure k_{i4}; security k_{i5}); k_t *technological* (age k_{t1}; building maintenance status k_{t2}; building structure k_{t3}; building finishes k_{t4}, property maintenance, k_{t5}); k_a *architectural* (*building*: architectural type k_{a1}; super elevations k_{a2}; floor k_{a3}; terraces k_{a4}; *property*: size and functional adequacy k_{a5}; accessories

k_{a6}; property finishes k_{a7}) (Forte, 1968). Each k_h is the weighed average score of the correspondent i

$$k_h = \sum_i k_{hi}\, c_{hi}; \qquad \sum_i c_{hi} = 1$$

where: the weight c_{hk} measures the relative importance of each k_{hi} within each of each group and k_h ranges from 1 (low quality degree) to 5 (high quality degree).

identification				dimensions								characterization										
				rooms				area														
id	address: street	address: n.	floor	main rooms	large kitchen	facilities	total rooms	inner surface area	outer surface	total surface	garage	renovation data	ke	ki	kt	ka	rooms	area (sqm)	ask price	overall quality	price per room	price per sqm
1	Brancaccio	56	1	2,0	1,0	1	2,8	45	3	46		2004	1,35	1,60	3,17	2,10	2,8	46	€ 30.000	2,40	€ 10.909	€ 656
2	Brancaccio	74	0-1	2,0		1	2,3	60	0	60		2007	1,35	1,60	4,67	2,10	2,3	60	€ 37.500	3,08	€ 16.667	€ 624
3	Brancaccio	76	1	2,0		1	2,3	46	2	47		2003	1,35	1,60	3,93	2,30	2,3	47	€ 39.000	2,79	€ 17.333	€ 839
4	Alduino de Candi	12	3	2,0		1	2,3	45	1	45			1,35	3,00	2,70	2,28	2,3	45	€ 60.000	2,72	€ 26.667	€ 1.326
5	Cortile La Rocca	8	0	2,0	1,0	1	2,8	60	9	62			1,35	3,00	2,70	2,30	2,8	62	€ 63.000	2,72	€ 22.909	€ 1.012
6	Brancaccio	41	3	3,0	1,0	1	3,8	65	1	65			1,35	3,60	2,70	1,80	3,8	65	€ 90.000	2,84	€ 24.000	€ 1.379
7	Maione da Bari	60	1	3,0		1	3,3	90	15	94			1,35	3,60	2,70	2,20	3,3	94	€ 95.000	2,92	€ 29.231	€ 1.013
8	Brancaccio	74	2	2,0		1	2,3	65	0	65		2008	1,35	1,60	4,70	2,10	2,3	65	€ 50.000	3,09	€ 22.222	€ 768
9	Azolino Hazor	59	5	4,0	1,0	1	4,8	125	7	127			1,07	4,40	2,70	2,17	4,8	127	€ 98.000	3,19	€ 20.632	€ 773
10	Sarmiento	8	5	4,0	1,0	1	4,8	125	11	128	2		1,35	4,40	2,70	2,17	4,8	128	€ 109.000	3,19	€ 22.947	€ 853
11	via conte federico	190	3	4,0	1,0	1	4,8	75	106	86		1994	1,07	4,40	2,83	3,03	4,8	86	€ 65.000	3,42	€ 13.684	€ 759
12	via conte federico	241	0	1,0	1,0	1	1,8	43	0	43		2010	1,07	2,20	3,17	2,34	1,8	43	€ 44.000	2,66	€ 25.143	€ 1.023
13	via emiro giafar	193	6	3,0		1	3,3	91	19	96		2012	1,07	4,40	4,83	2,24	3,3	96	€ 115.000	4,16	€ 35.385	€ 1.201
14	via emiro giafar	104	9	3,0	1,0	1	3,8	100	21	105	2	2006	1,07	3,80	2,63	1,98	3,8	105	€ 210.000	2,91	€ 56.000	€ 1.993
15	via conte federico	178	3	3,0		1	3,3	110	7	112	2		1,07	4,40	2,10	2,20	3,3	112	€ 140.000	2,93	€ 43.077	€ 1.254
16	cortile chiazzese	0	0,5	2,0	1,0	1	2,8	76	42	87	2		1,27	2,20	2,70	2,65	2,8	87	€ 105.000	2,51	€ 38.182	€ 1.214
17	via mariano camp	48	6	2,0	1,0	1	2,8	72	4	73	2		1,07	3,60	2,70	2,28	2,8	73	€ 75.000	2,93	€ 27.273	€ 1.027
18	vi azolino hazon	1	7	3,0	1,0	1	3,8	115	24	121	2		1,07	4,40	2,70	2,20	3,8	121	€ 125.000	3,20	€ 33.333	€ 1.036
19	via brancaccio	73	0_1	2,0		1	2,3	70	3	71			1,35	3,60	3,50	2,32	2,3	71	€ 37.500	3,30	€ 16.667	€ 530
20	via brancaccio	75	0_1	2,0	1,0	1	2,8	55	6	57			1,35	3,00	3,90	2,52	2,8	57	€ 39.000	3,31	€ 14.182	€ 690
21	via brancaccio	56	2	2,0	1,0	1	2,8	54	3	55			1,35	1,60	1,10	1,70	2,8	55	€ 30.000	1,39	€ 10.909	€ 547
22	via funaioli gino	11	4	3,0	1,0	1	3,8	114	16	118			1,75	2,20	2,70	2,20	3,8	118	€ 135.000	2,43	€ 36.000	€ 1.146
23	via azzolino hazo	57	11	3,0		1	3,3	104	57	119		2001	1,07	4,40	4,47	3,25	3,3	119	€ 115.000	4,20	€ 35.385	€ 970
24	largogiuliani	1	2	4,0	1,0	1	4,8	112	12	115	1		1,07	4,40	3,50	2,43	4,8	115	€ 140.000	3,60	€ 29.474	€ 1.220
25	via mariano camp	17	9	3,0	1,0	2	4,0	95	38	105			1,07	2,80	3,50	3,10	4,0	105	€ 100.000	3,18	€ 25.000	€ 955
26	via albricci alberi	4	2	3,0		1	3,3	122	3	123			1,27	3,60	4,10	2,62	3,3	123	€ 150.000	3,63	€ 46.154	€ 1.221
27	via pino puglisi	40	9	3,0		1	3,3	114	15	118		2011	1,35	3,60	4,00	2,80	3,3	118	€ 125.000	3,62	€ 38.462	€ 1.063
28	via sperone	204	2	2,0	1,0	1	2,8	59	1	59		1994	1,27	2,20	2,03	2,32	2,8	59	€ 30.000	2,15	€ 10.909	€ 508

Figure 2. **Sample of the database**

Figure 2 shows a part of the whole database with the main quantitative and qualitative characteristics of the properties: total and unit price, partial and overall weighed score:

$$k_h = \sum_h k_h\, c_h; \qquad \sum_h c_h = 1$$

k_h allows us to display the relationship between unit price and overall quality (fig. 3, 1st graph); the distribution of price is more unequal than the distribution of scores (fig. 3, 2nd graph), that is a measurement of the distance between monetary and real variables, that typically characterizes in a semiotic sense such a complex market in which prices vary differently than values; the same analysis we carried out in order to compare the distribution of the four characteristics, showing how the environmental-architectural score distribution is more unequal than the others (fig. 3, 3rd graph); at last, the Lorenz curves and the correspondent Gini indexes of all the variables (fig. 3, 4th graph) confirm that the most unequal distribution are price ($G = 0{,}304$), and architectural quality ($G = 0{,}227$).

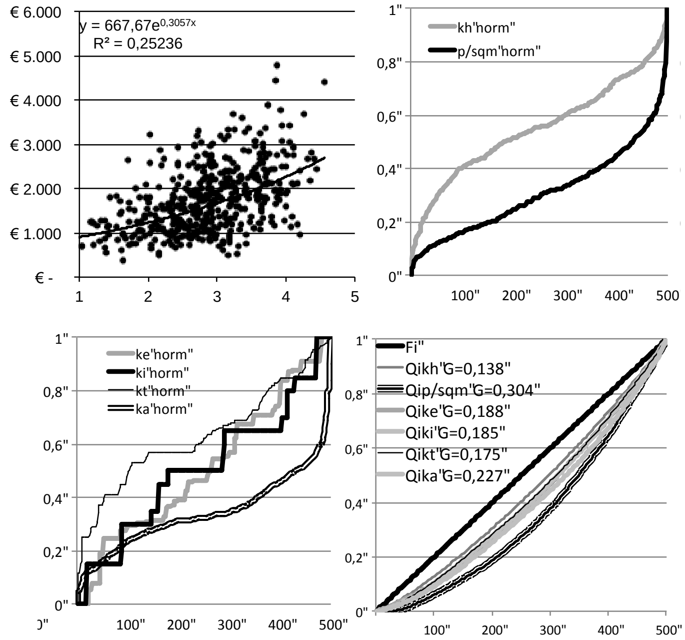

Figure 3. **Complexity measures of the database (1st) unit price/overall score; (2nd) unit price/overall score distributions; (3rd) score distributions of K_h; (4th) Lorenz curves and Gini indexes of unit price, overall and partial scores)**

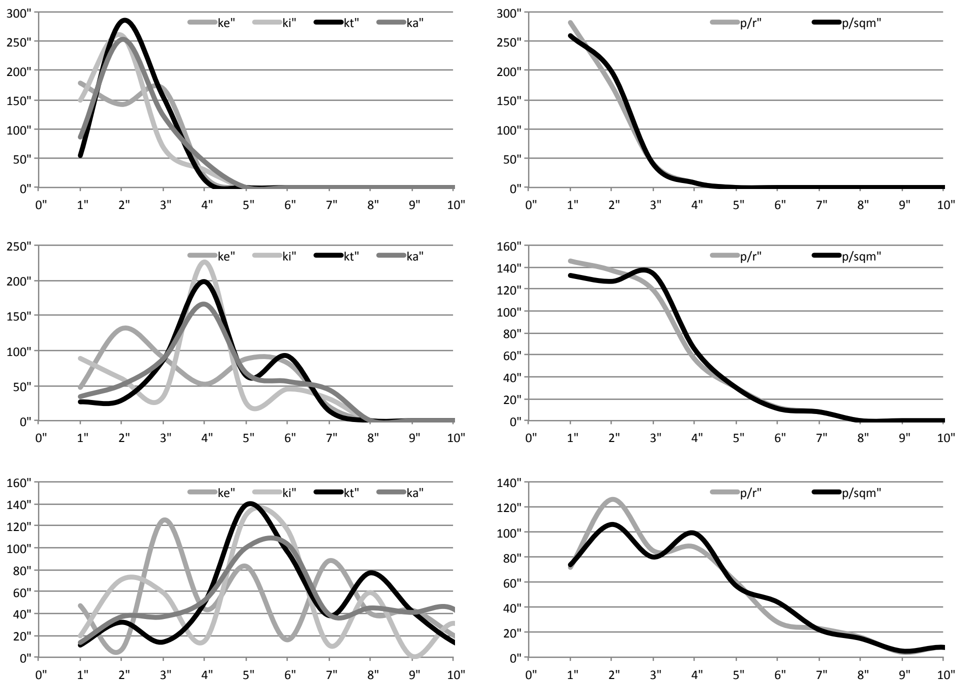

*Figure 4***. Sample distribution function of four partial scores and unit prices for tree (1st and 2nd graphs), six (3rd and 4th graphs) and nine classes (5th and 6th graphs)**

A further analysis about the articulation of this real estate market sample concerns the frequency of the four partial scores and the unit prices (per sqm and per room) that shows a progressive increasing of the irregularity of the distribution function for tree, six and nine classes (fig. 4). A further remark concerns the distribution of prices that shows a decisive prevalence of low prices and a remarkable asymmetry of the function towards the high value classes.

4. Method

Within a large and heterogeneous urban area it is possible to define a consistent articulation in sub-markets by using many different data-mining procedures. They are helpful to represent similitudes between objects that are described by a standardised set of characteristics they share. The k-mean procedure we applied to this dataset, belongs to not hierarchical methods,

Not hierarchical algorithms. Not hierarchical algorithms give as output only one partition of items, instead a hierarchy of partitions, which is obtained through the hierarchical algorithms, and they are based on the assumption of dividing the elements of the sample in a predetermined number of groups (King, 2014; Everitt et al., 2011; Kaufman and Rousseeuw, 1990). After each routine, the partition obtained from the previous routine is modified in the successive routine until achieving a convergence so the partition is not subjected to further variations.

Due to the high computational cost, it is not expedient to proceed by determining all possible partitions and then choosing the optimal one that maximizes a certain objective function. In fact, for n distinct observations, the number of possible partitions is $2^{(n-1)} - 1$ (i.e. for n=7, p=63). The number of partitions can be reduced through the initial choice of the groups' number of the partition and, subsequently, the optimal partition can be obtained –among all those that have the number of groups chosen– through a criterion depending on the applied algorithm.

K-means algorithm. The k-means algorithm is a not hierarchical aggregative algorithm, which forms k groups using some values as initial centres and placing the elements in the groups on the basis of the maximum proximity to the centres (proximity is measured in the Euclidean metric). After obtaining the first partition, the new centres are recalculated. It proceeds iteratively until each element is assigned to the same group in the previous partition. When this condition is checked, there will be convergence (each new partition will always be equal to the previous one) and has reached the optimal partition (Steinley, 2003 and 2006).

The *k-means algorithm* can be summarized in the following steps:

Step 0 - Initialization. k "*temporary centres*" are chosen (the choice may be random or guided by an empirical criterion).

Step 1 - Construction of the partition and determination of the new centres. Each

item of the sample is assigned to a centre (the one which minimizes the Euclidean distance from it). So k groups of items arise. For each assignment of a new element to a group, it is calculated the centre of this group.
Step 2 - Identification of the new partition. The process of allocating items to the groups on the basis of minimum distance from the centres is repeated. Then it returns to step 1.
Step 3 - Verification of the partition. If the partition constructed in the step 1 is the first partition or it is equal to the previous partition, go to step 1, otherwise go to step 4.
Step 4 - Stopping procedure.
The *k-moving means algorithm* is a variant of the K-means one. In this case, for each allocation of an item in a new group, it is recalculates the mean of the group.
Steps 0 and 1 - Same as *k-means algorithm*.
Step 2 - Identification of the new partition. The process of allocating items to the groups on the basis of minimum distance from the centres is repeated. Unlike the k-means algorithm, for each assignment of an item to a new group, it will proceed recalculating the mean of the group. So the step 2 is iterated until every item is assigned to a group. Then it goes to the successive step.
Steps 3 and 4 - Same as k-means algorithm.
The convenience of this algorithm over the k-means method is a greater and faster settlement of clusters around the centres, which become increasingly representative of the elements that form the cluster itself.
The iterative procedure underpinning the k-means algorithm has some problematic aspects, regarding the choice of the initial centres and the number of groups G.
Choosing the initial centres. The choice of the initial centre is the starting point from which it begins the search for the final partition that can be considered a satisfactory solution. The most obvious approach is the random selection of the centres. Otherwise, the analysis can be performed many times and the final partition will be the more consistent one respect to the information in the data set resulting from cognitive domains, which are different from the merely statistical ones. In this study we have proceed letting the software (IBM SPSS) choose the initial centres. If there aren't specific indications about the initial centres, this software chooses them among the items of the sample through an internal algorithm so that they are well spaced.
Number of the groups. If this information is not available a priori on the basis of the information about the dataset, then the procedure several can be applied several times by varying g ($g = 2,3,\ldots$) and choosing the value of g corresponding to the best partition. To make the best choice, we have adopted a statistical index, the Calinsky-Harabasz index (Milligan and Cooper, 1985; Yanchi, 2010), which gives us information on the best partition in terms of maximizing the external heterogeneity among groups and the internal

homogeneity for each group. It is defined in the following way:

$$\frac{B(g)/g-1}{W(g)/n-g}$$

Where:

$$B(g) = \sum_{i=1}^{g} d(\bar{x}_i, \bar{x})$$

$$W(g) = \sum_{i=1}^{g} \sum_{j:x_j \in C_i} d(x_j, \bar{x}_i)$$

$\bar{x}_i$ is the mean of the observations belonging to the i-th cluster C_i, $\bar{x}$ is the mean of the entire sample, d is the Euclidean metric, n is the total number of the observations. Obviously, the more growing this index is, the more goodness of the partition improves because it represents the ratio between the external variance and the internal variance of the partition.

5. Results

The application of the not-hierarchical algorithm gives as result that nine clusters is the best partition, which corresponds to the highest value of the Calinsky-Harabasz index. Some remarks can be made on the basis of the cluster characteristics (Fig. 5) and the spatial distribution of each cluster data (Fig. 6).

		Overall	Clusters								
		sample	1	2	3	4	5	6	7	8	9
ke	mean ke	2,90	2,35	3,45	2,66	2,54	2,38	3,95	2,30	1,36	1,40
	deviation (from mean of sample)		-0,55	0,55	-0,24	-0,36	-0,52	1,05	-0,60	-1,54	-1,50
	deviation %		-19%	19%	-8%	-12%	-18%	36%	-21%	-53%	-52%
	standard deviation	0,97	0,65	0,77	0,58	0,74	0,40	0,44	0,62	0,50	0,33
	standard deviation %	34%	28%	22%	22%	29%	17%	11%	27%	36%	24%
ki	mean	3,04	1,66	3,33	2,77	1,89	3,25	3,75	3,68	4,29	2,39
	deviation (from mean of sample)		-1,38	0,29	-0,25	-1,15	0,21	0,71	0,64	1,26	-0,51
	deviation %		-45%	10%	-8%	-38%	7%	23%	21%	41%	-18%
	standard deviation	1,02	0,49	0,66	0,38	0,41	0,33	0,72	0,57	0,50	0,47
	standard deviation %	33%	29%	20%	14%	22%	10%	19%	15%	12%	19%
kt	mean	3,02	1,40	1,57	1,85	4,22	2,85	3,49	4,30	2,82	2,95
	deviation (from mean of sample)		-1,62	-1,45	-1,19	1,21	-0,17	0,47	1,28	-0,19	0,05
	deviation %		-54%	-48%	-39%	40%	-6%	16%	42%	-6%	2%
	standard deviation	0,99	0,50	0,50	0,42	0,38	0,39	0,70	0,35	0,35	0,42
	standard deviation %	33%	36%	32%	23%	9%	14%	20%	8%	12%	14%
ka	mean	2,29	1,78	2,13	2,09	2,50	2,13	2,52	2,67	2,31	2,26
	deviation (from mean of sample)		-0,51	-0,17	-0,21	0,20	-0,17	0,22	0,37	0,02	-0,63
	deviation %		-22%	-7%	-9%	9%	-7%	10%	16%	1%	-22%
	standard deviation	0,46	0,30	0,39	0,28	0,32	0,31	0,46	0,44	0,35	0,33
	standard deviation %	20%	17%	18%	13%	13%	15%	18%	17%	15%	14%
price per sqm	mean	1.758	1.114	1.745	1.370	1.799	1.459	2.401	1.895	1.158	1.094
	deviation (from mean of sample)		-644	-12	-387	41	-299	643	137	-600	-663
	deviation %		-37%	-1%	-22%	2%	-17%	37%	8%	-34%	-38%
	standard deviation	731	434	585	510	674	475	624	636	358	338
	standard deviation %	42%	39%	34%	37%	37%	33%	26%	34%	31%	31%

Figure 5. **Cluster characteristics**

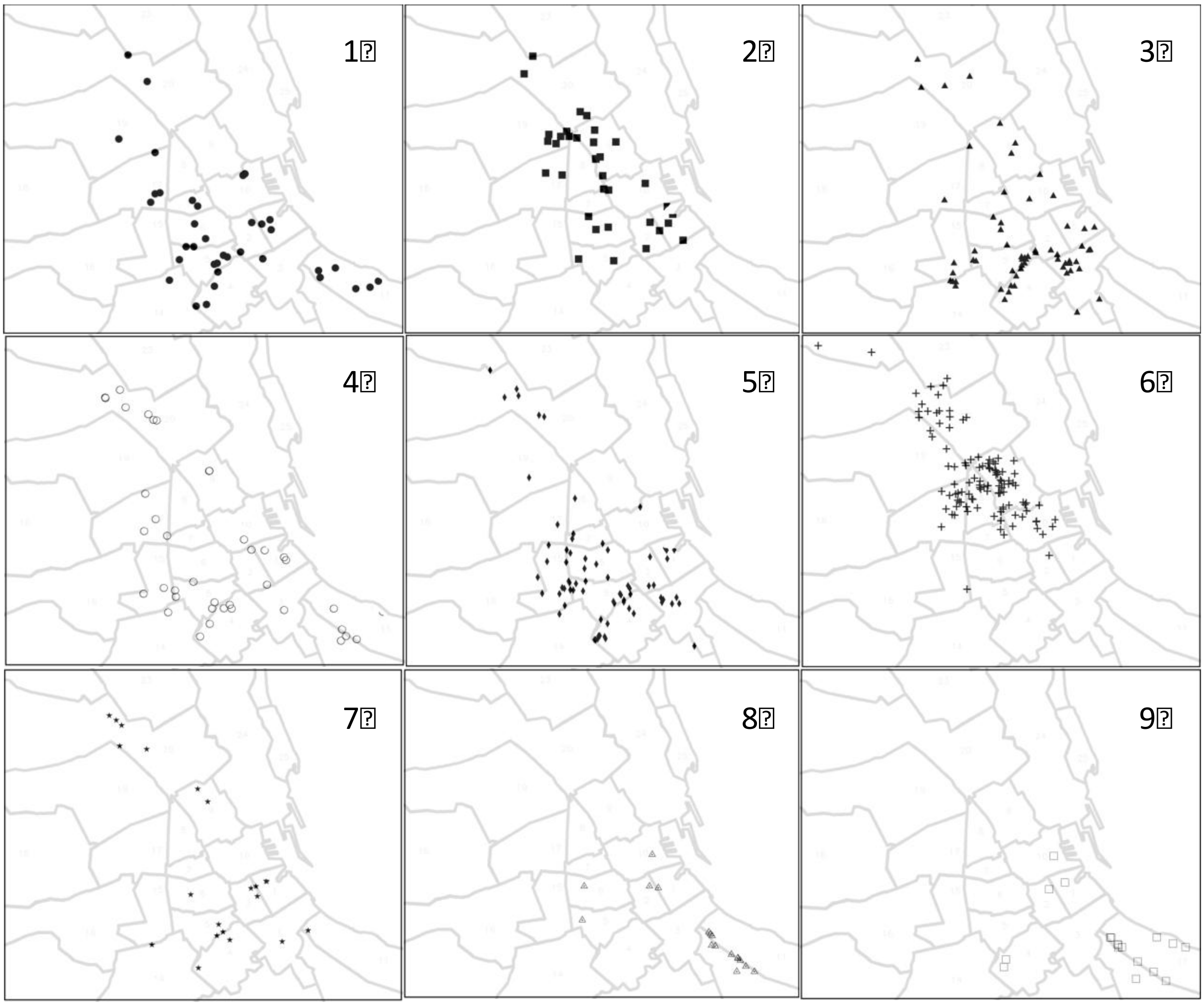

Figure 6. **Data spatial distribution of the nine clusters**

Cluster 1 puts together properties located both in central and mid-central districts and having different quality degree of the urban land. In this cluster, every value of k_h is lower than the corresponding mean of the sample, especially for the k_i and k_t because the technological and intrinsic characteristics are strongly bad. As a consequence, the average value of price is almost the lowest among other clusters and the prices are scattered around the means (standard deviation is equal to 39%).

In cluster 2 the data location of the data, whereas the technological characteristics are not very good, as result the mean price is equal to the mean price sample nevertheless a significant value of standard deviation.

Cluster 3 is similar to cluster 1, but their k values and price are just under the means except the k_t value that is higher.

The data of cluster 4 are located over a wide area (from central districts to suburbs) and their dispersion is almost high, otherwise they have a high level of technological characteristics quality as well as the architectural ones. The mean price is very close to the mean sample price.

Cluster 5 is similar to 3 for k_i, k_a and prices, otherwise k_e is worst (because data

are only located in mid-central areas), and k_t is less negative than in cluster 3.
Cluster 6 is a homogenous group of properties. The overall level of quality is high to be every k values above the means. Because of the properties concentrated in the central districts, the quality of the location k_e is high and homogeneous, and its standard deviation is the smallest one (11%). Nevertheless other characteristics go over the mean, prices vary strongly and their standard deviation is the highest (26%) of this cluster.
Cluster 7 is similar to cluster 4 even there are differences regarding k_e (it is worst), k_i (it is strongly better), and k_a (it is better).
Cluster 8 has the highest dispersion degree of the location of the sample and the lowest k_e mean. Nevertheless the most data are located in the same district, which is a suburbs, a high standard deviation notices that the quality of this urban areas is irregular. In fact, the land uses includes factories, storages, and transportation infrastructure, which fragment and interfere with the residential use. Nevertheless the intrinsic characteristics are good, the prices are very low and variable.
Cluster 9 is similar to cluster 8, but k_i and k_a are worst, so that the mean price is the lowest in the sample.
Applying the Cluster Analysis to urban estate market has shown that it is possible to represent the complexity of urban landscape through submarkets (clusters) forming the monetary shape of the city (Napoli, 2007b). Although clusters are composed of comparable properties, their characteristics have a significant degree of variability, which depends on the urban spatial pattern, on the barely homogeneous urban growth, as well as on the technological and architectural characteristics of the buildings constructed in different ages. Furthermore, prices have a larger variance than k, and it points out that the market, which is under continuous external and internal fluctuations, makes floundering translations of real estate characteristics in price.

Summary

The study proposed the real state analysis as a key for representing the complexity of urban landscape through a sample of 500 properties directly collected in ten districts of Palermo and articulated in submarkets. The sample was described through prices and twenty-six characteristics, and their distribution was analysed by Lorenz curves and Gini indexes.
The application of the Clustering Analysis allowed to us to outline the multilevel urban landscape and to map the spatial distribution of the properties belonging to clusters within the whole city area. Applying not-hierarchical algorithm and adopting the Calinsky-Harabasz index, the best partition of the sample was nine clusters, each of them representing a different mixture of the variable degree of quality depending both on the localization pattern and technological and architectural characteristics.
A significant standard deviation of price, which is higher than the ones of every k, shows that the real estate market makes floundering and irregular translation of characteristics in price, while the predominance of low prices in the local market proves that the economic crisis

prevent the rice of prices even when the property characteristics are good.

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