* Rocco Curto
** Elena Fregonara
** Patrizia Semeraro

How can land registry values be made fairer pending a review of valuations?

DOI: 10.14609/Ti_1_14_5e

Keywords: fiscal fairness, land registry reform, land registry taxable values, correction coefficients, census Microzones, Osservatorio Immobiliare Città di Torino (Turin Real Estate Market Observatory).

Abstract This study proposes an operational methodology for determining correction coefficients to apply to land registry values, determined on the basis of the marginal contribution of the location of a property to its market value. The importance of location in determining the value of a property is confirmed by empirical analyses described in the literature and by property valuation practices. The methodology proposed is deliberately simple so that it can serve as a useful operational tool for public administration. A case study of the property market in the city of Turin is discussed.

INTRODUCTION

Property taxation in Italy is extremely unfair, as it is based on taxable values which bear no relation to the market values of properties. If property tax is not rapidly made more equitable, it will not be possible to undo the "social block" which, having been strengthened following the implementation of the *Imposta comunale propria* or *Imposta municipale unica* (IMU), brings together the interests of small and large property owners. A more equitable taxation system – though not compulsory – might, on the other hand, help property taxation to be seen once more as a tool for local development, capable of enabling the construction sector to stimulate the economy during a downturn and sustain demand, which increasingly comes from more strictly industrial sectors on which environmental sustainability depends. Unfortunately, the process of revision of land registry values – which has been under discussion for many years – takes rather a long time if the opportunity to establish a more modern land registry system is to be taken: not only one which is dynamic but one which can also support to public administration reform, particularly for all of the bodies – of which there is no small number – which are responsible for safeguarding and regulating land use at the local and national level. As a result, the amount of time required to revise valuations for the whole country is at odds with the country's more pressing needs, to the extent that it is opportune to determine whether it is possible to bring forward at least some of the results of the revision process by adopting measures that are "immediate". The paper sets out to determine whether and to what extent the inequity of the current property taxation system can be reduced, by introducing correction coefficients of values based on property locations. In particular, it focuses on the distortions produced by the current census areas, which for many years (for decades) have no longer represented the geographical

* Director, Department of Architecture and Design – Polytechnic of Turin (*Politecnico di Torino*)
** Department of Architecture and Design – Polytechnic of Turin (*Politecnico di Torino*)

"hierarchies" defined by property values. The introduction of correction factors relating to the location of properties would make it possible to introduce their location as a contributory factor to land registry values, thus reducing gaps between land registry values and market values. The paper focuses on the possibility of using market values of census Microzones to determine location-related coefficients to correct land registry – and consequently taxable – values. Census Microzones, which were determined following the implementation of Law no. 138 of 1998, represent geographical segments of the property market which, as a result of their homogeneity, are able to take into account the location factor which is currently completely distorted by the census areas. Given the timing and the need to extend the methodology to the entire country, a simplified procedure which is easy to implement and can provide immediate, significant results, was deliberately chosen. The paper is organised as follows. The first section introduces the context and the reasons underlying the project. The following section describes the methodology. The third section introduces the case study: the Turin property market. Finally, the fourth section contains an empirical analysis, followed by conclusions.

CONTEXT AND REASONS

Legislative Decree no. 23 of 11 March 2014 considers reform of the land registry a single process, the results of which can only be achieved upon conclusion, in other words only when the value of all national properties can be estimated by means of the value functions determined according to geographical and functional segments (Curto and Fregonara, 2013). As a result, the period of time required to revise land registry values in the whole of Italy is excessive, given the more immediate needs of the economy and the growing demand for fairness due to the fact that land values on which property tax is based show no degree of significant correlation with the market values of properties. Indeed, rents and land values have remained unchanged for decades, since the establishment of the land registry, even though geographical hierarchies and physical and construction characteristics used to determine market values have changed. It is sufficient to recall, for example, that until the 1980s the values of new residences and semi-central and/or outlying areas were markedly higher than those of older properties and central areas and that in the last few decades these same hierarchies have not only changed but have also been completely reversed.

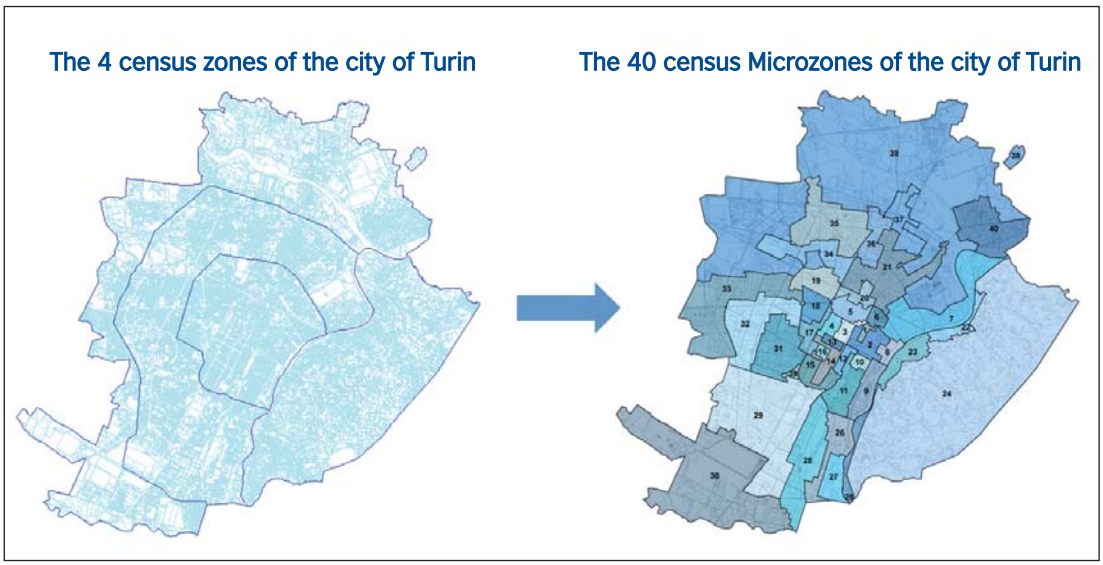
Consequently, the land classification system has become so out of date that the generally large differences between land registry values and market values of properties are not attributable to unequivocal factors.

The recent increase in IMU rates, being indistinct, has in turn increased the unfairness of the system. It has given rise to a general increase in taxes regardless of the physical and construction characteristics of properties and of their location. The identification and application of differentiated rates according to suitably defined corrective measures might have reduced the margins of unfairness and brought land values – used as tax bases – closer to the real market values of properties. Corrective action could have been established in a manner consistent with Presidential Decree no. 138 of 1998, which had considered, as the initial steps of the process, the use of square meters to measure the size of a property (replacing the land registry "number of rooms") and had considered establishing homogeneous Microzones corresponding to the geographical segments of the housing market (replacing the now-outdated census zones). Indeed, this paper proceeds from the belief that by acting on these two aspects, to which a significant share of the unfairness of the system can be attributed, land registry values can be corrected and linked – in a significant manner – to market values, thus making the taxable value of properties more realistic.

The corrective effects of using square meters to determine rents and land values have already been observed in the context of research activities that were carried out by the Turin Real Estate Market

Observatory (*Osservatorio Immobiliare della Città di Torino*, *OICT*) starting in 2002[1]. The current aim is to verify whether it is possible to eliminate distortions arising from census areas which, in the case of Turin, as in many other places, include geographical segments which differ widely in terms of quality and accessibility, ranging from more prestigious to more run-down zones. In the case of Turin, the anachronism of census areas is particularly evident, even considering only the fact that the city divided into four large municipal divisions determined by the census zones has been restructured – following the implementation of Law no. 138 – into 40 municipal Microzones, as shown in Figure 1.

Figure 1 From 4 census zones to 40 Microzones in the city of Turin (source: OICT data)



It is particularly instructive to compare the 4 census zones with the 40 municipal Microzones to understand how the whole land registry classification system, built only on 4 large geographical divisions, lies at the basis of the distortions that are present in the determination of land rates and rents. The municipal Microzones, as will be explained in greater detail later on, "redraw" the geographical segments of the city on the basis of the assumptions underlying the land registry review process – acknowledged by Law no. 138 of 1998 – and introduce new policies designed to overcome the limits of said land registry census zones, thus being superimposed over the boundaries of 10 constituencies, 95 statistical zones and 3,700 census sections, including the 120,000 house numbers which make up the city.

The land registry system of classes/rates underlying the building registry established under Royal Charter (*Regio Decreto Legge*, *RDL*) no. 652 of 1939 and Law no. 1142 of 1949, made provision for a system of land rents based on property categories (ordinary and not ordinary) and on the class, leading to rates of return that are not without "census inconsistencies" (which are obvious, for example, in the case of neighbouring census areas).

According to the rationale behind Microzones, as drawn up under Presidential Decree no.138 – which essentially clarifies the main outlines of Law no. 662 of 1996 – the allocation of levels of rates of

1 Reference is specifically made to the following projects: "Classification and property tax" (2002/2003) (Classamento e fiscalità immobiliare) and "Classification and taxation – operational proposals" (2004/2005) (Classamento e fiscalità: proposte operative), carried out by working groups of the Osservatorio Immobiliare Città di Torino (Turin Real Estate Market Observatory) under the scientific responsibility of Prof. Rocco Curto, as part of its conventional activities.

return for property is no longer conceived in relation to a "typical" unit, as in the case of census zones, but by means of appropriate valuation procedures. In this context, the introduction of Microzones is therefore, an important act compared to the long series of attempts to renew the old land registry prior to 1996, not unrelated to the impetus provided by administrative decentralisation and fiscal federalism, of which the introduction of the municipal property tax represents an important step.

The paper uses information from a number of trials to determine whether and to what extent it is possible to correct the taxable values used to calculate property tax, by introducing corrective measures relating to location, determined on the basis of differences in values between current municipal Microzones. Indeed, these – the differences in values between one Microzone and another – may reflect the influence of different location on the market values of properties, an influence considered anything but insignificant in the national and international literature (see, for example, Bourassa *et al.*, 2010).

In particular, the paper focuses on the possibility of determining such location-based coefficients, *i.e.* property values in municipal Microzones, a possibility stemming from the fact that under Presidential Decree no. 138/98 the values of municipal Microzones must be updated periodically and therefore subject to monitoring and observation. In short, location coefficients, to be used as multipliers to recalculate taxable values on the basis of adjusted land values, can be expressed by the ratio between an index price which most accurately sums up property values in individual municipalities or aggregations of municipalities in the case of the smallest municipalities (determined on the basis of market observations constituting the entire statistical sample) and the corresponding price indices of the values of each Microzone, defined on the basis of market observations (sub-samples). It is therefore clear that the robustness of the result depends on the statistical index selected (for example minimum, mean, maximum or median prices) and on the statistical samples and sub-samples used in the analyses. The proposed methodology, applied to the case of the city of Turin, now divided into 40 Microzones as against 4 census areas, is intentionally simple, as it is intended to be easily replicated and useable by the municipalities themselves.

METHODOLOGY

This paper proposes a first operating procedure to define adjustment coefficient to correct land registry values (or land rents) on the basis of the marginal contribution of location to price. As is known, the quality of a location depends on various positional factors – on the provision of services, on building and urban strata, on accessibility, on the social and economic fabric, on territorial and environmental quality; in other words it depends on a very large number of variables, to encapsulate by means of specific analyses (factor analysis using principal component analysis and cluster analysis). The problem to determine the contribution of location to market values, which has been extensively covered in the real estate literature, has been addressed mainly by means of two approaches: by the introduction of statistical spatial models (Peace *et al.*, 1998) and by defining geographical segments to introduce as dummy variables in hedonic models. Empirical analysis performed using the two approaches show that the hedonic approach based on the introduction of geographical segments is the most effective for forecasting market prices (Bourassa *et al.*, 2003; Bourassa *et al.*, 2007 and Bourassa *et al.*, 2010). Establishing geographical and functional segments of the property market, however, requires a specific analysis of the spatial structure of the market (Kauko, 2006). In Italy, as mentioned earlier, Presidential Decree (Law) no. 138 of 1998 provides for the subdivision of municipal territories into geographical segments according to specific homogeneity requirements. In 1999, Turin was divided into 40 Microzones by the Politecnico di Torino (Curto and Fregonara, 2002). The Microzones were defined according to the provisions of the aforementioned law and subsequent

amendments by the Ministry of Finance and subsequently approved by the Turin City Council. Given the means by which the land registry Microzones were established, the property values in these zones should make it possible to "measure" the marginal contribution of the location to the market value of properties in these areas. Indeed, in recent studies (Fregonara and Semeraro, 2013; Curto *et al.*, 2014) it has been shown empirically that in the case of the city of Turin, Microzones can account for up to approximately 40% of the market prices of properties.

Based on these assumptions, the paper sets out to establish possible correction coefficients to apply to land registry values, to incorporate the location contribution to property value. In fact, as discussed above, land registry values include the location only by considering census zones, which are no longer representative of the geographical hierarchies inherent in land values.

The procedure for determining multipliers consists of three steps:

- definition of a price index for the whole city and a price index for each land registry Microzone;
- determination, based on the price indices, of location adjustment coefficients for rents and values for each of the 40 land registry Microzones;
- calculation of adjusted assumed revenues and verification of differences for each Microzone compared to current revenues.

These steps are analyzed below.

Calculation of price indices for each land registry Microzone

This section establishes the price indices for the whole city and each of its geographical segments to determine location adjustment coefficients. The most natural choice would be to compute a centrality index (for example, a sample mean) for each of the 40 Microzones based on samples of transactions occurred during a given period. As transaction prices are not a public information and are difficult to obtain in Italy, we considered a sample of properties for sale. The sample is collected by the Turin Real Estate Market Observatory (*Osservatorio Immobiliare Città di Torino*, *OICT*) using robust data gathering, sampling and cleaning procedures. We could consider a longer time period to get a greater stability of the result over time, despite a loss of accuracy. Furthermore, Microzones since the data are geo-referred the analysis could be performed by considering any geographical segmentation.

The proposed methodology may also be applicable by using price indices published by institutional bodies, first and foremost those developed by the Real Estate Market Observatory (*Osservatorio del Mercato Immobiliare*, *OMI*) of the Revenue Agency (*Agenzia delle Entrate*), provided that accurate information on real estate prices is available. It was decided not to use the OMI indices, since we have the opportunity to use sample data. By using indices published by institutional bodies we do not have the opportunity to change the spatial segmentation or the time period considered.

Determination of adjustment coefficients for each Microzone on the basis of reference prices

This section introduces the procedure to compute the location adjustment coefficients. **With a sufficiently large sample it is possible to determine specific coefficients for the different categories of properties for each Microzone.**

If P_i, $i=1,\ldots, N$, where N is the number of the Microzone (or, more generally, geographical segments) and P_i is the sample mean of prices in Microzone i, the coefficients may be defined by:

$$c_i = \frac{N P_i}{\sum_{i=0}^{40} P_i} \quad (1)$$

We have introduced a coefficient for each Microzone defined as the ratio between the Microzone sample mean of prices and a mean price for Turin Microzones. The coefficients are therefore chosen to be greater than one in areas where the mean price exceeds the arithmetic mean of mean prices and lower than one in the remaining Microzones. By changing the reference index for Turin it is pos-

sible to modify the range of variation of coefficients and the number of Microzones that undergo a reduction in assumed revenues. It is to be noted that:

$$\sum_{i=1}^{N} \frac{c_i}{N} = \sum_{i=1}^{N} \frac{P_i}{\sum_{i=0}^{N} P_i} = 1$$

Once the coefficients have been determined, the adjusted revenue $R^c_j(I)$ of a property I located in Microzone j, $j=1,...,N$ is given by:

$$R^C_j(I) = c_j R_j(I), \quad (1)$$

where $R_j(I)$ is the current assumed revenue for property I.
The relationship between the adjusted revenue $R^c_i(I_i)$ and $R^c_j(I_j)$ of two properties I_i and I_j belonging respectively to Microzones i and j does not depend on the reference price but only on the mean prices in the two Microzones. Hence:

$$\frac{R^C_i(I_i)}{R^C_j(I_j)} = \frac{c_i R_i(I_i)}{c_j R_j(I_j)} = \frac{\frac{N P_i}{\sum_{i=0}^{40} P_i} R_i(I_i)}{\frac{N P_j}{\sum_{i=0}^{40} P_i} R_j(I_j)} = \frac{P_i R_i(I_i)}{P_j R_j(I_j)}$$

The choice of the reference price serves therefore to adjust the range within which actual rents are to be redistributed, according to the different location of the properties and the influence of this location on the market value.

The case study: the city and property market of Turin

Before presenting the empirical analysis, it is necessary to introduce briefly the Turin property market that has been chosen as a case study. Turin has the third most dynamic property market, measured in terms of number of transactions in the residential segment. It is also distinguished by generally lower property values than other Italian cities (Rome, Milan, Florence, Bologna, Bari, etc.). In Turin, as in many other cities, the evolution of the market can be traced, as well as the profound changes that have taken place since the implementation of the land registry system, which was conceived and developed in relation to a specific stage in the city's development, organisation and operation of the property market, the rental market and commercial transactions. It is no coincidence that the land registry is based on rents and not on land values and that it takes on a model for the classification and calculation of rates underpinned by large-scale geographical divisions and perfectly categorisable types. Specifically, in the 1980s a profound schism developed, in two stages – so-called "quantitative" growth during which urban development was based on property market transactions mainly involving new buildings and the expansion of the city into semi-central and outlying areas. This stage saw new housing predominate over older housing stock and middle and upper-middle class residents move away from the centre, which has now become an exclusive area, to semi-central and outlying districts. The Santa Rita district is a typical example of a district with a high concentration of middle-class residents.
In a market context prior to the economic and financial crisis – and therefore very different from today – Turin was called upon to establish its Microzones in accordance with Presidential Decree (Law) no. 138 of 1998 (previously mentioned several times) and the related regulations concerning the general revision of the census areas, of estimates of the value of individual urban properties and related criteria as well as census commissions pursuant to article 3, paragraphs 154 and 155, of Law no. 662 of 23 December 1996. The methodology that led to the segmentation of the property market in Turin is reported in working reports produced for the city of Turin – supplemented by all of the

graphical and textual documentation required by law – as a result of accords implemented by means of official agreements between 1997 and 1999.

The Microzones are numbered from one to forty, starting from the city centre to the suburbs. The central zones are characterised by historic buildings of architectural interest, while the semi-central areas were built mainly in the 1960s and the 1970s. Some are particularly interesting in that they exhibit more individual market behaviour, linked to the characteristics of the properties and their geographical setting: for example Microzone 16 (Duca d'Aosta), characterised by prestigious properties which are frequently not sold on the open market but privately, Microzone 24 (Collina) which includes most of the hilly area, and Microzone 23 (Crimea), which delineates a particularly prestigious area at the foot of the hills.

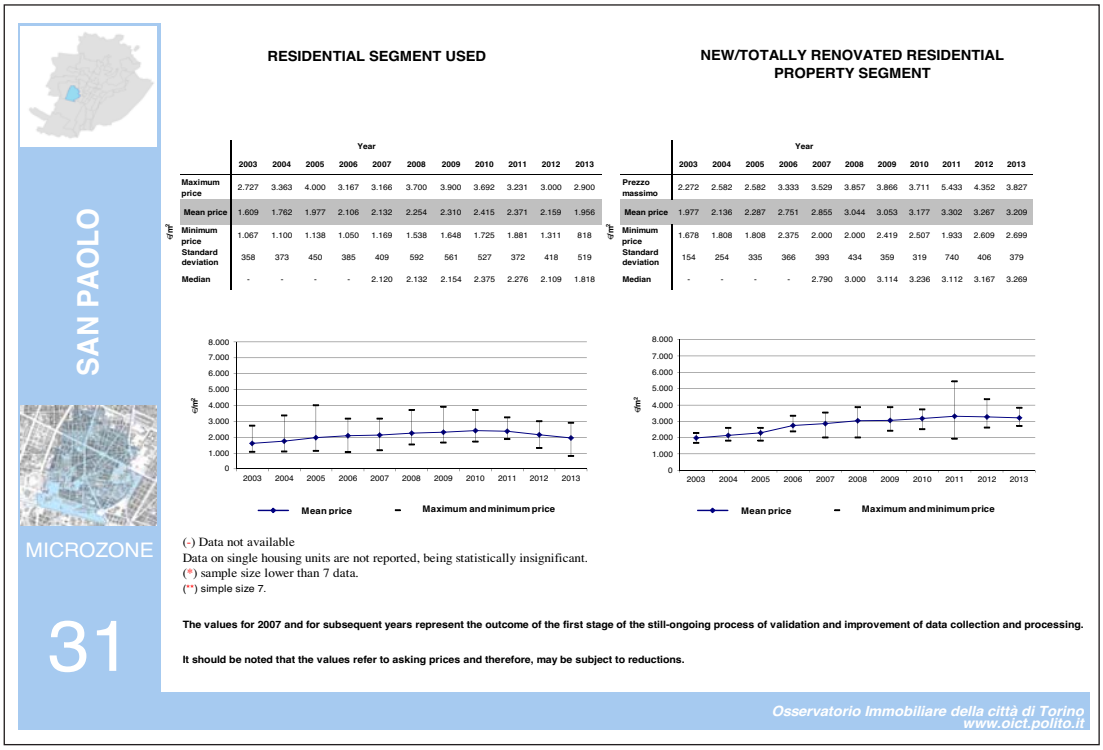
Immediately after the Microzones were established, Turin established its own Observatory for Real Estate as always envisaged by Presidential Decree (Law) 138/98. The Turin Real Estate Market Observatory, in operation since 2000 after an experimental phase, was established through a collaboration – officialised through agreements or memoranda of understanding that have been progressively renewed up until the present date – between the Politecnico di Torino, the City Council of Turin and, subsequently, the Turin Chamber of Commerce, in collaboration with the associations (estate agents and construction firms) in the property sector.

The main aim of the Turin Real Estate Market Observatory is to monitor the value of real estate in the municipality of Turin and the segments defined by the 40 Microzones, enabling, among other things, the Microzones to be updated, as already provided for by law (see Chapter I, article 2, paragraph 5 of Presidential Decree no. 138 of 1998). In addition to tasks of a more fiscal nature, the OICT provides support in decisions relating to land use planning, scheduling interventions and managing and promoting the use of public assets as well as to the simplification of a number of administrative procedures concerning land transformations as well as project assessment support.

Given these assumptions, the observatory's Land Information System was conceived from the outset to be open to and test the integration of various data sources after verifying their effective potential, and was progressively implemented until the structure of its current data ware house was achieved. The information gathered, which since 2008 has undergone a rigorous quality control process, gradually refined over time, provides a solid base for the testing of models, including advanced statistics, and for the development of specific studies, designed to provide an answer to specific queries by partner institutions or to be of use for search purposes in public administration procedures. In addition, the systematic updating of values and construction activity (with the production of "value tables" updated every six months: see example in Figure 2) enables market trends to be monitored and analysed over time in the 40 "sub-markets", checking their validity. For example, Semeraro (2011) verified empirically that market values and the liquidity of property markets in many areas are poorly correlated, in support of the validity of market segmentation defined by them. Previously, starting from 2003, in a specific study,[2] the Politecnico di Torino made a proposal of adjustments to Microzones boundaries, adjustments – it should also be noted – referred to in the form of the verification and the adjustment of boundaries. Subsequently – once again as part of specific projects and studies agreed with the city administration – Microzone 24 (Collina) was further divided into sub-segments (together with a number of adjacent Microzones, which together delineate the so-called "hilly area"). It then began to identify –initially for a number of Microzones and subsequently, in a more recent study, extending the procedure to the whole city – the geographical sub-segments on the basis of a specific methodology (incorporating specific data drawn from various disciplines).

2 Reference is made to the specific project The revision of municipal Microzones of the city of Turin (La revisione delle Microzone comunali della città di Torino) carried out by a working group of the Politecnico di Torino under an agreement with the Municipality of Turin.

Figure 2 An example of "value tables" for Microzone 31 (source: data drawn up by OICT)



Empirical analysis

The empirical analysis consisted in the determination of location coefficients for each Microzone in the city of Turin. Taking a year as a time reference period, the test determined the coefficients for 2012 and 2013 to highlight the usefulness of periodically updating the coefficients.

Data

The analyses used two separate OICT databases: **Offerte** (BDO) and **Catasto** (BDC). The first database is maintained internally by OICT through random sampling of individual residential properties for sale in Turin. The data is collected from advertisements placed on specialised websites. The BDO database contains information on both asking prices and the features of each property. The data are georeferenced by means of an address identification code. Turin's 40 Microzones, which are heterogeneous by definition, differ markedly from one another in terms of size, types of buildings and residential density. Thus it is appropriate to analyse them as separate markets and study property price trends relating to each geographical segment delineated by them.

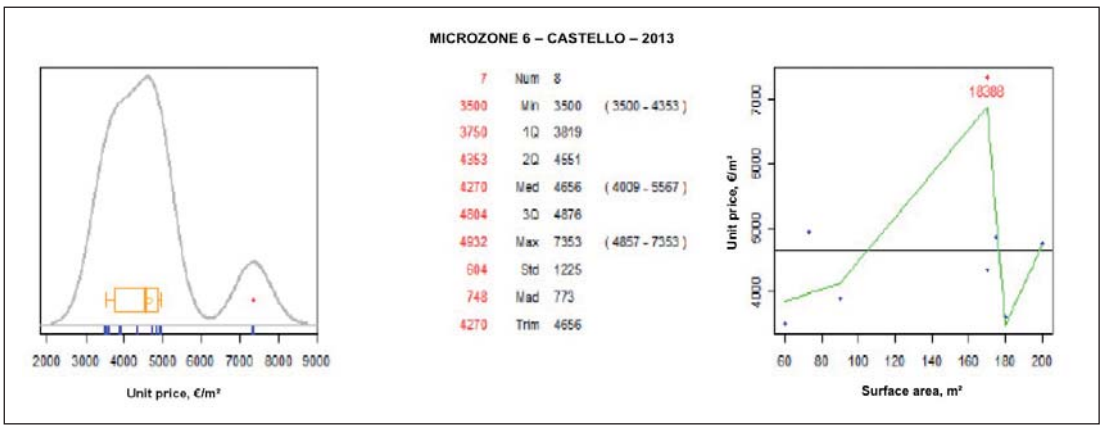
The analyses were carried out using samples collected by OICT in 2012 (OICT 2012 sample) and in 2013 (OICT 2013 sample). The OICT 2012 sample contains 640 records while the OICT 2013 sample contains 566 records.

Turin property asking price data, as already mentioned, underwent a quality control process designed to provide more statistically robust data and ensure a sufficient number of records and adequate coverage of the area concerned.

The "quality control process" performed on the OICT databases fulfils the requirement of gathering a sufficient number of records to ensure that the samples are statistically representative of individual Microzones, thus enabling the data to be subsequently processed and analysed. In addition, outliers

are identified for each Microzone. Figure 3 (2013 database) illustrates the process: for each Microzone any potential outliers are identified by means of a graphical and statistical analysis. In the case in question, concerning Microzone 6, it can be seen that a data item initially considered an outlier was subsequently retained in the BDO database, as following the quality control process it was found to be correct.

Figure 3 Example of analysis of Microzone 6, 2013 database (source: data drawn up by OICT)



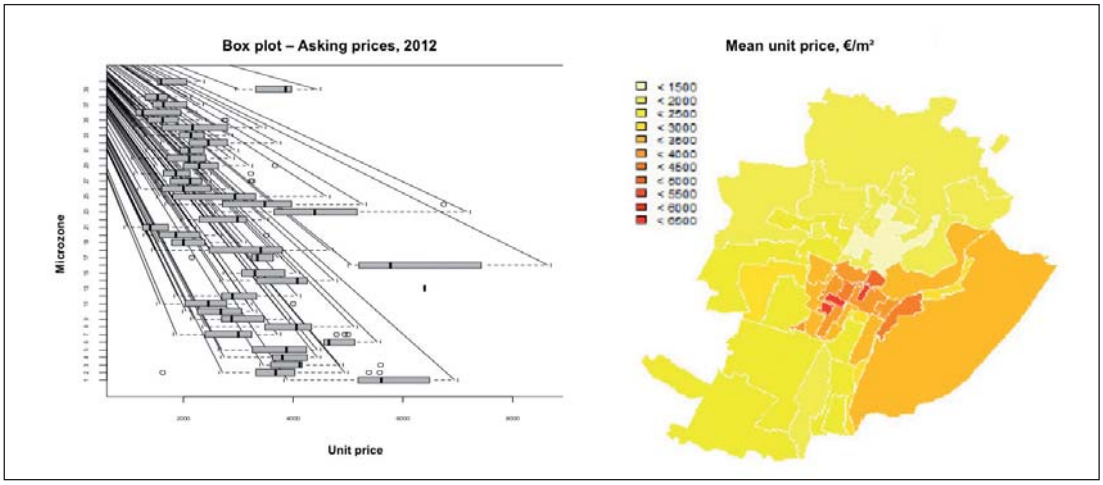
The empirical coefficients were calculated using the OICT 2012 sample, descriptive statistics for which are provided in Table 1.

Table 1 Descriptive statistics, 2012 sample (expressed in €/m²)

Microzone	Sample Size	Minimum	Mean	Maximum	Standard deviation	Median	Standard deviation/Mean (%)
01.Roma	7	3830	5681	7000	1078	5610	18,98%
02.Carlo Emanuele II	23	1625	3724	5571	872	3688	23,42%
03.Solferino	10	3391	4138	5588	677	4117	16,36%
04.Vinzaglio	11	2676	3814	4500	518	3800	13,58%
05.Garibaldi	15	2640	3757	4500	610	3878	16,24%
06.Castello	4	4500	4845	5588	501	4646	10,34%
07.Vanchiglia	23	1818	3019	5000	909	3000	30,11%
08.Rocca	11	2343	3845	5161	861	4056	22,39%
09.Valentino	13	2133	3043	3941	507	2880	16,66%
10.San Salvario	13	1975	2642	3333	499	2680	18,89%
11.Dante	20	1519	2458	4000	608	2454	24,74%
12.San Secondo	13	1833	3013	4133	566	2889	18,79%
13.Stati Uniti	NA	NA	NA	NA	NA	NA	NA
14.Galileo Ferraris	13	2667	3900	4800	660	4074	16,92%
15.De Gasperi	13	2720	3449	4115	474	3309	13,74%
16.Duca d'Aosta	4	5000	6309	8696	1662	5769	26,34%
17.Spina 2	7	2150	3293	3792	556	3350	16,88%
18.Duchessa Jolanda	13	1414	3104	4732	946	3414	30,48%
19.San Donato	17	1490	2119	3130	470	2000	22,18%
20.Porta Palazzo	14	1271	1996	3507	607	1867	30,41%

21.Palermo	35	917	1468	2222	352	1389	23,98%
22.Michelotti	11	1957	2759	3545	557	2982	20,19%
23.Crimea	14	2578	4444	7232	1229	4386	27,66%
24.Collina	50	1660	3461	6750	1023	3481	29,56%
25.Zara	10	1513	2826	4667	983	2940	34,78%
26.Carducci	19	1170	2077	2895	521	2000	25,08%
27.Unità D'Italia	11	1500	2181	3250	593	2120	27,19%
28.Lingotto	14	1100	1941	3222	513	1866	26,43%
29.Santa Rita-Mirafiori	47	1462	2341	3667	502	2290	21,44%
30.Mirafiori Sud	17	1064	2069	2917	456	2111	22,04%
31.San Paolo	20	1311	2159	3000	418	2109	19,36%
32.Pozzo Strada	25	1583	2524	3778	598	2451	23,69%
33.Aeronautica/Parella	17	1280	2164	2895	371	2138	17,14%
34.Spina 3	12	1082	2225	3500	733	2165	32,94%
35.MadonnaCampagna	28	1055	1695	2778	459	1618	27,08%
36.Spina 4	10	947	1507	2240	503	1253	33,38%
37.Rebaudengo	17	1047	1716	2362	388	1633	22,61%
38.Corona Nord Ovest	19	1062	1531	2138	290	1533	18,94%
39.Spina 1	8	2952	3716	4500	495	3859	13,32%
40.Barca Bertolla	11	1352	1797	2380	363	1593	20,20%
TORINO	**640**	**917**	**2710**	**8696**	**1135**	**2477**	**41,88%**

Figure 4 Asking prices, 2012 (Source: data drawn up by OICT)



The box plot in Figure 4 shows the large differences in asking prices in 2012 between Microzones. At the two extremes lie Microzone 1 (Roma), with an mean value of €5,681 per m², and Microzone 36 (Spina 4), where the mean value was €1,507 per m². Large differences in values exist not only between the different Microzones but also within each Microzone. It will be noted that in outlying Microzones the values tend to be lower and are less variable than in central and hilly areas. This can be explained by the greater homogeneity of outlying zones, both geographically as well as in terms of physical characteristics, building types and architectural features, as is typical of the "quantitative growth" phase of cities such as Turin. Larger differences exist in Microzones in the hilly area, such as in Microzones 23, 24 and 25. In general, variations in the central Microzones are attributable to the

high degree of differentiation that characterises older housing and to the fact that their values may also vary considerably as a result of the different state of conservation of historic buildings with the same architectural characteristics. The older housing segment is characterised on the one hand by higher prices and on the other by particularly low values (ranges). Last but not least, differences in value can also be explained by positional factors, limited to the "micro-context" level, which can have a significant positive or negative impact on values, as they can be determined by factors of social deprivation or prestige, owing among other things to the quality of public spaces (historic gardens, squares, etc.). It should be stressed once more that it was for this very reason that the Microzones were subsequently sub-segmented to reflect differences in values due to "micro-positional" factors more accurately. It should be pointed out in this regard that in the regulatory guidelines the positional factor regains its central importance, which was ignored by previous legislation.[3] Indeed, one of the most significant aspects in setting out the methodology for identifying and subsequently determining Microzones was, in the case of Turin, the analysis not only of the physical and construction characteristics intrinsic to the city's property, but also its extrinsic features, expressed through variables inherent in the quality of the micro-context, such as amenities, the composition of the social fabric and the presence of green areas, to mention the main ones. Specific sources and cross-disciplinary knowledge contributions have supported the identification and measurement of variables, incorporating previous research, conducted on the case of Turin. Indeed, the Microzones identified according to such regulatory guidelines constitute a more finely-tuned subdivision of the area than the census areas and thus lend themselves better to a grasp of micro-contextual factors; the sub-segmentation of the Microzones – currently being performed by the OICT as a specific study – represents a step forward with regard to the handling of "micro-positional" aspects.
We also computed the coefficients using the 2013 sample, descriptive statistics for which are provided in Table 2.

Table 2 Descriptive statistics, 2013 sample (expressed in €/m²)

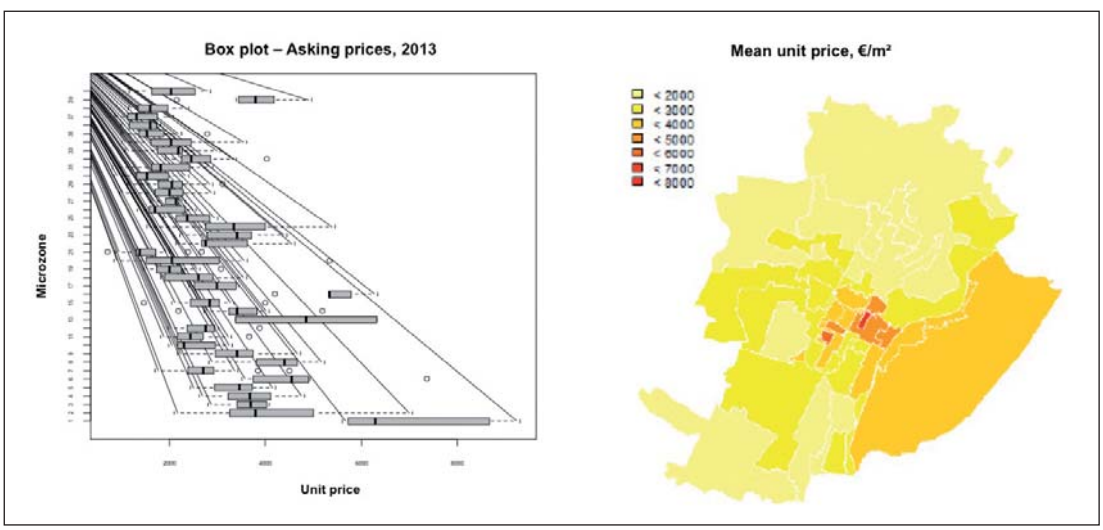
Microzone	Sample Size	Minimum	Mean	Maximum	Standard deviation	Median	Standard deviation/Mean (%)
01.Roma	5	5,603	7,111	9,294	1,740	6,281	24,47%
02.Carlo Emanuele II	18	2,109	4,085	7,059	1,245	3,789	30,48%
03.Solferino	11	2,800	3,658	4,071	442	3,688	12,08%
04.Vinzaglio	12	2,620	3,699	4,813	618	3,669	16,71%
05.Garibaldi	16	2,438	3,340	4,214	555	3,458	16,62%
06.Castello	8	3,500	4,656	7,353	1,225	4,551	26,31%
07.Vanchiglia	25	1,693	2,724	4,500	622	2,709	22,83%
08.Rocca	11	2,821	4,242	5,231	696	4,389	16,41%
09.Valentino	11	2,167	3,454	4,722	769	3,400	22,26%
10.San Salvario	11	1,985	2,529	3,311	475	2,300	18,78%
11.Dante	23	1,816	2,498	3,650	466	2,429	18,65%
12.San Secondo	11	1,971	2,707	3,870	537	2,760	19,84%

3 By law (Chapter I, articles 1 and 2, Presidential Decree no. 138 of 1998), a Microzone is a part of the municipal territory which, being identified in the land registry by one or more map sheets, must be homogeneous in an urban planning sense and at the same time represent a fully-fledged segment of the property market. Specifically, paragraph 1 states that "A Microzone represents a part of the municipal territory or, in the case of zones consisting of groups of municipalities, an entire municipal territory which is homogeneous in terms of location, urban character, historical and environmental features, socio-economic factors and in terms of provision of amenities and urban infrastructure. In each Microzone individual properties are homogeneous in terms of primary type, period of construction and use; it delineates geographical areas of a homogeneous market in terms of rents and values, and in particular the impact of characteristics extrinsic to properties on them." Indeed, the drawings representing Microzone perimeters, with reference to land registry maps, also include summaries describing each Microzone, referring to specific aspects such as geographical location; land registry map sheets representing the Microzone, requirements of existing planning instruments, settlement and construction characteristics, and socio-economic characteristics (classes of housing such as civile, economico, popolare, ultrapopolare, etc.).

Microzone	Sample Size	Minimum	Mean	Maximum	Standard deviation	Median	Standard deviation/Mean (%)
13.Stati Uniti	2	3,379	4,850	6,320	2,079	4,850	42,87%
14.Galileo Ferraris	13	2,190	3,503	5,185	709	3,409	20,24%
15.De Gasperi	14	1,467	2,771	4,000	605	2,834	21,83%
16.Duca d'Aosta	5	4,200	5,393	6,333	787	5,333	14,59%
17.Spina 2	4	2,400	2,957	3,444	519	2,991	17,55%
18.Duchessa Jolanda	10	1,810	2,583	3,611	664	2,607	25,71%
19.San Donato	13	1,467	2,073	3,067	444	2,000	21,42%
20.Porta Palazzo	11	844	2,430	5,333	1,313	2,045	54,03%
21.Palermo	17	707	1,523	2,667	501	1,381	32,90%
22.Michelotti	10	2,133	3,024	4,606	773	2,746	25,56%
23.Crimea	10	2,222	3,332	4,444	678	3,400	20,35%
24.Collina	41	1,538	3,386	5,455	978	3,333	28,88%
25.Zara	10	1,875	2,410	3,000	400	2,368	16,60%
26.Carducci	12	1,333	1,891	2,560	453	1,700	23,96%
27.Unità D'Italia	11	1,600	2,037	2,330	230	2,133	11,29%
28.Lingotto	17	965	1,973	2,941	512	2,000	25,95%
29.Santa Rita-Mirafiori	41	1,133	2,008	3,111	418	2,056	20,82%
30.Mirafiori Sud	13	852	1,638	2,407	495	1,524	30,22%
31.San Paolo	19	818	1,956	2,900	519	1,818	26,53%
32.Pozzo Strada	18	1,909	2,597	4,033	532	2,453	20,49%
33.Aeronautica/Parella	20	1,077	2,069	3,056	429	2,178	20,73%
34.Spina 3	12	1,013	2,072	3,608	716	2,028	34,56%
35.MadonnaCampagna	21	1,000	1,675	2,790	438	1,533	26,15%
36.Spina 4	11	989	1,459	1,818	320	1,600	21,93%
37.Rebaudengo	14	867	1,426	2,082	385	1,315	27,00%
38.Corona Nord Ovest	17	1,148	1,642	2,409	380	1,600	23,14%
39.Spina 1	8	2,154	3,745	4,971	821	3,797	21,92%
40.Barca Bertolla	10	1,167	2,038	2,863	547	2,038	26,84%
TORINO	**566**	**707**	**2648**	**9294**	**1146**	**2400**	**43,28%**

Figure 5 shows the spatial distribution of 2013 data.

Figure 5 Asking prices, 2013 (source: data drawn up by OICT)



The observations made concerning the 2012 data essentially apply to the 2013 data too, although changes in values over time can be observed, which, as we shall see, may make it necessary to draw up procedures for periodically updating coefficients at suitably determined intervals. Such updates may be carried out annually, given the easy replicability of the procedure.

The Municipality of Turin provided the OICT with the BDC (Banca Dati Catasto) database in Microsoft Excel (.xls) format. It contains land registry data on properties, including assumed revenues, category, class, number of rooms, location (map sheet, number, subdivision), etc. After cleaning the BDC contained 49,305 data items. The database was acquired to analyze the values and the differences in land registry values and, in particular, to determine what factors may underlie them, distinguishing between locational factors and physical/construction factors.

Table 3 provides descriptive statistics for the BDC sample. It is worth underlining the high degree of variability of land registry values in almost all of the Microzones, as can be inferred both from the standard deviation, the values of which often have the same order of magnitude as the mean values, as well as from the variation expressed as a range between the minimum and maximum values. The variability indicators emphasise how the classification system on which the land registry is based has been defined by means of a system which, structured on a broad spectrum of categories and classes, has certainly favoured physical and construction variables over other factors to record the heterogeneity of properties.

Table 3 Descriptive statistics, BDC database

Microzone	Freq	Min_rent	Mean_rent	Rent_St. dev	Max_rent
01.Roma	676	64,56	1248,08	892,39	6688,12
02.Carlo Emanuele II	1379	64,56	700,31	738,63	7901.79
03.Solferino	862	64,56	1272,61	1088,98	13107,68
04.Vinzaglio	916	72,3	1040,89	783,44	5132,29
05.Garibaldi	1515	64,56	794,54	586,99	5298,85
06.Castello	500	64,56	856,96	743,36	6979,91
07.Vanchiglia	1269	59,39	699,69	429,83	3579,05
08.Rocca	1092	64,56	790,69	765,34	9854,00
09.Valentino	1311	59,39	1612,70	1219,35	8837,87
10.San Salvario	1183	64,56	668,93	643,72	5132,29
11.Dante	1971	64,56	744,79	482,77	4668,77
12.San Secondo	1017	64,56	804,29	613,01	3207,20
13.Stati Uniti	416	96,84	2331,67	1780,23	11155,47
14.Galileo Ferraris	1009	161,39	2018,22	1397,10	7643,56
15.De Gasperi	1275	85,22	1092,01	737,39	7251,05
16.Duca d'Aosta	259	116,2	2646,69	2009,31	9466,65
17.Spina 2	583	77,47	1058,41	603,15	2928,31
18.Duchessa Jolanda	1123	77,47	1066,26	694,93	4389,88
19.San Donato	1274	64,56	739,62	548,73	4880,52
20.Porta Palazzo	1341	64,56	578,70	389,43	3416,36
21.Palermo	1632	52,00	534,84	329,33	2379,58
22.Michelotti	667	54,23	745,72	478,33	5666,82
23.Crimea	569	152,35	1235,70	778,83	6058,04
24.Collina	528	64,56	1801,78	1343,85	9265,24
25.Zara	521	111,04	896,49	633,08	4979,94
26.Carducci	1673	72,3	780,78	388,41	3355,68

Microzone	Freq	Min_rent	Mean_rent	Rent_St. dev	Max_rent
27.Unità D'Italia	1909	46,48	1095,53	1079,10	39601,92
28.Lingotto	1507	92,96	713,32	362,03	2917,98
29.Santa Rita-Mirafiori	2659	69,72	890,22	420,41	4183,30
30.Mirafiori Sud	2306	54,23	548,56	182,91	1508,05
31.San Paolo	1261	46,48	769,91	394,53	5981,86
32.Pozzo Strada	2098	161,39	1184,65	602,62	5298,85
33.Aeronautica/Parella	1365	77,47	709,56	372,17	2755,30
34.Spina 3	973	28,92	734,55	403,01	3005,78
35.MadonnaCampagna	1521	99,42	754,56	279,83	2464,79
36.Spina 4	1019	82,63	699,92	315,99	2346,01
37.Rebaudengo	1337	48,03	638,57	316,26	2357,63
38.Corona Nord Ovest	3258	46,48	560,71	302,62	2630,06
39.Spina 1	519	275,01	1291,13	365,50	4085,17
40.Barca Bertolla	1012	50,61	466,85	301,84	2231,09

To give an idea of the distribution of rents in each Microzone, a box plot is provided in Figure 6. The graph shows the large number of outliers, which points to the high degree of heterogeneity of the sample compared to the poor differentiation of values between the city's different Microzones.

Figure 6a Box plot of actual rents based on land registry values (source: data drawn up by OICT)

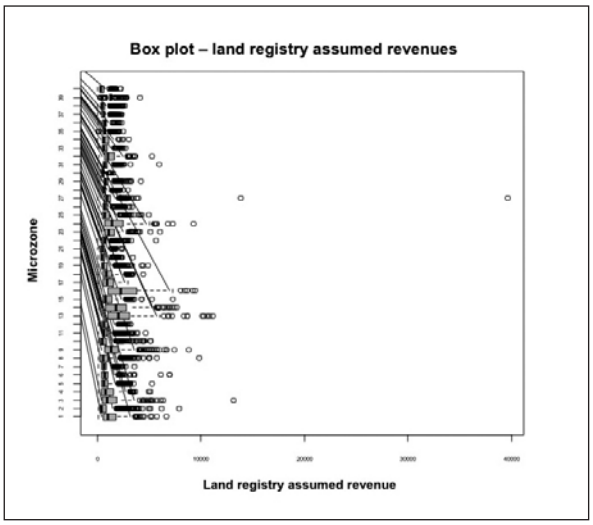
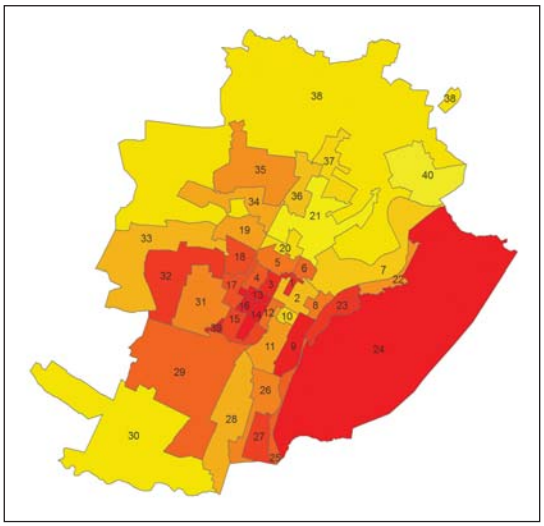


Figure 6b Mean actual rents based on land registry values by Microzone (source: data drawn up by OICT)



Before entering into the merits of the results of the analyses carried out using the two databases (BDO and BDC), to have an initial representation of the difference between actual values and land registry values, a sub-sample was selected consisting of 129 residential units for sale on the Turin real estate market in 2013. Each property with a known asking price was associated with an assumed revenue based on its land registry value, the assumed revenue was calculated on the assumption that the individual properties were the main dwelling, the asking price was based on square meters and the land registry value was expressed in terms of square meters. The values, disaggregated by Microzone, appear in Table 4. The sample of 129 properties (the BDM sample) was achieved through a merge between the OICT sample for 2013 and the BDC sample. This merge was carried out by using properties address. However, in view of the lack of land registry references in the 2013 OICT sample, not all of the individual units in the OICT database could be identified in an unequivocal manner.
Despite the small sample size, the statistics in Table 4 highlight the need to adjust actual rents based on the location of buildings. Table 4 includes Microzones with at least 3 observations and highlights Microzones with at least 7 observations in bold, thus allowing a comparison between mean prices.

Table 4 Mean market prices and land registry values by Microzone

Microzone	Frequency	Mean rent	Mean asking price	Mean land registry value	Mean asking price (m^2)	Mean land registry value (m^2)
02.Carlo Emanuele II	3	1848,91	543333,33	232963,08	3600,62	1791,84
05. Garibaldi	4	513,34	464750,00	64680,21	4016,52	648,98
07. Vanchiglia	5	694,38	319600,00	87491,38	2844,39	1056,14
08. Rocca	3	1672,03	678333,33	210675,78	4277,47	1563,17
09. Valentino	3	1160,30	451666,67	146198,22	3207,66	1093,05
10. San Salvario	4	362,17	252250,00	45632,79	2844,11	595,83
11. Dante	5	897,08	345800,00	113032,58	3209,02	1011,38
15. De Gasperi	**7**	**1048,41**	**400714,29**	**132099,66**	**3395,85**	**1070,64**
16. Duca d'Aosta	3	1659,98	1350000,00	209157,48	6860,09	1095,03
18. Duchessa Jolanda	3	950,71	651333,33	119789,46	3635,02	744,58
19. San Donato	4	1077,78	265750,00	135800,60	2243,70	1077,13
21. Palermo	**8**	**599,25**	**135737,50**	**75505,82**	**1362,05**	**785,37**

Microzone	Frequency	Mean rent	Mean asking price	Mean land registry value	Mean asking price (m^2)	Mean land registry value (m^2)
22. Michelotti	3	1428,87	433666,67	180037,20	3230,67	1302,63
23. Crimea	3	881,85	753333,33	111113,10	4281,90	752,56
24. Collina	**9**	**1107,80**	**651555,56**	**139582,80**	**3400,95**	**784,65**
25. Zara	3	1380,23	374666,67	173908,98	3095,20	1710,10
28. Lingotto	4	774,69	285750,00	97610,31	1962,17	904,75
29. Santa Rita-Mirafiori	**10**	**661,32**	**184000,00**	**83326,82**	**2247,16**	**1005,18**
31. San Paolo	4	434,47	143250,00	54743,22	1983,44	856,99
33. Aeronautica/Parella	**12**	**522,38**	**211083,33**	**65819,25**	**2163,56**	**700,22**
35. Madonna Campagna	**8**	**732,40**	**139125,00**	**92282,56**	**2024,10**	**1358,78**
36. Spina 4	3	384,33	68333,33	48426,00	1143,50	907,00

From both the comparison of the BDC with BDO databases (for 2012 and 2013) and the direct comparison with the sample (BDM), a strong discrepancy emerges between land registry values and asking prices. Moreover, it is clear that actual rents do not reflect the differences in asking prices in the various Microzones, which are thus due to the contribution of location to price. For example in Microzones 29, 33 and 37 (all with more than 7 records in the BDM), it can be seen that the sort order between mean revenues does not match the sort order between their values. For further confirmation of the discrepancy between actual rents and market values, a linear correlation was calculated between the two variables, with the result ρ=0.53 with a p-value of less than 0.01. Figures 3, 4 and 5 represent the spatial distribution of asking prices and of actual rents in the various Microzones. Specifically, Figure 5 shows differences in actual rents, Figure 3 shows asking prices variation in the 2012 database, and Figure 4 shows asking prices variation in the 2013 database. A comparison of the graphs shows that while asking prices have very different central values in the various Microzones, actual rents are aligned, according to the intuition that rents do not depend on location.

RESULTS

This section presents the empirical location adjustment coefficients calculated for each Microzone and, therefore, enables positive and negative deviations which would determine assumed revenues. Specifically, Table 5 provides the coefficients c_i, i=1,...,40 calculated using equation (1), where P_i, i=1,...,40 are the mean asking prices calculated in the 40 land registry Microzones, using the OICT's *Offerte 2012* sample. Figure 6 highlights the Microzones in which adjusted rents would increase as opposed to those in which they would decrease.

Table 5 Coefficients calculated taking mean prices published by OICT in 2012 as reference prices

Microzone	Reference price: Mean AP 2013	Empirical coefficients	Microzones with increase in revenues	Microzone	Reference price: Mean AP 2013	Empirical coefficients	Microzones with increase in revenues
01.Roma	5681	2,10	1	21.Palermo	1468	0,54	0
02.Carlo Emanuele II	3724	1,37	1	22.Michelotti	2759	1,02	1
03.Solferino	4138	1,53	1	23.Crimea	4444	1,64	1
04.Vinzaglio	3814	1,41	1	24.Collina	3461	1,28	1
05.Garibaldi	3757	1,39	1	25.Zara	2826	1,04	1
06.Castello	4845	1,79	1	26.Carducci	2077	0,77	0
07.Vanchiglia	3019	1,11	1	27.Unità D'Italia	2181	0,80	0
08.Rocca	3845	1,42	1	28.Lingotto	1941	0,72	0
09.Valentino	3043	1,12	1	29.Santa Rita-Mirafiori	2341	0,86	0
10.San Salvario	2642	0,97	0	30.Mirafiori Sud	2069	0,76	0

Microzone	Reference price: Mean AP 2013	Empirical coefficients	Microzones with increase in revenues	Microzone	Reference price: Mean AP 2013	Empirical coefficients	Microzones with increase in revenues
11.Dante	2458	0,91	0	31.San Paolo	2159	0,80	0
12.San Secondo	3013	1,11	1	32.Pozzo Strada	2524	0,93	0
13.Stati Uniti	NA	NA	NA	33.Aeronautica/Parella	2164	0,80	0
14.Galileo Ferraris	3900	1,44	1	34.Spina 3	2225	0,82	0
15.De Gasperi	3449	1,27	1	35.MadonnaCampagna	1695	0,63	0
16.Duca d'Aosta	6309	2,33	1	36.Spina 4	1507	0,56	0
17.Spina 2	3293	1,22	1	37.Rebaudengo	1716	0,63	0
18.Duchessa Jolanda	3104	1,15	1	38.Corona Nord Ovest	1531	0,56	0
19.San Donato	2119	0,78	0	39.Spina 1	3716	1,37	1
20.Porta Palazzo	1996	0,74	0	40.Barca Bertolla	1797	0,66	0
Torino	**2710**						

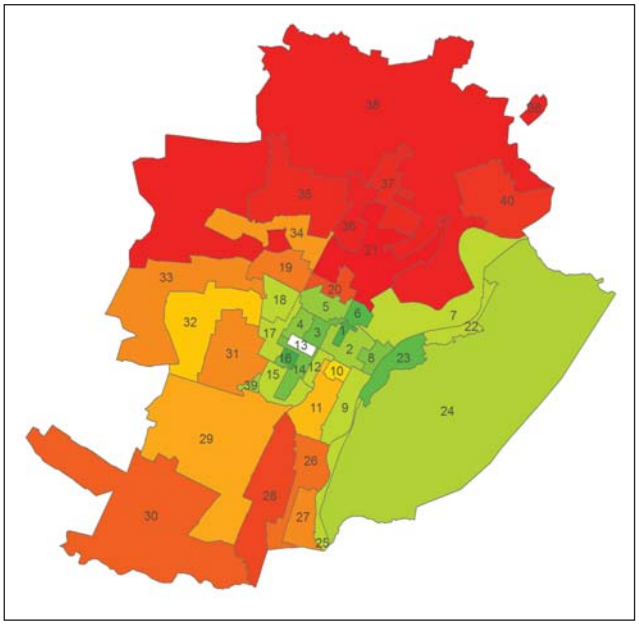
Table 6 provides mean values and standard deviations of actual rents and of adjusted rents calculated by assuming that they are all the main dwelling, and using location adjustment coefficients calculated using the OICT 2012 sample. It is clear that in Microzone 1 the adjusted rents almost doubles whereas in outlying Microzones (see, for example, Microzones 33-40, with the exception of Microzone 39, Spina 1, which sees an increase in revenues) it falls by almost half. To get an immediate idea of the spatial variation in actual rents or of land registry values due to adjustments, see Figure 7.

Table 6 Descriptive statistics with adjusted values, database 2012

Microzona	Rendita_media	R_media agg12	R_Dev.st agg12	Valore_Cat medio.	Val_Cat_medio agg12	Val_Cat_Dev.st agg12
01.Roma	1248,08	2620,97	1874,02	157258,09	330241,98	236126.96
02.Carlo Emanuele II	700,31	959,42	1011,92	88238,53	120886,78	127502.44
03.Solferino	1272,61	1947,10	1666,13	160349,20	245334,28	209932.95
04.Vinzaglio	1040,89	1467,65	1104,65	131151,86	184924,12	139185.74
05.Garibaldi	794,54	1104,40	815,92	100111,42	139154,87	102805.45
06.Castello	856,96	1533,96	1330,61	107976,92	193278,70	167656.58
07.Vanchiglia	699,69	776,66	477,11	88161,42	97859,18	60115.45
08.Rocca	790,69	1122,78	1086,79	99626,82	141470,09	136935.35
09.Valentino	1612,70	1806,22	1365,68	203200,19	227584,21	172075.21
10.San Salvario	668,93	648,86	624,41	84285,00	81756,45	78675.18
11.Dante	744,79	677,76	439,32	93843,97	85398,02	55354.36
12.San Secondo	804,29	892,76	680,45	101340,45	112487,90	85736.19
13.Stati Uniti	2331,67	NA	NA	293790,72	NA	NA
14.Galileo Ferraris	2018,22	2906,24	2011,82	254296,24	366186,58	253489,42
15.De Gasperi	1092,01	1386,85	936,49	137593,26	174743,44	117997,85
16.Duca d'Aosta	2646,69	6166,78	4681,70	333482,56	777014,35	589893,78
17.Spina 2	1058,41	1291,27	735,85	133360,18	162699,42	92716,93
18.Duchessa Jolanda	1066,26	1226,20	799,17	134348,55	154500,83	100695,06
19.San Donato	739,62	576,91	428,01	93192,55	72690,19	53929,31
20.Porta Palazzo	578,70	428,24	288,18	72916,55	53958,25	36310,41
21.Palermo	534,84	288,81	177,84	67389,31	36390,23	22407,83
22.Michelotti	745,72	760,64	487,90	93960,85	95840,07	61475,11
23.Crimea	1235,70	2026,56	1277,27	155698,82	255346,06	160936,51

Microzona	Rendita_media	R_media agg12	R_Dev.st agg12	Valore_Cat medio.	Val_Cat_medio agg12	Val_Cat_Dev.st agg12
24.Collina	1801,78	2306,28	1720,12	227024,49	290591,35	216735,49
25.Zara	896,49	932,35	658,40	112957,26	117475,55	82958,63
26.Carducci	780,78	601,20	299,07	98378,13	75751,16	37683,06
27.Unità D'Italia	1095,53	876,42	863,28	138036,55	110429,24	108773,24
28.Lingotto	713,32	513,59	260,66	89878,55	64712,56	32843,66
29.Santa Rita-Mirafiori	890,22	765,59	361,55	112167,93	96464,42	45555,66
30.Mirafiori Sud	548,56	416,90	139,02	69118,13	52529,78	17515,90
31.San Paolo	769,91	615,93	315,63	97008,30	77606,64	39768,85
32.Pozzo Strada	1184,65	1101,73	560,43	149266,24	138817,61	70614,57
33.Aeronautica/Parella	709,56	567,65	297,74	89404,24	71523,39	37514,82
34.Spina 3	734,55	602,33	330,47	92552,86	75893,34	41638,89
35.MadonnaCampagna	754,56	475,37	176,29	95074,29	59896,80	22213,10
36.Spina 4	699,92	391,96	176,96	88189,93	49386,36	22296,38
37.Rebaudengo	638,57	402,30	199,25	80460,30	50689,99	25105,02
38.Corona Nord Ovest	560,71	314,00	169,47	70648,92	39563,40	21352,86
39.Spina 1	1291,13	1768,85	500,73	162682,32	222874,78	63092,13
40.Barca Bertolla	466,85	308,12	199,21	58823,02	38823,19	25100,98

Figure 7 Change in actual rents in land registry Microzones, 2012 database. Microzones which experienced a decrease are shown in red and Microzones which experienced an increase in revenues are shown in green. (Source: data drawn up by OICT)



The same analysis was also conducted with a data sample extracted from the *Offerte* (asking price) 2013 database, to see whether in two consecutive years there are any significant changes in the coefficients.

Table 7 provides the coefficients c_i, i=1,...,40 calculated using equation (1), where P_i, i=1,...,40 are the mean asking prices calculated in 40 land registry Microzones using the OICT 2013 *Offerte* sample.

Table 7: Estimated coefficients with reference mean prices published by OICT in 2013

Microzone	Reference price: Mean AP 2013	Empirical coefficients	Microzones with an increase in assumed revenues	Microzone	Reference price: Mean AP 2013	Empirical coefficients	Microzones with an increase in assumed revenues
01.Roma	7111,34	2,41	1	21.Palermo	1523,45	0,52	0
02.Carlo Emanuele II	4085,07	1,38	1	22.Michelotti	3024,45	1,02	1
03.Solferino	3657,50	1,24	1	23.Crimea	3332,25	1,13	1
04.Vinzaglio	3698,51	1,25	1	24.Collina	3385,51	1,15	1
05.Garibaldi	3339,78	1,13	1	25.Zara	2410,15	0,82	0
06.Castello	4655,57	1,58	1	26.Carducci	1891,46	0,64	0
07.Vanchiglia	2723,83	0,92	0	27.Unità D'Italia	2037,50	0,69	0
08.Rocca	4241,69	1,44	1	28.Lingotto	1972,60	0,67	0
09.Valentino	3453,77	1,17	1	29.Santa Rita-Mirafiori	2007,99	0,68	0
10.San Salvario	2529,38	0,86	0	30.Mirafiori Sud	1638,11	0,55	0
11.Dante	2498,03	0,85	0	31.San Paolo	1955,98	0,66	0
12.San Secondo	2706,89	0,92	0	32.Pozzo Strada	2597,43	0,88	0
13.Stati Uniti	4849,66	1,64	1	33.Aeronautica/Parella	2069,47	0,70	0
14.Galileo Ferraris	3503,47	1,19	1	34.Spina 3	2071,55	0,70	0
15.De Gasperi	2770,62	0,94	0	35.MadonnaCampagna	1674,88	0,57	0
16.Duca d'Aosta	5392,77	1,83	1	36.Spina 4	1458,67	0,49	0
17.Spina 2	2956,51	1,00	1	37.Rebaudengo	1426,22	0,48	0
18.Duchessa Jolanda	2583,26	0,87	0	38.Corona Nord Ovest	1642,46	0,56	0
19.San Donato	2072,50	0,70	0	39.Spina 1	3745,39	1,27	1
20.Porta Palazzo	2429,70	0,82	0	40.Barca Bertolla	2038,43	0,69	0
Torino	**2648,00**						

Once the coefficients have been calculated by applying formula (1), land registry revenue values can be obtained for each individual property, adjusted for each Microzone. Table 8 provides mean values and standard deviations of rents and of adjusted land registry values, also in this case calculated by assuming that they are the main dwelling, with by using location adjustment coefficients calculated on the OICT 2013 database. Using the OICT 2013 sample, we find – according to the results obtained using OICT 2012 sample -, in Microzone 1 the mean rent more than doubles whereas in outlying Microzones (see, for example, Microzones 33-40, with the exception of Microzone 39, which sees an increase in assumed revenue) it is virtually halved.

Table 8 Descriptive statistics, adjusted values, 2013 database

Microzone	Rendita_media	R_media_agg13	R_Dev.st_agg13	Val_Cat_medio	Val_Cat_medio_agg13	Val_Cat_Dev.st_agg13
01.Roma	1248,08	3005,68	2149,10	157258,09	378715,40	270786,03
02.Carlo Emanuele II	700,31	968,80	1021,82	88238,53	122069,19	128749,56
03.Solferino	1272,61	1576,27	1348,81	160349,20	198609,58	169950,55
04.Vinzaglio	1040,89	1303,71	981,25	131151,86	164267,04	123637,90
05.Garibaldi	794,54	898,63	663,89	100111,42	113227,13	83650,44
06.Castello	856,96	1351,08	1171,97	107976,92	170236,29	147668,81
07.Vanchiglia	699,69	645,41	396,48	88161,42	81321,80	49956,45
08.Rocca	790,69	1135,78	1099,37	99626,82	143107,91	138520,68
09.Valentino	1612,70	1886,23	1426,17	203200,19	237665,43	179697,56
10.San Salvario	668,93	572,98	551,39	84285,00	72195,98	69475,02
11.Dante	744,79	630,06	408,40	93843,97	79387,57	51458,43
12.San Secondo	804,29	737,28	561,94	101340,45	92897,03	70804,40
13.Stati Uniti	2331,67	3829,37	2923,72	293790,72	482500,31	368388,74
14.Galileo Ferraris	2018,22	2394,51	1657,58	254296,24	301708,23	208854,86
15.De Gasperi	1092,01	1024,60	691,87	137593,26	129099,01	87175,84
16.Duca d'Aosta	2646,69	4833,51	3669,51	333482,56	609022,60	462357,79
17.Spina 2	1058,41	1059,70	603,89	133360,18	133522,23	76089,83
18.Duchessa Jolanda	1066,26	932,78	607,93	134348,55	117530,38	76599,77
19.San Donato	739,62	519,10	385,13	93192,55	65407,13	48525,96
20.Porta Palazzo	578,70	476,16	320,43	72916,55	59996,63	40373,85
21.Palermo	534,84	275,93	169,91	67389,31	34767,16	21408,40
22.Michelotti	745,72	763,78	489,92	93960,85	96236,85	61729,62
23.Crimea	1235,70	1394,44	878,87	155698,82	175699,80	110738,00
24.Collina	1801,78	2065,74	1540,71	227024,49	260282,69	194129,99
25.Zara	896,49	731,71	516,71	112957,26	92195,02	65106,08
26.Carducci	780,78	500,12	248,79	98378,13	63015,03	31347,36
27.Unità D'Italia	1095,53	755,91	744,57	138036,55	95244,60	93816,31
28.Lingotto	713,32	476,51	241,84	89878,55	60040,46	30472,42
29.Santa Rita-Mirafiori	890,22	605,35	285,88	112167,93	76274,53	36020,91
30.Mirafiori Sud	548,56	304,31	101,47	69118,13	38342,75	12785,28
31.San Paolo	769,91	509,98	261,33	97008,30	64257,18	32928,03
32.Pozzo Strada	1184,65	1042,04	530,07	149266,24	131296,94	66788,91
33.Aeronautica/Parella	709,56	497,27	260,83	89404,24	62656,44	32864,00
34.Spina 3	734,55	515,30	282,72	92552,86	64928,39	35622,97
35.MadonnaCampagna	754,56	427,98	158,72	95074,29	53925,58	19998,63
36.Spina 4	699,92	345,74	156,09	88189,93	43563,76	19667,66
37.Rebaudengo	638,57	308,42	152,75	80460,30	38861,13	19246,59
38.Corona Nord Ovest	560,71	311,87	168,32	70648,92	39296,13	21208,61
39.Spina 1	1291,13	1637,63	463,59	162682,32	206341,11	58411,73
40.Barca Bertolla	466,85	322,27	208,36	58823,02	40606,21	26253,79

Figure 8 gives a geographical representation of the macro-areas that would undergo an increase or a decrease in rents by using location adjustment coefficients calculated using the sample OICT 2013. It is clear that, as was seen with the 2012 data, the increase would affect the more prestigious central and hilly areas.

Figure 8 Variations in assumed revenues by Microzone, 2013 database. Microzones in which revenues decreased are shown in red and Microzones in which rents increased are shown in green (source: data drawn up by OICT)

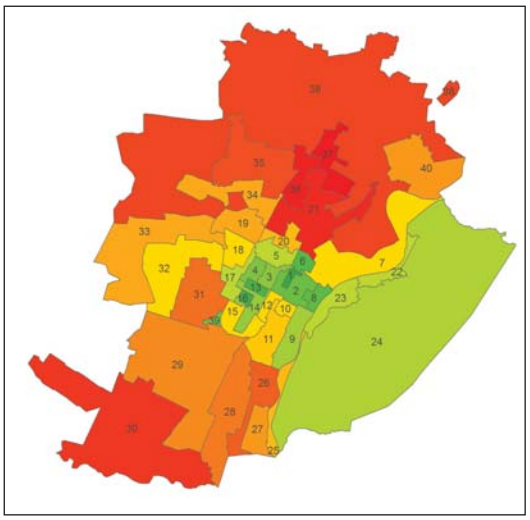


Figure 9 shows box plots by Microzone of adjusted rents with both the 2012 and 2013 databases. From a look at the charts and after comparing them with Figure 6, box plot of assumed revenues, it is immediately apparent that the adjusted actual rents present more heterogeneous central values by Microzones and that the variability of data is less homogeneous in several Microzones with respect to assumed revenues. In contrast, the comparison with Figure 4 and with Figure 5 – respectively the box plots of asking prices in 2012 and 2013 – shows a behaviour of adjusted revenues which is more closely correlated with the behaviour of market prices.

Figure 9a Box plot, adjusted revenues (source: data drawn up by OICT)

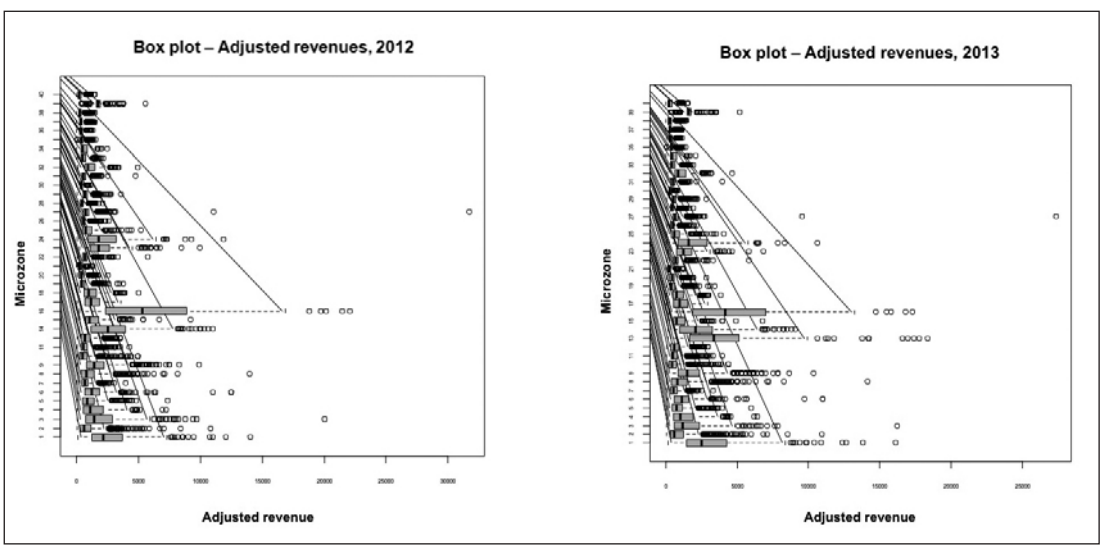
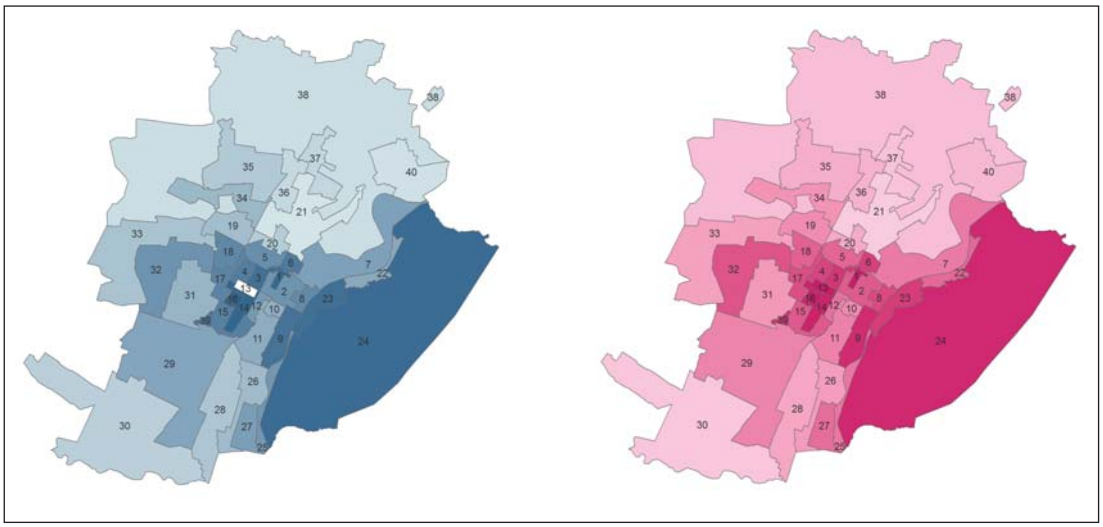


Figure 9b Mean adjusted revenues per Microzone (2012 database in blue and 2013 database in pink). (Source: data drawn up by OICT)



As can be seen from results obtained by the case study, both by using data for 2012 as well as data for 2013 for central and hilly areas there would be an increase in adjusted rents, while in outlying and semi-outlying areas there would be a decrease. A comparison between the graphs in Figure 10 also shows that the results obtained from the databases for the two consecutive years are very similar. However, a comparison between coefficients calculated on the basis of the 2012 sample and coefficients calculated on the basis of the 2013 sample (Table 9) shows that the coefficient percentage difference, Microzones $\Delta c\%=(c_{2012}-c_{2013})/c_{2012}$, where c_{2012} and c_{2013} are the coefficients calculated using 2012 and 2013 data respectively, in half of the Microzones would be greater than 20%. The highest percentage coefficient difference occurs in Microzone 23 (Crimea), where $\Delta c\%=27.15\%$, which is consistent with the fact that the Microzone in question is considered one of the most prestigious. In all other cases $\Delta c\%<25\%$. This result highlights the importance of the time period used for the analysis, which should appropriately identified to obtain sufficiently stable coefficients over time. In any case the periodic revision of these coefficients is essential for a correct geographical distribution of land registry values, both on economic grounds and because of the effects produced by public measures at both the urban and the micro-geographical scale, as in the case of redevelopment of public spaces.

Table 9 Change in coefficients calculated in 2012 and 2013

Microzone	Δc	Δc%	Microzone	Δc	Δc%
01.Roma	-0,43	-21,61%	21.Palermo	0,00	-0,82%
02.Carlo Emanuele II	-0,09	-6,57%	22.Michelotti	-0,06	-6,50%
03.Solferino	0,20	14,13%	23.Crimea	0,42	27,15%
04.Vinzaglio	0,08	5,79%	24.Collina	0,06	4,97%
05.Garibaldi	0,18	13,64%	25.Zara	0,17	17,15%
06.Castello	0,11	6,65%	26.Carducci	0,08	11,53%
07.Vanchiglia	0,13	12,35%	27.Unità D'Italia	0,07	9,24%
08.Rocca	-0,10	-7,17%	28.Lingotto	0,01	1,27%
09.Valentino	-0,11	-10,26%	29.Santa Rita-Mirafiori	0,14	16,67%
10.San Salvario	0,06	6,99%	30.Mirafiori Sud	0,17	23,08%
11.Dante	0,01	1,27%	31.San Paolo	0,09	11,99%
12.San Secondo	0,13	12,72%	32.Pozzo Strada	0,00	0,02%
13.Stati Uniti	NA	NA	33.Aeronautica/Parella	0,05	7,09%
14.Galileo Ferraris	0,17	12,73%	34.Spina 3	0,07	9,55%
15.De Gasperi	0,26	21,96%	35.MadonnaCampagna	0,02	4,00%
16.Duca d'Aosta	0,37	16,96%	36.Spina 4	0,03	5,97%
17.Spina 2	0,15	12,78%	37.Rebaudengo	0,12	19,26%
18.Duchessa Jolanda	0,21	19,15%	38.Corona Nord Ovest	-0,02	-4,22%
19.San Donato	0,04	4,98%	39.Spina 1	0,03	2,08%
20.Porta Palazzo	-0,12	-18,25%	40.Barca Bertolla	-0,06	-10,20%

It should be underlined that the increase/decrease in adjusted actual rents will vary between Microzones as a result of the density of residential units that are very different from each other, and that the contribution made by each Microzone to tax revenues for the whole city will depend on the tax rates themselves, which may be established by implementing additional corrective actions which may concern specific situations regarding properties or the socio-economic situation of individual owners. It should also be underlined that the land registry values were recalculated with the sole assumption being that the property is a main dwelling, while it would be necessary to have information on ownership of the property to be able to produce simulations on the whole city which correspond more closely to reality.

CONCLUSIONS

This study fully confirms the hypothesis according to which by introducing corrective measures relating to location the taxable values on which property taxes are based can be redefined, thus reducing significantly current fiscal inequity due to the obsolescence of the current land registry system. In particular, it sets out to stress the effectiveness of the proposed procedure, one aspect of which is the short timescale required for its implementation, since the procedure can be deployed easily, being quite simple in itself – as it is based on basic statistical indicators – and uses market data that disregards the physical and construction characteristics of properties, being based instead on asking prices and size, and disaggregated only by municipal Microzones. The use of asking prices as a proxy variable for actual sale prices, can be considered admissible since location-based correction indicators are based on relative prices and not on absolute values. Furthermore, where land registry databases allow, the convergence between land registry values and actual market values could be further improved by transforming the actual rents based defined by considering the number of rooms into

rents defined by considering property sizes, as shown by previous analyses conducted in the field by the OICT. The results achieved in terms of equity are extremely positive if consideration is given to the fact that the proposed procedure – which is highly functional and at the same time methodologically correct – makes it possible to restructure land registry values, which would rise in more prestigious, higher quality Microzones of higher quality and merit – such as those in central and hilly areas – and would decrease in semi-central and outlying areas. This adjustment could also take place by introducing the obligation to maintain the same total tax revenues and, therefore, could allow more equitable property taxation, whatever this may be and regardless of the rates it is decided to apply. The introduction of a variable regarding location to recalculate assumed revenues based on land registry values is consistent with what has been empirically established in both the Italian and international literature, which have documented the importance of the contribution of location to the market price of residential units. The simulations produced results which went beyond the proposed objectives because it was possible to ascertain whether and how a variable location was considered in the formation of rents in the land registry system at the moment when it was established. Strong evidence emerged that the 4 census areas at the basis of Turin's land classification system have no influence on the determination of actual rents, differences in which seem to be largely determined by the building class system, in other words because of the characteristics considered under this system to be of a related to buildings' physical and construction characteristics and their type. Census areas, therefore, have no distorting effect on actual rents, insofar as it transpires that they have no influence whatsoever on differences between them. After so many years, nevertheless, it is incredible that such a system was able to survive without ever having been verified in terms of its ability to determine rents depending on geographical hierarchies as well as on building categories and classes. The limitations of the current land registry system are certainly due to the fact that a complex, highly structured system of classification had been determined, without submitting it to reviews or checks, when statistical classification tools were available which could have anticipated the result verification stage.

References

Bourassa, S., Cantoni, E. & Hoesli, M. (2007), Spatial Dependence, Housing Submarkets, and House Prices. *Journal of Real Estate Finance and Economics,* 35(2), pp. 143–160.

Bourassa, S., Cantoni, E. & Hoesli, M. (2010), Predicting house prices with spatial dependence: a comparison of alternative methods. *Journal of Real Estate Research,* 32(2), pp. 139-159.

Bourassa, S., Hoesli, M. & Peng, V. S. (2003), Do housing submarkets really matter?, *Journal of Housing Economics,* 12(1), pp. 12-28.

Curto R., Fregonara E. (2002), "Un Sistema Informativo Territoriale per l'osservazione del mercato immobiliare a supporto dei catasti urbani e della gestione del territorio", in Roscelli R. (a cura di), Mercato immobiliare, innovazione e gestione dei catasti urbani, *Quaderno Ce.S.E.T.* n. 8, 2002.

Curto R., Fregonara E. and Semeraro P. (2014), Listing behaviour in the Italian real estate market. Accettato per la pubblicazione su *International Journal of Housing Markets and Analysis.*

Fregonara E., Semeraro P. (2013), The impact of house characteristics on the bargaining outcome, *Journal of European Real Estate Research*, 6, pp. 262-278.

Pace R. K., Barry R., Sirmans C. F. (1998), Spatial Statistics and Real Estate, *Journal of Real Estate Finance and Economics*, 17 (1), pp. 5-13.