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The empirical experience for a comparison between land value and market value: the case of Milan

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Abstract The project evaluates the quality of the cadastral classification of the city of Milan determined by an index of the deviation between the value of the land and the most likely market value of immovable property. The processing was done on the whole building cadastral ordinary stock (categories A0* and C0*) consisting of more than 1,200,000 urban immovable properties. The determination, for each unit of urban real estate, of an index and of the relative value of its deviation was able to provide the model for a wide and detailed analysis that was useful for the definition of local tax policies and interventions aimed at the attainment of fiscal equalization. The geographical distribution of the index and the possibility to represent the data for different areas such as buildings, building complexes, blocks, neighbourhoods, regions or areas selected independently are, therefore, also particularly interesting.

INTRODUCTION

This study aims to verify and quantify the variation between the cadastral value of individual immovable urban units (UIUs) and the most likely market value of these same units calculated on the basis of data published by the Observatory of the Housing Market (Osservatorio del Mercato Immobiliare, OMI).

In order to be able to monitor the state of the real estate market the OMI, by means of the Inland Revenue Agency – Office of the Territory (formerly the Agency of the Territory), divided the city in 55 areas (**Figure 1 – A breakdown of Milan in Microzones OMI**) with homogeneous characteristics (Microzones) and estimated for each area the most likely market values of the individual units by type and according to their finish.

The Observatory of the Housing Market, by means of the sampling of real estate transactions that took place in a homogeneous areas (Microzones), determines the minimum and maximum market values of different building types that constitute the urban building stock. These values are published semi-annually and help to monitor the reference housing market by providing a picture of trends in market values of immovable properties in the city.

The determination and quantification of the variation in fact establishes the degree of the quality and of the reliability of the cadastral value of building stock falling within the bounds of the Milanese territory.

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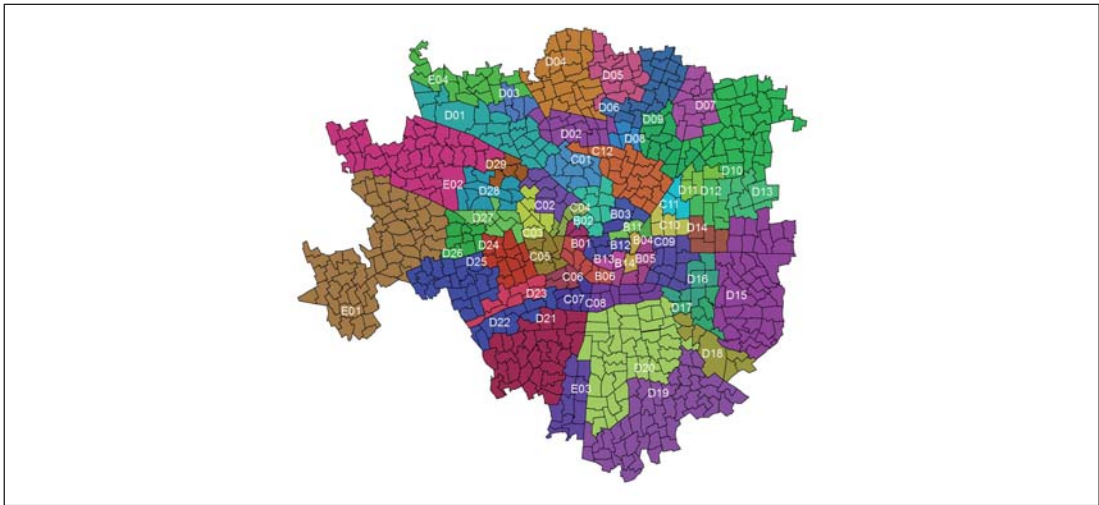
** Milan City Council – Service Manager – Central Unit for Revenue and Fight against Tax Evasion – Service – Territorial Information System and Place Names

*** Milan City Council – Service Manager – Central Unit for Revenue and Fight against Tax Evasion – Service – Cadastral Surveying

The need to implement a thorough and balanced Reform of the National Cadastre is today a fundamental need to “adjust” or at least to reduce existing inequalities and to have in place a fair and proper tax base.

It is only possible to overcome the parameters that are used to prepare estimates (space, sq metres, cubic metres) by the help of a new alignment mechanism, the adjustment and the application of algorithms that bring economic optimization within the boundaries of fairness for cadastral purposes. In fact, for ordinary cadastral categories,¹ complex procedures have to be drawn up in order to have available information that relates to the area of every immovable property and consequently also update the corresponding cadastral value.

Figure 1 A breakdown of Milan in OMI Microzones



This study emphasizes the territorial boundaries, cadastral categories and classifications that provide an index for the division of land that is determined by a variation in value that rises or falls in relation to cadastral values and estimated economic values.

The overview provides a picture of the urban cadastral classification that does not show the extensive and deep urban changes that in the last decade have contributed to an increase in the widening of the limits of the current microzones and brought to the fore the need to intervene in a timely manner on the complete reorganization of cadastral microzones and, in some cases, even to abandon them.

Successive paragraphs describe the methodological concepts that have been applied, a summary of the processing, the results and the conclusions of the empirical experience, highlighting the ability of a timely return of information through the use of geographical software.

The Territorial Information System (Sistema Informativo Territoriale, SIT) of the Milan City Council, under the responsibility of the Central Unit for Revenue and Fight against Tax Evasion, in close collaboration with the Focal Point for Cadastral Services (Servizio Polo Catastale), developed an extensive set of data to provide the Administration with a tool for urban verification and to ascertain in detail the degree of the quality of the classification of the urban cadastral building stock.

¹ Group A, B and C, Royal Decree – Law 13 April 1939 n. 652.

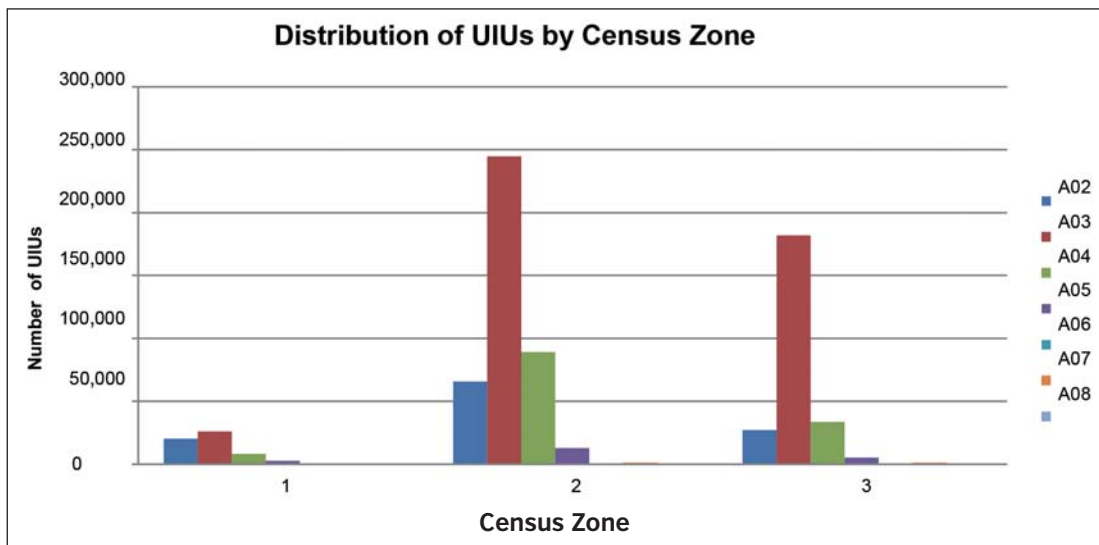
In order to carry out a study of the characteristics of land classification in Milan to determine its quality indicators and the actual deviation from the line of demarcation of cadastral equalization and fiscal consequences, the first line of approach of the following study examined some types of cadastral categories² that will be the subject of the procedure called A). With regard to other immovable urban units that are always included in the ordinary cadastral category, the methodology that was applied is described in the procedure denominated B).³

This distinction was in fact rendered necessary because of the availability of different benchmarks and the non-homogeneous characteristics of the cadastral categories involved.

AN EMPIRICAL APPROACH FOR A COMPARISON BETWEEN LAND VALUE AND MARKET VALUE

The study that was carried out covered the entire cadastral building stock falling within ordinary cadastral categories and involves about 1,200,000 building units that were surveyed (Diagram 1 – distribution of UIUs by Census Zone).

Diagram 1 Distribution of UIUs by Census Zone



In order to have a representative sub-sample, errors were taken into account while UIUs with no useful reference to the procedural process were eliminated.

The next step was to process the allocation of Microzones to UIUs falling in the same zones and to define the sub-sample that was the object of the study.

Determination of the cadastral value

The determination of the cadastral value of individual immovable urban units follows instead a mere calculation of the revaluation coefficients that vary according to the Cadastral Category bestowed upon the property upon being measured and/or any variation.

² Cadastral categories: A02, A03, A04, A05, A06, A07, A08.

³ Cadastral categories: A10, C01, C02, C03, C04, C06, C07.

Estimate of the cadastral value

The cadastral value is determined on these valid UIUs with the following formula:

$$\text{VALCATUIU} = [\text{RENDITA}] * 1,05 * 100^4$$

Where

- VALCATUIU is the revalued cadastral value
 - RENDITA is the amount of the surveying tariff related to the class and cadastral category
 - 1,05 is the revaluation coefficient for the purpose of ICI
 - 100 is the revaluation factor for the determination of the actual taxable cadastral assessment
- for a total value of Euro **54,152,762,428.70**;
 - for an average value of Euro **75,180.63**;
 - for a total surface area of **62,004,960.01** m²;
 - an average UIU surface area of **86.08** m².

It was necessary to estimate the most probable market value, according to parameters available in OMI reference tables, of every single immovable unit according to the following steps:

Estimate of the most probable market value

Market value is based on economic value in terms of square metres; it was therefore necessary to assign to each individual urban unit (UIU) its relative surface area by applying the provisions of the Decree of the President of the Republic of 23 March 1998 Law No 138 “Regulation for a revision of census areas and of valuation fees applicable under Law No. 662 of 23 December 1996”.

Estimate of the OMI value

Value according to OMI parameters, with the following formula:

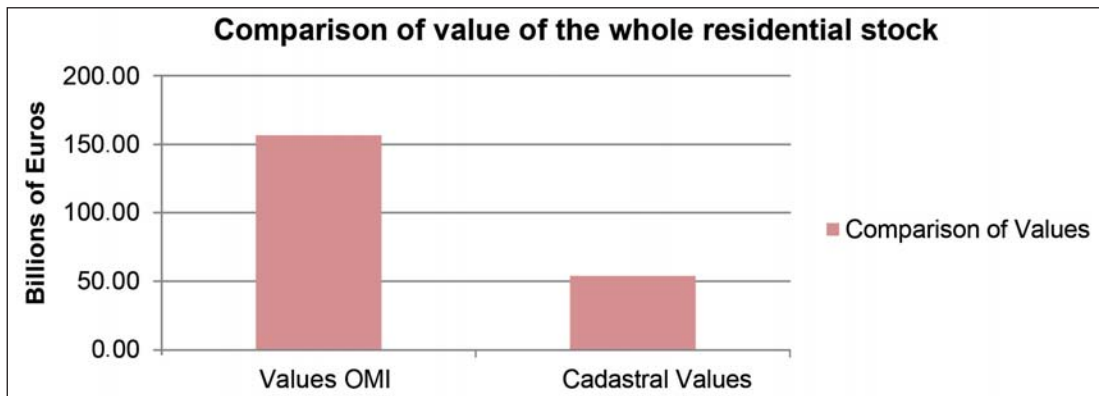
$$\text{VALOMIUIU} = [\text{SUDPR}] * [\text{VALOMI}]$$

Where:

- VALOMIUIU is the OMI value calculated in the secondo semestre of 2004
 - SUDPR is the surface area calculated in compliance with Law 138/98
 - VALOMI is the value in m² determined by the Microzone under reference
- for a total value of Euro **156,637,253,572.00**;
 - for an average value of Euro **217,460.53**;
 - for a total surface area of **62,004,960.01** m²;
 - an average UIU surface area of **86.08** m².

⁴ For immovable units falling within cadastral category A10 (Offices) the coefficient is equivalent to 50 while for cadastral category C01 (Shops and stores) the coefficient is equal to 34.

Diagram 2 Comparison of value of the whole residential stock



The methodology applied in this study conforms to the directives used by the Revenue Agency – Territorial Office (*Agenzia delle Entrate – Ufficio del Territorio*) and basically envisages for some types of immovable units the determination of a threshold index of a standard classification on the strength of which can be established whether a unit is above or below this classification.

The value of the threshold index is the relationship that exists between the most likely market value, calculated according to OMI values of the relative Microzone, and the Cadastral Value of the same urban property, calculated by applying the appropriate revaluation coefficients. The index threshold of this ratio is 3,⁵ in other words to maintain the equalization concept the most likely market value is three times the Cadastral Value.

The methodology (procedure A) applies to individual urban properties that fall in categories that can be defined as residential (A02, A03, A04, A05, A06, A07 and A08) while for other UIUs that are associated with other types (for example, offices, shops, garages, warehouses, etc.), the determination of the variation is done by means of another methodology (procedure B): in other words, there is a comparison between the classification (class assignment) in the real cadastral registration in the Cadastral Census and the classification expected for that territory provided by the Revenue Agency – Territorial Office. The deviation identifies the number of the classes of difference and consequently a different application of the estimated appraisal fee: the higher the difference in the classification, the higher is the determination of the differential between the actual effective land value and the estimated cadastral value.

Immovable urban units were developed without taking account of two factors that are currently known but are difficult to resolve in the process undertaken, namely:

- urban immovable units located in microzones and in sheets affected by “paragraph 335”;⁶
- urban property standing in border areas between the different census zones.⁷

To make results easy to read, standard indices were formulated that refer to the number of immovable

⁵ Application in Milan of Law No 311/2004, art. 1, paragraph 335 “Regulations for the compilation of the annual and the longer-term budget of the State – Financial Law 2005”.

⁶ Cfr.

⁷ On a purely indicative basis, these immovable properties are already subject to rules under “paragraph 335” while for those properties above census zones the compensation may cancel the effective reclassification and consequently the relative fluctuation of the classification expected for similar urban immovable property.

urban units that were under classified and those that were over classified; this index was therefore calculated as follows:

$$K = \frac{\text{Number of UIUs underclassified}}{\text{Number of UIUs overclassified}}$$

The K that was calculated was later normalized on the parameter of the resultant ranking from 1 to 55 (number of microzones).

The different interpretations refer to the calculation of the index K in the first instance on the total number of UIUs for a single microzone and then K_p is carried as a rebuilding of the index within the same cadastral category by the application of the following formula:

$$K_p = \frac{\text{Number of UIUs underclassified (Cadastral Category)}}{\text{Number of UIUs overclassified (Cadastral Category)}}$$

The following analyses were performed by making reference to the cadastral category. It should be noted, however, that from the Territorial Information System used it is possible, where appropriate, to carry out further processing by making reference to individual cadastral sheets or to individual buildings.

The extent of processing capacity that is required to enhance the study with the territorial component is evident in order to analyze and identify urban areas with the highest deviation and with heavy misalignments with the concept of equalization. It is therefore only by means of the use of geographical tools with a massive capacity for analysis (Geographical Information System) that it was possible to accompany the study with different methods of representation and restitution, increasing considerably the quality of the information that a traditional tabular representation is unable to provide.

Thanks to the processing tasks that were done, an analysis can be made on the feasibility of undertaking any eventual cycles for a wide-ranging review of the current classification of some local urban properties that show a deviation that is more or less remarkable when compared to the classification that is expected for the corresponding cadastral category and for the microzone where it belongs. Having completed the necessary assumptions and explanations, the technical results that emerged from the processing are listed below.

APPLICATION OF THE PROCEDURE

The verification of the classification covered 1,226,289 immovable urban units falling under an ordinary category, of which 720,302 properties fell under the residential category, with the exclusion of category B and of special categories (D and E) whose income is calculated directly by means of an estimate.

This is followed by reference to the course of the process regarding procedure A, that is by reference to urban residential immovable property.

Procedure A involved the following processing steps:

1. Description and cleaning of the sample (Cadastral databank - UIUs surveyed in categories A02, A03, A04, A05, A06, A07 e A08);
2. Attribution to each UIU of the microzone cadastral reference;
3. Definition of the sub-sample;
4. Calculation of the cadastral value of each UIU;

5. Estimate of the most likely market value of each UIU;
6. Calculation for each UIU of an index for the deviation between the cadastral value and the most likely market value;
7. Grouping of UIUs on the strength of the deviation index (threshold) and maps;
8. Timely analysis (geographical representation by category, by threshold and by building construction).

Step 1 – Description and cleaning of the sample.

The stages of standardization and selection of information focused on various tasks to reclaim and to verify so as to have available a database that can be as close as possible to reality. In fact the cadastral database suffers from a series of anomalies that greatly lower its matching value if no “cleaning” takes place. At the starting point several exercises took place to remedy these anomalies with a view to the elimination of inconsistencies or errors; and these steps can be summarized as follows:

STEP	Initial record	Final record	Variation
Starting record:	832,990	832,990	0
Elimination of ceased cadastre	832,990	829,424	3,566
Elimination of invalid sheets	829,424	829,420	4
Elimination of invalid categories	829,420	829,230	190
Eliminazione of invalid census zones	829,230	829,028	202
Eliminazione of invalid cadastral class	829,028	828,950	78
Elimination of UIUs with maps greater than the maximum allotment per sheet	828,950	825,695	3,255
Select query to scrap A10 cadastral category	825,695	783,857	41,838
Select query to scrap A01 cadastral category	783,857	781,359	2,498
Elimination of invalid amounts	781,359	781,057	302
Elimination of UIUs with surface areas DPR 138/98 = 0	781,057	726,322	54,735
Elimination of UIUs with relationship MQ/VANO inferior to 7m ² .	726,322	724,565	1,757
Elimination of UIUs with relationship MQ/VANO superior to 40m ² .	724,565	720,302	4,263
Total variations for errors		67,992 * (8,63% su 788,654)	
Selected total variations		44,336	

This processing still includes UIUs with maps that are less than the maximum mapping allotment per sheet but that are still surveyed in the ceased land registry and in a cadastral section that is invalid.

Each UIU was populated with a surface area that was calculated according to the criteria of Presidential Decree 138/1998. The data show a lack of information for UIUs that are standardized of 54,735 equivalent to 7.01% of the whole building stock in the cadastre in a residential category.

The next step consisted in the check of inconsistent surface areas that gave rise to a control field [MQVANO] that would eliminate and submit to a further adjustment inconsistent UIUs, most of which complain about an error regarding scale while these UIUs were being surveyed.

For greater caution the selection was made on the basis of ratio $m^2/space$ that is larger than $7m^2$ and less than $40m^2$.⁸

This phase yielded the following results:

TYPE OF INCONSISTENCY	NUMBER	CONTROL CODE
UIU with MQVANO < than $7 m^2$ and $\neq 0$	1,757	5
UIU with MQVANO > $40 m^2$.	4,263	3
UIU not negotiable SUDPR = 0	54,735	99
Valide UIU MQVANO > $7 m^2$ and < $40 m^2$.	720,302	1

The evaluations mentioned above result in two remedial approaches:

- the correction of surveying errors of the layout;
- a missing survey of a UIU renders null the subsequent surface area for the purpose of DPR 138/98.

At the end of the processing for the standardization of the data on the cadastral database, the representative sample of residential UIUs is composed as shown in the following Table:

Details by Census Zona of valid residential UIUs :

ZONE	A02	A03	A04	A05	A06	A07	A08	Total
001	20,158	26,116	8,358	2,627	0	21	4	57,284
002	65,817	244,679	89,236	12,817	0	1,041	40	413,630
003	27,230	181,843	33,720	5,277	152	1,165	1	249,388
Total	113,205	452,638	131,314	20,721	152	2,227	45	720,302

Step 2 – The allocation of a reference cadastral microzone to each UIU.

The association between cadastral microzones and UIUs was done with the assistance of geographi-

⁸ For this group the calculation must be made on the basis of the measurement of the various useful spaces, a theoretical measure, that is measured as follows:

- for every main place, provided with direct light, that conforms to hygienic standards, with a surface area that is larger than the minimum surface area that is envisaged for the category, for the purpose of art. 46 of D.P.R. 1142/49, this is considered as 1 useful space;
- for every kitchen having a surface area of at least $1 m^2$ with direct light, this is considered as 1 useful space;
- for every direct accessory: an entrance, corridor, utility room, bathroom, hallway and similar amenities as well as for each space with a surface area that is inferior to the minimum envisaged for the category – this is considered as 1/3 of a useful space;
- for every complementary accessory: basement, attic, farm building, chicken coop, shed, etc. – this is considered as 1/4 of a useful space;
- for places with ample dimensions that exceed the maximum of the category, the excess is calculated by dividing the surplus surface area by the maximum surface area of the main space;

In this regard, it should be noted that the minimum and the maximum surface areas in the municipalities of the province of Milan, net of external walls, are as follows:

- Category A/1 - A/8 - A/10: min. $10m^2$ max $30 m^2$;
- Category A/2 - A/3 - A/7: min. $9m^2$ max $27 m^2$;
- Category A/4 - A/5: min. $8m^2$ max $24m^2$.

N.B. - In the case of premises with an anomalous structure or open-plan offices, the calculation regarding consistency should be done by means of a division of the comprehensive surface areas (including external walls) by the average surface area of the spaces (Circ. 14/3/92 n. 3/11008), derived from a study of premises that are typically found in the zone and that ordinarily are as follows:

- A/1 and A/8: $24 m^2$;
- A/2 and A/7: $19m^2$;
- A/3: $18m^2$;
- A/4 and A/5: $19 m^2$;
- A/10: $22m^2$.

cal software of the GIS⁹ type that made use of the potential association between the maps of buildings and microzones.

Microzones are represented by polygons that are built on the basis of cadastral sheets and as a result may be perfectly enrolled in the rules of cardinality between:

maps → sheets → microzones and back

with the use of *join spaziale*¹⁰ it was possible to transfer the elements and the attributes of microzones to the sheet and consequently to an individual map and the relative UIUs belonging to it.

Step 3 – Definition of the sub-sample.

With a view to determining the OMI value, UIUs were subdivided in two big categories¹¹ according to the algorithm to verify the classification that appears below:

Categories A/02 – A/07 – A/08 – A/09 are consolidated
 The values taken into account are the OMI values
 that are applicable for civilian housing Denominated **[AC]**
 Categories A/03 – A/04 – A/05 – A/06 are consolidated
 The values taken into account are the OMI values
 that are applicable for civilian housing + low-cost housing Denominated **[AP]**

NEW CONSTRUCTION

For categories A/02 – A/07 – A/08 – A/09 are applicable the values “OTTIMI” for civilian housing:

$$\text{ValueNCac} = (\text{ValueMin} + \text{ValueMax})/2$$

For categories A/03 – A/04 – A/05 – A/06 are applicable the values “OTTIMI” for civilian housing added to the values “OTTIMI” for low-cost housing:

$$\text{ValueNCap} = [(\text{ValueMin} + \text{ValueMax})/2 \text{ ottimoAC}] + [(\text{ValueMin} + \text{ValueMax})/2 \text{ ottimoAP}]$$

VARIATION

For categories A/02 – A/07 – A/08 – A/09 are applicable the values “NORMALI” for civilian housing:

$$\text{ValueVARac} = (\text{ValueMin} + \text{ValueMax})/2$$

For categories A/03 – A/04 – A/05 – A/06 are applicable the values “NORMALI” for civilian housing added to the values NORMALI for low-cost housing:

⁹ Geographical Information System.

¹⁰ GIS software function for the aggregation of layer attributes that share their geographical position.

¹¹ The proposed merger is the fruit of an analysis of building types and of the relative geographical distribution of UIUs of the cadastral database. This allocation was rendered necessary in order to take into account the entire cadastral building stock upon consideration of the imperfect compatibility with the classification of the types listed by the OMI and the actual set of cadastral database for Milan.

$$\text{ValoreVARap} = \left\{ \left[\frac{\text{ValueMin} + \text{ValueMax}}{2\text{normaliAC}} \right] + \left[\frac{\text{ValueMin} + \text{ValueMax}}{2\text{normaliAP}} \right] \right\} / 2$$

For this study the values of the Variations in the second semester of 2004¹² were considered. As represented in the following Table:

MICROZONE	TYPE	MINIMUM VALUES CIVILIAN HOUSING [AC]	MAXIMUM VALUES CIVILIAN HOUSING [AC]	MINIMUM VALUES LOW-COST HOUSING [AP]	MAXIMUM VALUES LOW-COST HOUSING [AP]	AVERAGE
B01	AC	3,850.00	5,450.00	-	-	4,650.00
B01	AP	3,850.00	5,450.00	3,600.00	5,350.00	4,562.50
B02	AC	3,600.00	4,850.00	-	-	4,225.00
B02	AP	3,600.00	4,850.00	2,700.00	3,450.00	3,650.00
B03	AC	3,950.00	5,400.00	-	-	4,675.00
B03	AP	3,950.00	5,400.00	3,300.00	4,250.00	4,225.00
B04	AC	5,100.00	6,000.00	-	-	5,550.00
B04	AP	5,100.00	6,000.00	4,450.00	5,550.00	5,275.00
B05	AC	3,750.00	4,450.00	-	-	4,100.00
B05	AP	3,750.00	4,450.00	3,150.00	4,100.00	3,862.50
B06	AC	2,850.00	4,050.00	-	-	3,450.00
B06	AP	2,850.00	4,050.00	2,650.00	3,150.00	3,175.00
B11	AC	6,500.00	9,500.00	-	-	8,000.00
B11	AP	6,500.00	9,500.00	5,400.00	6,400.00	6,950.00
B12	AC	4,900.00	6,050.00	-	-	5,475.00
B12	AP	4,900.00	6,050.00	4,500.00	5,550.00	5,250.00
B13	AC	4,100.00	4,850.00	-	-	4,475.00
B13	AP	4,100.00	4,850.00	3,850.00	4,500.00	4,325.00
B14	AC	4,800.00	5,650.00	-	-	5,225.00
B14	AP	4,800.00	5,650.00	4,200.00	5,050.00	4,925.00
C01	AC	1,900.00	2,500.00	-	-	2,200.00
C01	AP	1,900.00	2,500.00	1,700.00	2,250.00	2,087.50
C02	AC	2,700.00	3,550.00	-	-	3,125.00
C02	AP	2,700.00	3,550.00	2,350.00	3,100.00	2,925.00
C03	AC	2,800.00	3,800.00	-	-	3,300.00
C03	AP	2,800.00	3,800.00	2,500.00	3,450.00	3,137.50
C04	AC	4,100.00	4,600.00	-	-	4,350.00
C04	AP	4,100.00	4,600.00	3,400.00	4,250.00	4,087.50
C05	AC	2,750.00	3,550.00	-	-	3,150.00
C05	AP	2,750.00	3,550.00	2,400.00	3,050.00	2,937.50
C06	AC	2,500.00	3,300.00	-	-	2,900.00
C06	AP	2,500.00	3,300.00	2,200.00	3,050.00	2,762.50
C07	AC	2,400.00	3,400.00	-	-	2,900.00
C07	AP	2,400.00	3,400.00	2,150.00	3,150.00	2,775.00
C08	AC	2,300.00	2,950.00	-	-	2,625.00
C08	AP	2,300.00	2,950.00	2,000.00	2,600.00	2,462.50
C09	AC	2,850.00	3,850.00	-	-	3,350.00
C09	AP	2,850.00	3,850.00	2,500.00	3,300.00	3,125.00

¹² Annuity corresponding to the application of paragraph 335.

MICROZONE	TYPE	MINIMUM VALUES CIVILIAN HOUSING [AC]	MAXIMUM VALUES CIVILIAN HOUSING [AC]	MINIMUM VALUES LOW-COST HOUSING [AP]	MAXIMUM VALUES LOW-COST HOUSING [AP]	AVERAGE
C10	AC	2,850.00	3,550.00	-	-	3,200.00
C10	AP	2,850.00	3,550.00	2,500.00	3,350.00	3,062.50
C11	AC	2,650.00	3,150.00	-	-	2,900.00
C11	AP	2,650.00	3,150.00	2,200.00	2,800.00	2,700.00
C12	AC	2,700.00	3,300.00	-	-	3,000.00
C12	AP	2,700.00	3,300.00	2,200.00	2,850.00	2,762.50
D01	AC	1,750.00	2,350.00	-	-	2,050.00
D01	AP	1,750.00	2,350.00	1,500.00	2,000.00	1,900.00
D02	AC	1,750.00	2,250.00	-	-	2,000.00
D02	AP	1,750.00	2,250.00	1,500.00	2,050.00	1,887.50
D03	AC	1,450.00	1,900.00	-	-	1,675.00
D03	AP	1,450.00	1,900.00	1,250.00	1,600.00	1,550.00
D04	AC	1,850.00	2,350.00	-	-	2,100.00
D04	AP	1,850.00	2,350.00	1,600.00	1,950.00	1,937.50
D05	AC	1,700.00	2,300.00	-	-	2,000.00
D05	AP	1,700.00	2,300.00	1,550.00	2,100.00	1,912.50
D06	AC	1,800.00	2,400.00	-	-	2,100.00
D06	AP	1,800.00	2,400.00	1,600.00	2,150.00	1,987.50
D07	AC	1,950.00	2,350.00	-	-	2,150.00
D07	AP	1,950.00	2,350.00	1,750.00	2,150.00	2,050.00
D08	AC	1,800.00	2,350.00	-	-	2,075.00
D08	AP	1,800.00	2,350.00	1,700.00	2,150.00	2,000.00
D09	AC	2,000.00	2,700.00	-	-	2,350.00
D09	AP	2,000.00	2,700.00	1,700.00	2,250.00	2,162.50
D10	AC	1,750.00	2,350.00	-	-	2,050.00
D10	AP	1,750.00	2,350.00	1,500.00	2,050.00	1,912.50
D11	AC	1,900.00	2,500.00	-	-	2,200.00
D11	AP	1,900.00	2,500.00	1,650.00	2,150.00	2,050.00
D12	AC	2,450.00	3,150.00	-	-	2,800.00
D12	AP	2,450.00	3,150.00	2,150.00	2,650.00	2,600.00
D13	AC	1,850.00	2,300.00	-	-	2,075.00
D13	AP	1,850.00	2,300.00	1,600.00	1,950.00	1,925.00
D14	AC	1,950.00	2,650.00	-	-	2,300.00
D14	AP	1,950.00	2,650.00	1,900.00	2,550.00	2,262.50
D15	AC	1,650.00	2,000.00	-	-	1,825.00
D15	AP	1,650.00	2,000.00	1,400.00	1,800.00	1,712.50
D16	AC	1,800.00	2,250.00	-	-	2,025.00
D16	AP	1,800.00	2,250.00	1,700.00	2,000.00	1,937.50
D17	AC	1,850.00	2,250.00	-	-	2,050.00
D17	AP	1,850.00	2,250.00	1,750.00	1,950.00	1,950.00
D18	AC	1,750.00	2,250.00	-	-	2,000.00
D18	AP	1,750.00	2,250.00	1,650.00	1,900.00	1,887.50
D19	AC	1,750.00	2,250.00	-	-	2,000.00
D19	AP	1,750.00	2,250.00	1,650.00	2,000.00	1,912.50

MICROZONE	TYPE	MINIMUM VALUESA CIVILIAN HOUSING [AC]	MAXIMUM VALUESA CIVILIAN HOUSING [AC]	MINIMUM VALUESA LOW-COST HOUSING [AP]	MAXIMUM VALUESA LOW-COST HOUSING [AP]	AVERAGE
D20	AC	1,800.00	2,250.00	-	-	2,025.00
D20	AP	1,800.00	2,250.00	1,600.00	2,000.00	1,912.50
D21	AC	1,900.00	2,400.00	-	-	2,150.00
D21	AP	1,900.00	2,400.00	1,650.00	2,300.00	2,062.50
D22	AC	1,800.00	2,350.00	-	-	2,075.00
D22	AP	1,800.00	2,350.00	1,550.00	2,000.00	1,925.00
D23	AC	2,000.00	2,500.00	-	-	2,250.00
D23	AP	2,000.00	2,500.00	1,700.00	2,250.00	2,112.50
D24	AC	2,200.00	2,700.00	-	-	2,450.00
D24	AP	2,200.00	2,700.00	2,450.00	3,150.00	2,625.00
D25	AC	1,900.00	2,450.00	-	-	2,175.00
D25	AP	1,900.00	2,450.00	1,750.00	2,350.00	2,112.50
D26	AC	1,750.00	2,200.00	-	-	1,975.00
D26	AP	1,750.00	2,200.00	1,650.00	1,950.00	1,887.50
D27	AC	2,100.00	2,700.00	-	-	2,400.00
D27	AP	2,100.00	2,700.00	1,850.00	2,500.00	2,287.50
D28	AC	2,350.00	3,050.00	-	-	2,700.00
D28	AP	2,350.00	3,050.00	1,900.00	2,650.00	2,487.50
D29	AC	1,850.00	2,450.00	-	-	2,150.00
D29	AP	1,850.00	2,450.00	1,550.00	2,200.00	2,012.50
E01	AC	1,600.00	1,900.00	-	-	1,750.00
E01	AP	1,600.00	1,900.00	1,500.00	1,750.00	1,687.50
E02	AC	1,600.00	2,100.00	-	-	1,850.00
E02	AP	1,600.00	2,100.00	1,450.00	1,850.00	1,750.00
E03	AC	1,450.00	1,750.00	-	-	1,600.00
E03	AP	1,450.00	1,750.00	1,450.00	1,600.00	1,562.50
E04	AC	1,500.00	1,750.00	-	-	1,625.00
E04	AP	1,500.00	1,750.00	1,350.00	1,600.00	1,550.00

Step 4 – Estimate of the cadastral value of each UIU.

For each UIU the next step of the process was the determination of the cadastral value according to the appropriate formulae and coefficients.

This value represents a substantial component of the verification of the deviation since it is an integral part of the relationship between the economic value for cadastral purposes and the most likely economic value with reference to the property market.

Applying the following formula:

$$\text{ValueCATUIU} = [\text{INCOME}] * 1,05 * 100$$

Values grouped by cadastral category are reported below:

CADASTRAL CATEGORY	NUMBER OF UIUs	MOST PROBABLE MARKET VALUES IN EURO	AVERAGE PER UIU IN EURO
A02	113,205	17,431,789,996	153,984
A03	452,638	30,641,840,777	67,696
A04	131,314	5,144,614,981	39,177
A05	20,721	431,714,732	19,965
A06	152	2,712,754	17,847
A07	2,227	479,506,525	215,315
A08	45	38,582,663	857,392
TOTALE	720,302	54,152,762,428	75,180

Step 5 – Estimate of the most likely market value of each UIU.

Thanks to the allocation of a representative category for the sample (AP or AC) for every UIU whose surface area is known, it was possible to proceed to an estimate of the most likely market value relative to the quotations inferred from data furnished by the OMI.

Applying the following formula:

- for the grouping denominated AC: $\text{ValueOMIac} = \text{ValueVARac} * \text{SupDPR}$
- for the grouping denominated AP: $\text{ValueOMIap} = \text{ValueVARap} * \text{SupDPR}$

Values grouped by cadastral category are reported below

CADASTRAL CATEGORY	NUMBER OF UIUs	MOST PROBABLE MARKET VALUE IN EURO	AVERAGE PER UIU IN EURO
A02	113,205	47,573,044,099	420,238
A03	452,638	86,932,454,600	192,057
A04	131,314	18,894,914,735	143,891
A05	20,721	2,079,394,811	100,352
A06	152	16,837,416	110,772
A07	2,227	1,068,649,913	479,860
A08	45	71,957,998	1,599,066
TOTALE	720,302	156,637,253,572	271,460

Step 6 – Estimate for each UIU by the deviation index between cadastral value and the most likely market value.

Having traced the economic values with a cadastral origin and the findings by the OMI on each UIU of the sub-sample, it was possible to proceed to the actual calculation of the deviation index (NewITEM) by the application of the formula:

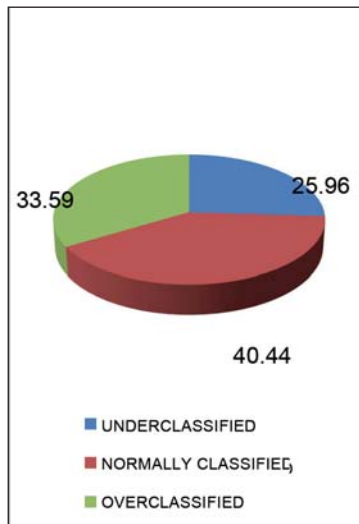
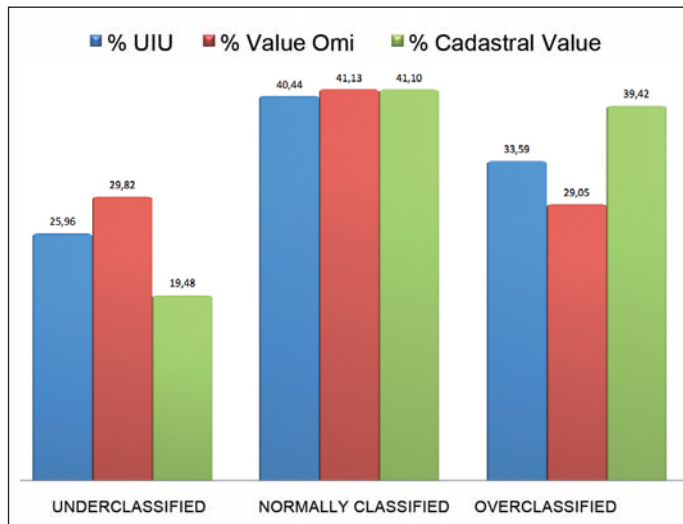
$$\text{NewITEM} = \frac{\text{ValueOMIac o ap}}{\text{ValueCATUIU}}$$

Step 7 – Grouping of UIUs on the basis of the deviation index (threshold) and maps.

Having organized the whole sub-sample, it was possible to proceed by summing up the values of the deviation index for each UIU in relation to the corresponding building.

In order to identify better the UIUs that were under classified, classified properly or under classified, the next step was the standardization of the deviation values by placing them in three distinct categories.

The representation of the results that were determined by the net values for the entire overview of the sub-sample of UIUs according to the deviation index or rather with the reference index \pm deviation index = 0 is represented in this way:

Diagram 3 % distribution of the classification**Diagram 4** Distribution and relationship between UIUs - Cadastral and OMI values as % of Total

In order to distribute the results a “guarantee threshold” was established or, in other words, an enlargement was carried out in the reference index of UIUs with a standard classification (equivalent to 3) at $\pm 0,5$.

The given results refer, therefore, to the processing threshold of 0,5.

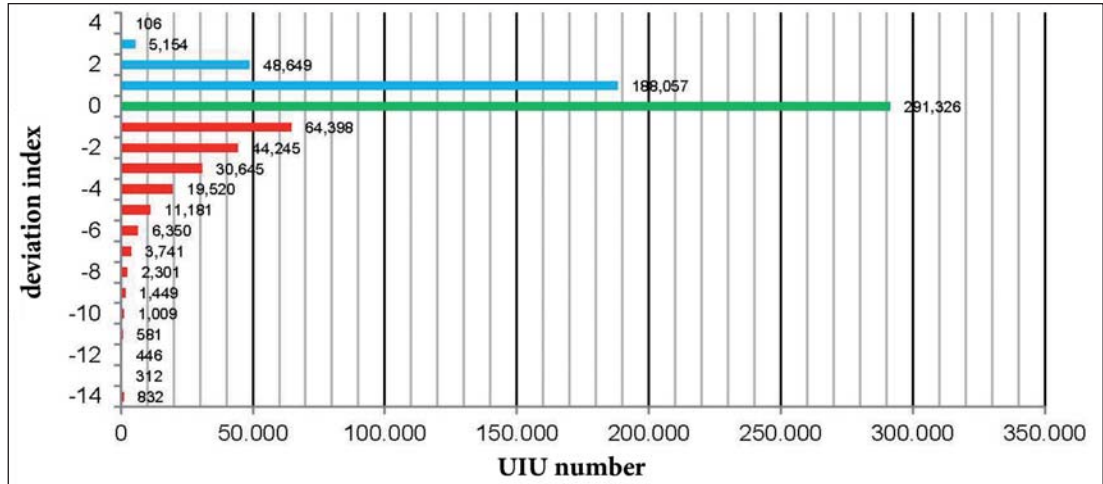
The field [NewITEM] determines the encoding of the threshold according to a scan of the limit values thus represented:

THRESHOLD - RELATIONSHIP	NUMBER OF UIUs	NEWITEM
Relationship > 10	832	-14
Relationship > 9.5 and \leq 10.0	312	-13
Relationship > 9.0 and \leq 9.5	446	-12
Relationship > 8.5 and \leq 9.0	581	-11
Relationship > 8.0 and \leq 8.5	1,009	-10
Relationship > 7.5 and \leq 8.0	1,449	-09
Relationship > 7.0 and \leq 7.5	2,301	-08
Relationship > 6.5 and \leq 7.0	3,741	-07
Relationship > 6.0 and \leq 6.5	6,350	-06
Relationship > 5.5 and \leq 6.0	11,181	-05
Relationship > 5.0 and \leq 5.5	19,520	-04
Relationship > 4.5 and \leq 5.0	30,645	-03
Relationship > 4.0 and \leq 4.5	44,245	-02
Relationship > 3.5 and \leq 4.0	64,398	-01
Relationship \geq 2.5 and \leq 3.5	291,326	00
Relationship \geq 2.0 and < 2.5	188,057	+01
Relationship \geq 1.5 and < 2.0	48,649	+02
Relationship \geq 1.0 and < 1.5	5,154	+03
Relationship \geq 0.5 and < 1.0	106	+04
Total	720,302	

The Table below indicates the distribution by threshold (deviation index) of the whole sub- sample that refers to residential UIUs and provides a chart with a summary of the results to enable a better understanding of the situation.

Distribution of UIUs according to the deviation index step 0,5:

Diagram 5 Distribution of UIUs according to the Deviation Index



Step 8 – An accurate analysis (geographical representation by category, by threshold and by type of construction).


Given the availability of details for single UIUs, it is possible to carry out an analysis of maps and to identify, even geographically, the distribution of the deviation index by a comprehensive analysis of the whole territory of the city.

The report below provides, for instance, merely by way of an example the cadastral characteristics of a Microzone, in this case C09 (Figure 2), reestablishing the results and the different representations that are useful for an understanding of the comparison between cadastral value and the most likely market value of the UIUs.

Figure 2 Microzone C09 - "Libia - XXII Marzo - Indipendenza"



Metric data:

	Microzone surface area 2.714.874,88m ²	Share of the whole of Milan 1,50 %	Cadastral surface area built 994.435,44m ²	Share of built surface area in the Microzone 36,63 %
	Number of maps for the Microzone 3,069	Number of valid UIUs in Microzone 31,911	Average UIUs per map 10,40	Average size 4,80 spaces
Relevant sheets: 393 – 394 – 440 – 441 – 442 – 479 – 480 – 481 – 482 – 483				

Details of UIUs in Microzone C09:

Diagram 6 Subdivisions of UIUs

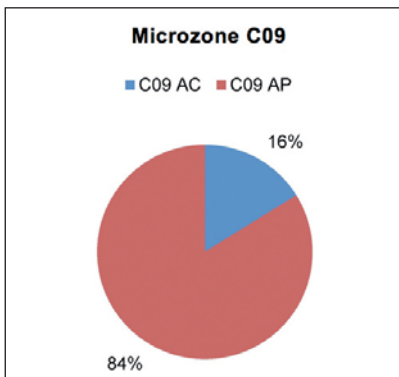
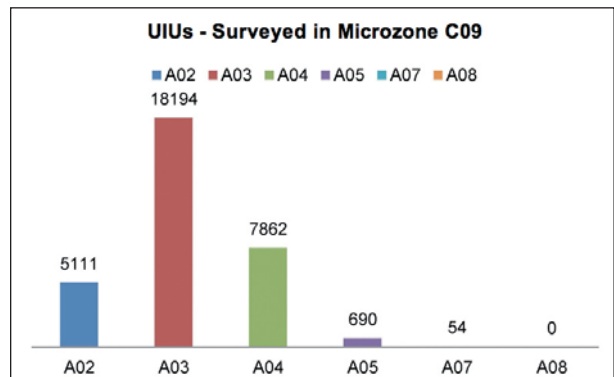
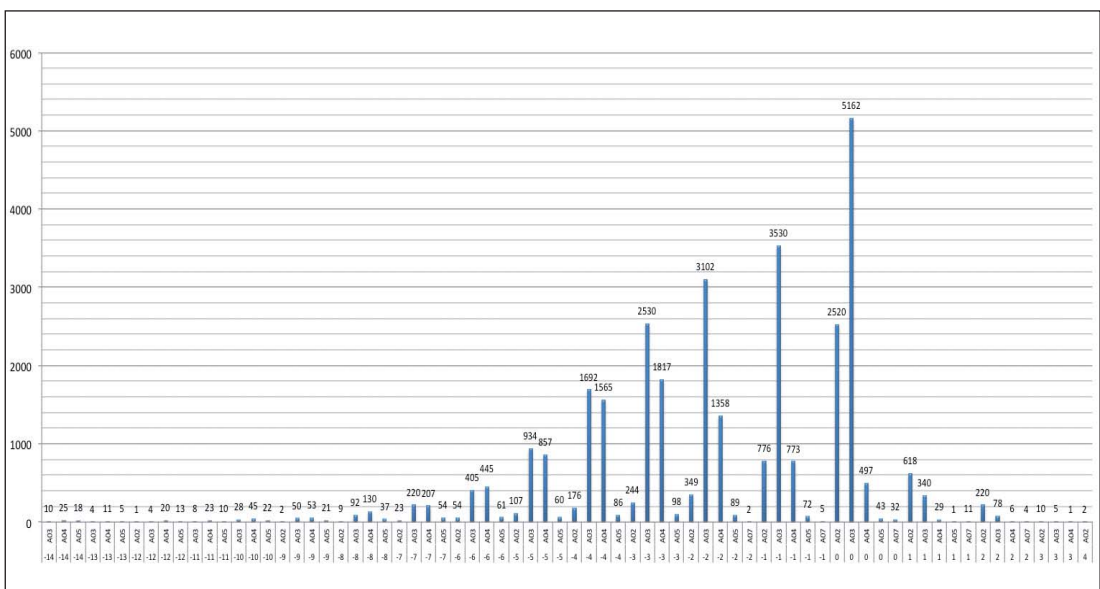


Diagram 7 Distribution of UIUs in the Microzone



In Microzone C09 there are no UIUs falling in Cadastral Category A06. Distribution by Deviation Index in Microzone C09:

Diagram 8 Distribution by Deviation Index in the Microzone



Subsequent sections include the processing stages that refer to the procedure denominated B), UIUs surveyed in categories A10, C01, C02, C03, C04, C06 and C07.

The methodology adopted is the deviation from the classification that is anticipated for each urban property surveyed in the reference category highlighting, wherever present, the net deviation index. In order to optimize the processing, a general table was established that covers all the categories involved and an accurate check was then made according to specific selections that indicate the status of the actual classification compared to the optimum one expected from classifications from the sheet and census area.

Purely by way of a summary, coverage is given to the steps undertaken in order to make the sub-sample of reference UIUs as close as possible to valid UIUs.

From a downloading of UIUs surveyed in Cadastral Category C0* and A10 an exercise for the processing of data was carried out to exclude UIUs subject to verification and that contain anomalies, in detail the operations concerned:

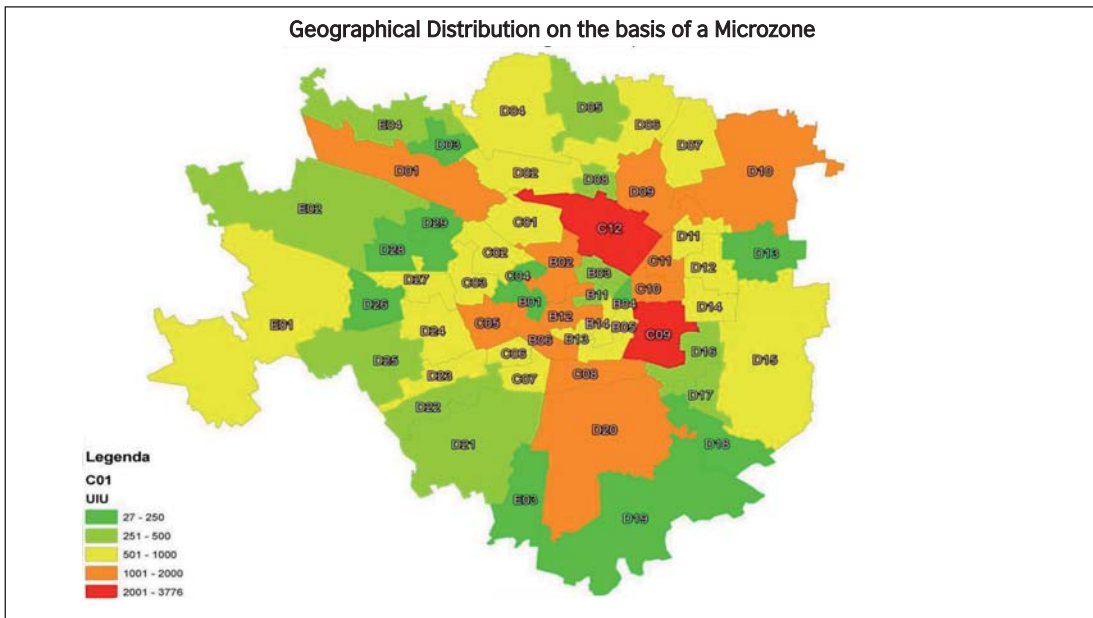
STEP	INITIAL RECORD	FINAL RECORD	DIFFERENCE
Starting record:	506,455	506,455	0
Record elimination with anomalous category	506,455	506,371	84
Elimination Old Cadastre	506,371	504,897	1,474
Elimination anomalous	504,897	504,896	1
Elimination Anomalous Class	504,896	504,877	19
Elimination Empty Parcel	504,877	504,872	5
Elimination lack of consistency	504,872	504,815	57
Elimination sheets not presented to NCEU	504,815	504,797	18
Elimination Parcels not valid after crossing with geometric buildings and maps Max x sheet	504,797	481,766	23,031
Elimination of UIUs with valid census zone but not corresponding with the combination ZC → FG	481,766	466,367	15,399
Total differences			40,088

The sub-sample, therefore, consists of about 465,000 UIUs whose classification was checked according to the cadastral classification expected from the sheet and from the census zones which they belong.¹³

¹³ The most frequent class per sheet was generated by a study by the former Agenzia del Territorio (Land Registry Office) in conjunction with the introduction of updated cadastral software denominated DocFA with the objective of addressing professionals, on the occasion of variations and/or start-ups, towards the expected classification.

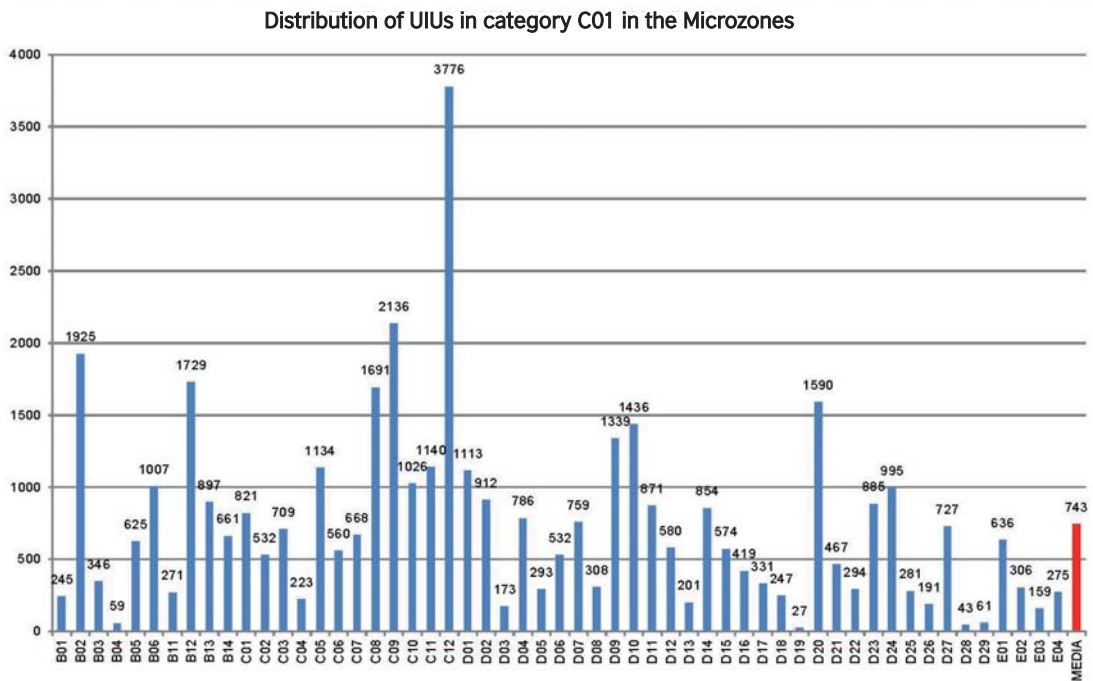
The report that follows gives some results of the processing with different groupings and restitutions (Figure 3):

Figure 3 Distribution of UIUs in Category C01 in each Microzone



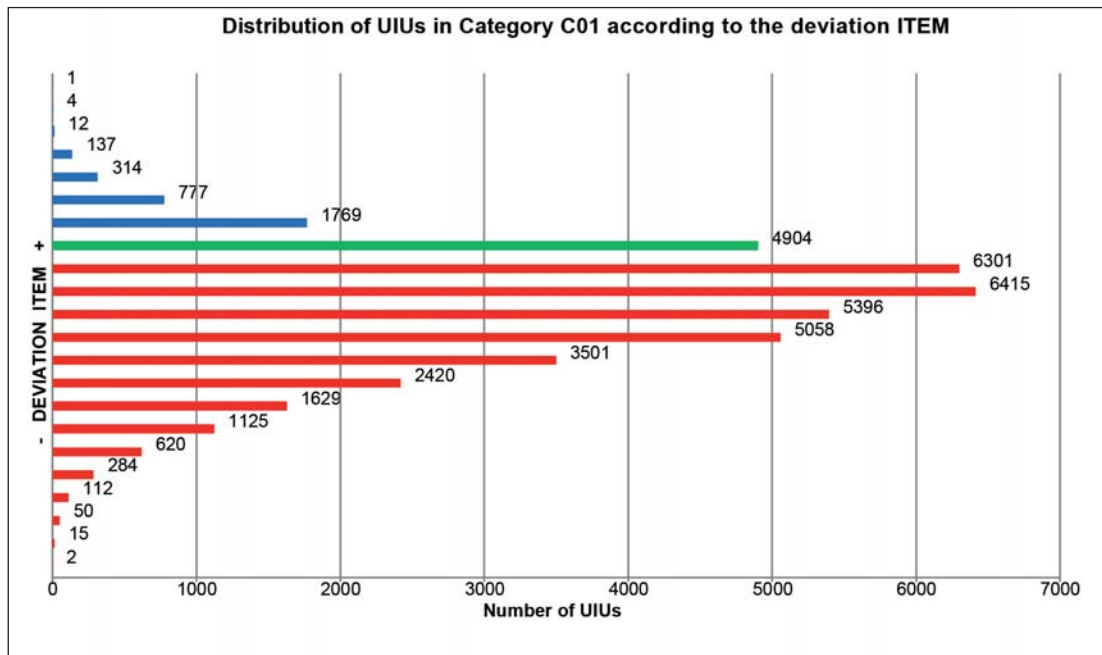
Share of surveyed UIUs in Cadastral Category C01 by Microzone:

Diagram 9 Distribution of surveyed UIUs in Cadastral Category C01 by Microzone



Distribution of the variation in the classification of the effective class in relation to the expected class:

Diagram 10 Distribution of UIUs in Category C01 by Deviation Index



Results

At the end of the processing that was described in the procedures mentioned above, the available data can be easily read according to the various methods of aggregation and restitution by means of the use of geographic software tools and as a result it is possible to find information that mere access to tables would make difficult if not impossible.

In order to be brief, therefore, only a few basic summaries have been considered that help to define the current status of urban cadastral classification and its relative quality when referred to the economic value of the sub-sample examined.

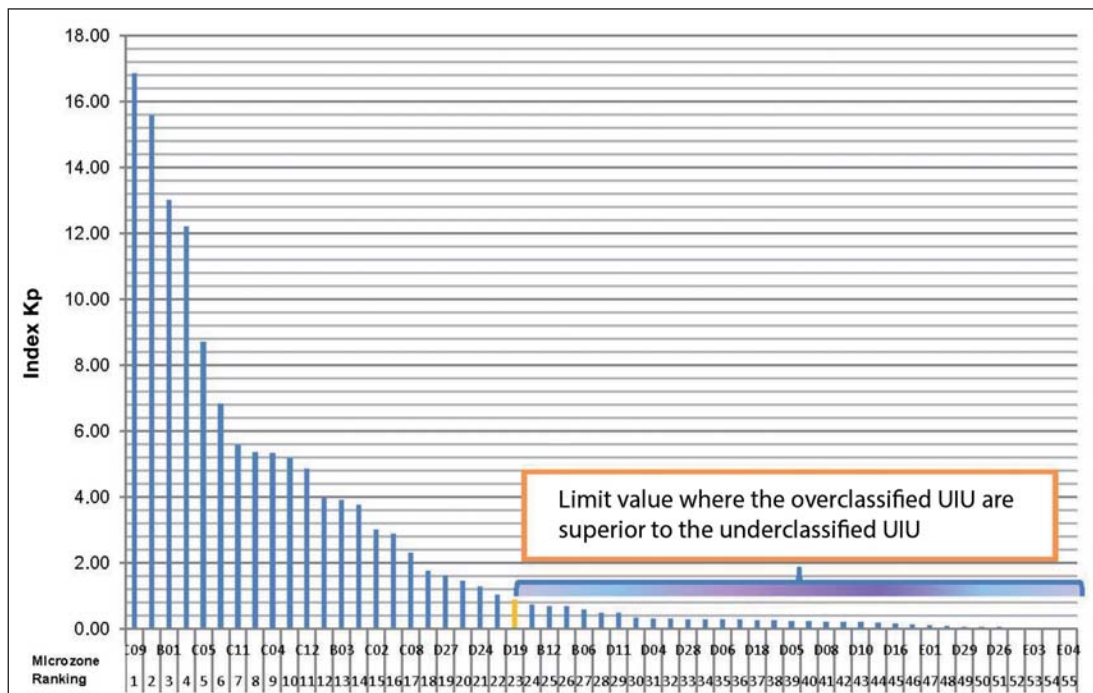
As mentioned earlier the detail values were processed in order to generate a detailed ranking for each single land category or, more generally, by reference to the whole sample of cadastral building stock.

Listed below are some borderline cases.

- Case 1 – Identification of critical Microzone due to the presence of **underclassified** urban property surveyed in category defined “**DWELLING**”
- Case 2 – Identification of critical Microzone due to the presence of **overclassified** urban property surveyed in category defined “**SHOP**”
- Case 3 – Identification of critical situations in order to determine intervention priorities.

Case 1 – A breakdown on the Kp basis of the ranking of Microzones in cadastral categories A0* appears below:

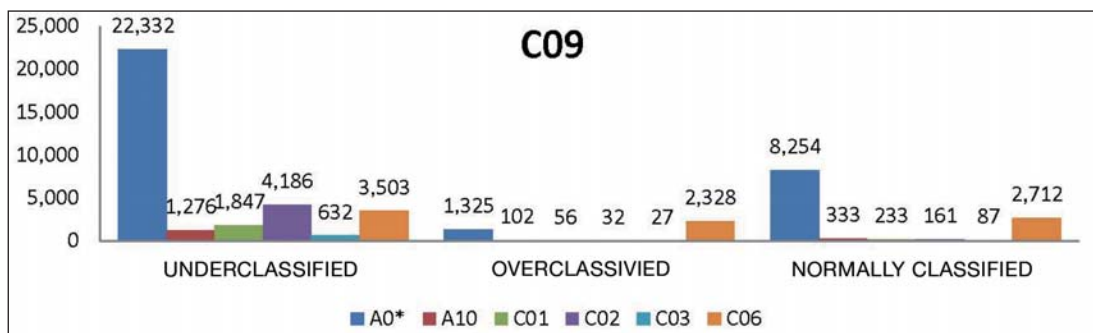
Diagram 11 Ranking for a Microzone on the basis Kp A0*



The distribution of the index represents a substantial subdivision that corresponds with the number of microzones but is largely oriented in terms of number of UIUs to microzones that show a strong deviation due to under classification.

The Diagram below shows details regarding residential UIUs related to Microzone C09 that is identified as the one that shows the highest critical situation:

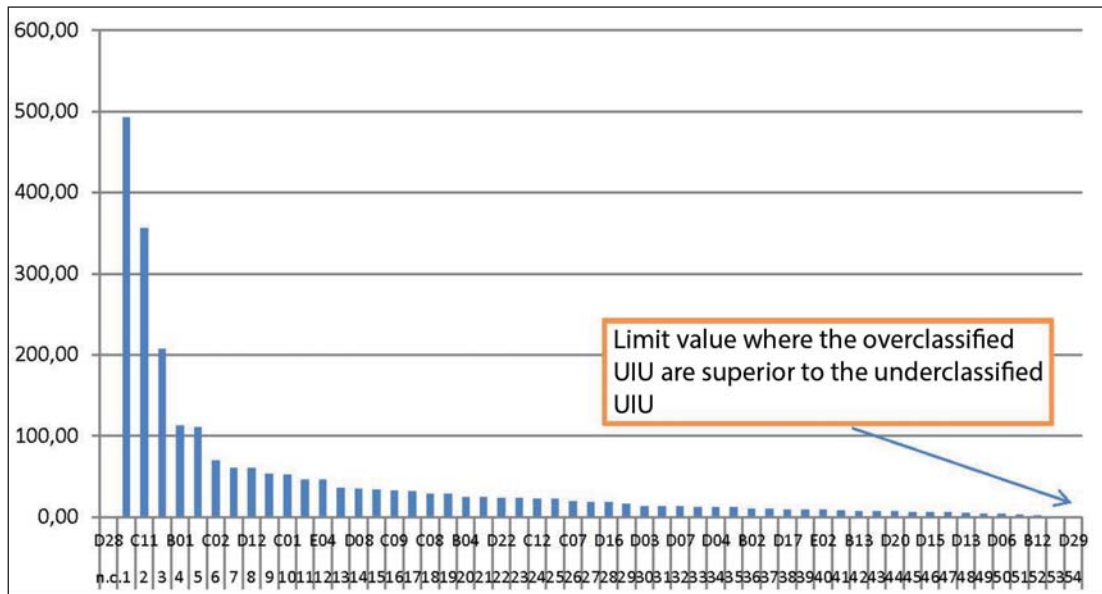
Diagram 12 Distribution of UIUs according to the characteristics of the deviation index



Microzone C09, located geographically in the semi-central section of the city, shows the highest concentration of underclassified residential UIUs. This feature might have its origin in the homogeneity of building characteristics and in the contemporary development (the first years of the 20th century) of urban planning on types of housing units of medium and large size and classified on cadastral parameters below the reference threshold of the era.

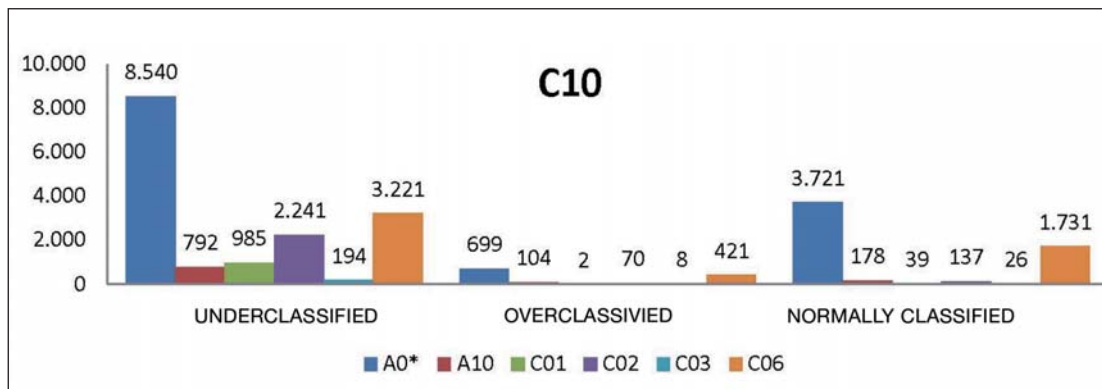
Case 2 – A breakdown on the Kp basis of the ranking of Microzones on cadastral category C01 appears below:

Diagram 13 Ranking per Microzone on the basis Kp C01



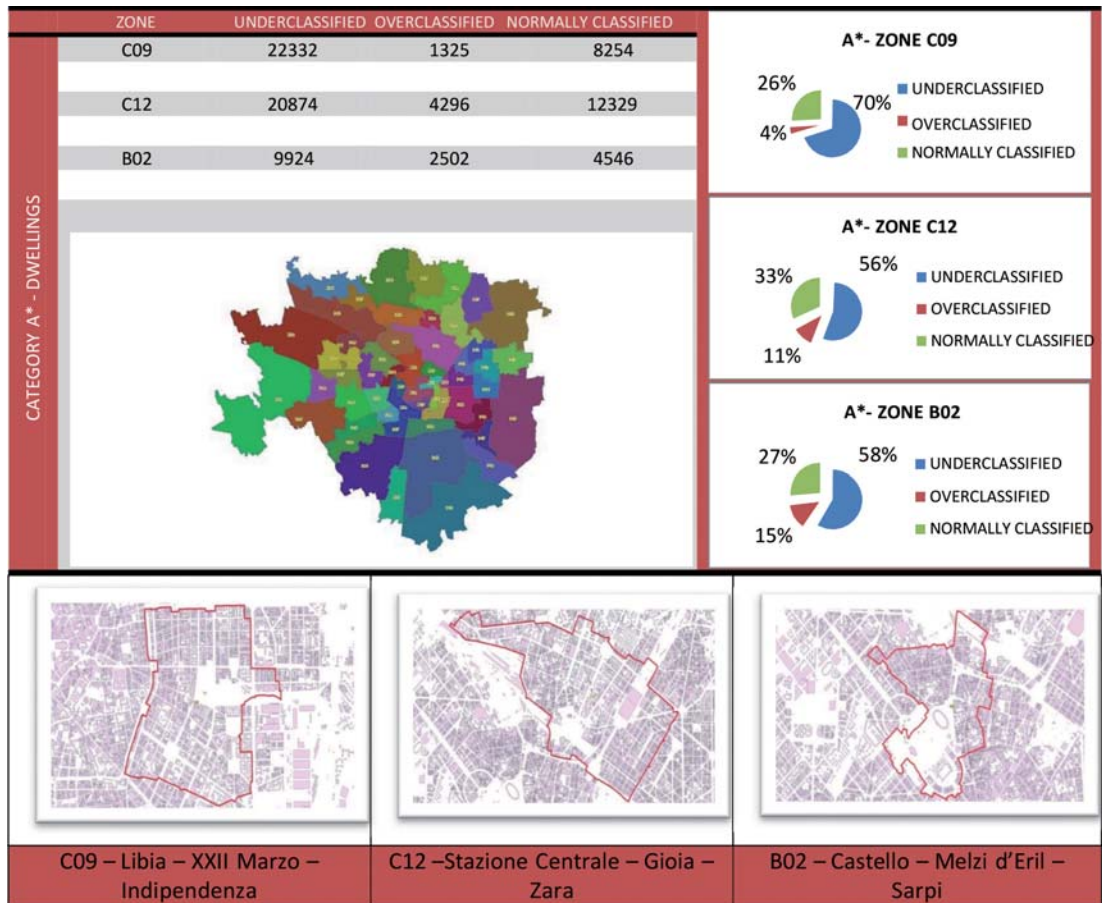
The Diagram below shows details of commercial UIUs (C01) with reference to Microzone C10 identified as the one with the highest critical situation:

Diagram 14 Distribution of UIUs according to the characteristics of the deviation index



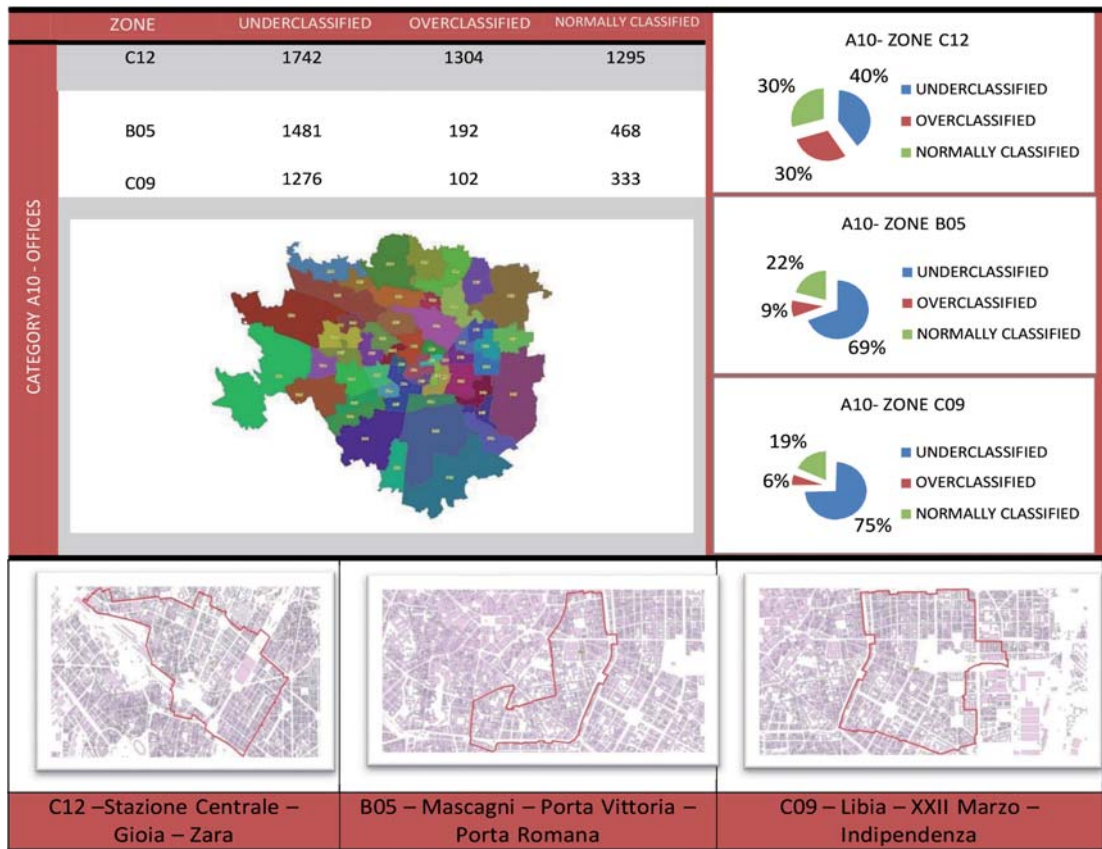
Case 3 – the critical situations of Microzones in relation to some cadastral categories appear below:

Dwellings (A0*):



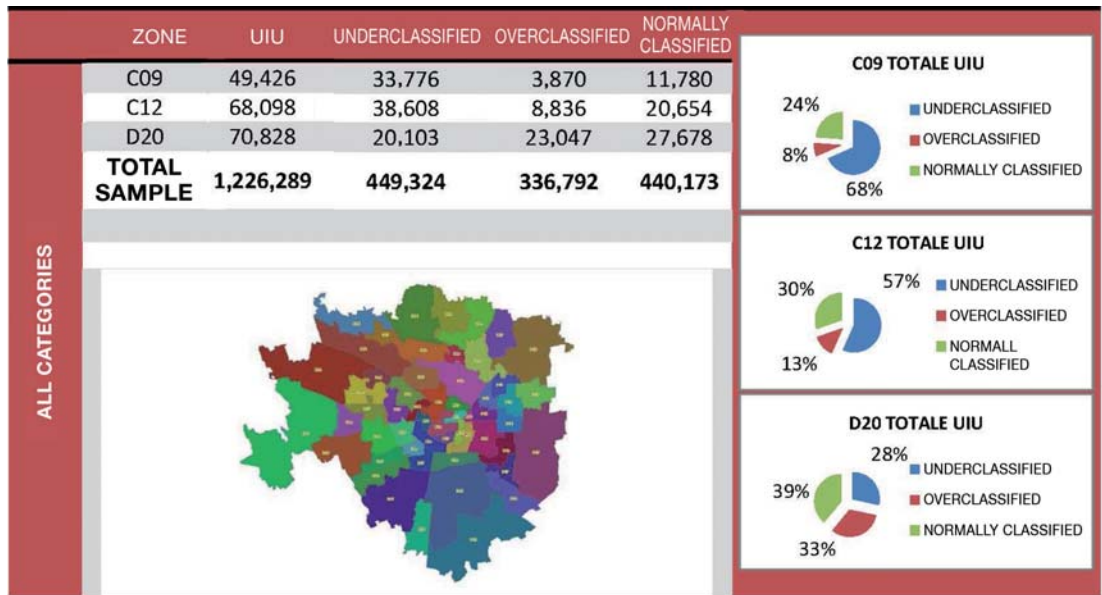
Same building features for Microzones C09 and C12 while for Microzone B02, situated in the immediate vicinity of the City Centre, the residential building characteristics are considered as having merit.

Offices (A10):



The three Microzones at the top of the ranking are almost homologous for building characteristics and for urban development, being zones positioned in a radial semi-central band.

Grand Total:



Analyzing the results with due precautions and limitations dictated by the architecture of the procedures performed, it is possible to define some Microzones with a high critical situation and that in the light of a first quick analysis can be defined as priorities in order to undertake an intervention on Microzones C09, C12 and D20 which represent 20,58 % of the total variance in the city.

In terms of a “city system” the analyses that were carried out have identified a clear breakdown of results between the territorial boundary of the central urban area, the semi-centre and the suburbs that is in the central zone, relative to residential building types, where this is evidence of a widespread underclassification of UIUs whereas in the suburbs that were developed under a planning regime as from the 60s, there is a concentration of overclassified UIUs.

CONCLUSIONS

In order to be concise, this document presents procedural aspects and the results of the study in different methods of representation and aggregation.

The study that was undertaken has provided the communal structure, entrusted with the management and the control of complex tax and fiscal dynamics, with an tool of useful in-depth knowledge to trigger the necessary actions that are meant to reduce inequality and at the same time ensure the balance of contributions from tax forms that base their calculations on a cadastral classification and on the consequent relative property income.

Some considerations include the need to define new basic parameters to establish estimates that should find fertile ground in developments of the property market in a dynamism that is anchored to variable environmental conditions (new urban infrastructures, the provision of amenities, urban re-development, etc.).

A static design of the Microzone leads to a notion of a link that is completely detached from urban policies and the establishment of parameters for the classification of surveyed UIUs in ordinary categories should face new models for estimation that must be based on elements that are measurable, variable and that are updated.

There are different types and methods for the determination of the perimeters of an area and for sampling, as opposed to the OMI which takes the “declared tax”, the Real Estate Exchange of the Chamber of Commerce (Borsa del Mercato Immobiliare della Camera di Commercio, OSMI) which takes the “sold/offered” based on a calculation that concerns a different sub-municipal subdivision (57 zones against 55 of OMI) and that, in some cases, has incorporated urban transformations that were carried over time.

For these reasons the study is not meant to be exhaustive but can serve as a tool for the awareness of cadastral values and, above all, of the effective degree of quality of these values. A further development of the topic can be found in the need to make combinations and comparative analyses in order to have a database that will adhere as much as possible to the actual situation and to determine, under the qualitative aspect, parameters for the market value of individual properties and the associated tax schedule avoiding, if possible, one-off revaluation coefficients.

Evaluating in a systemic manner the use of new modalities for enhancement that could even cover areas that have so far been hardly used or not used at all, such as, for example:

- concerning details of the property: the energy certification, the measurement of the frequency of the purchase/sale cycle (mobility index), rents, etc.;
- concerning details of the area corresponding to the “city-underground system”: the level of neighbourhood services, the extent of attractiveness, the index of competitiveness, international ranking indices.

This would be just a small hint of the new vision that the topic is called to face, with new tools for in-

vestigation and analysis (location intelligence), with the availability of data systems at all levels of knowledge (the Code of Digital Administration) and, above all, with a new and renewed level of participation of the different institutional forms in the daunting task of reforming the system. The results of the processing can be read from many aspects of analysis that relate to individual categories, individual cadastral sheets, individual microzones or more generally an opportunity to create a ranking for an intervention for the reconstruction of equalization that would be relative to the expected classification and so intervene on those microzones that register a strong differential in the value between individual urban properties that are over classified or under classified and individual urban immovable properties that have a standard classification.

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