

Urban Sprawl, Labor Incomes and Real Estate Values

Massimiliano Bencardino¹(✉) and Antonio Nesticò²

¹ Department of Political, Social and Communication Sciences,
University of Salerno, Via Giovanni Paolo II, 132, 84084 Fisciano, SA, Italy
mbencardino@unisa.it

² Department of Civil Engineering, University of Salerno, Fisciano, SA, Italy
anestico@unisa.it

Abstract. The analysis of the processes of urban growth and sprawl should be conducted taking into account the temporal evolution of a plurality of parameters: economic, demographic and socio-cultural. These factors are so related that the complex territorial system sometimes seems indecipherable. Thus, as the quantitative modeling suggests, the real phenomenon is simplified, identifying a limited number of exogenous variables and researching the effect that these variables generate on the simplersystem, object of the study. The goal is to find the functional relationships that govern the events.

In the present study, the temporal evolution of the built in a metropolitan area is investigated, in order to determine the effect that the age of construction and geographical location have on the market value of the property for residential use. Then, correlations are recorded with both the labor or capital income that the population perceives on the territory, and with the spatial distribution of the unemployment rate.

The construction of the reference dataset is conducted on the basis of official information provided in Italy by the National Institute of Statistics (ISTAT) and the Property Market Observatory (OMI) of Territorial Agency.

Finally, the implementation of Geographic Information Systems (GIS), at the level of Census and OMI units, allows to draw thematic maps, from which comparisonthe results of the study are derived (Both the authors conceived and designed the research and the paper. Massimiliano Bencardino collected data on the evolution of the built-up area and Antonio Nesticò collected data on real estate values, both wrote parts in every section.).

Keywords: Urban sprawl · Territorial planning · Appraisal · Real estate values · Spatial economic analysis · Geographic Information Systems

1 Introduction and Aim of the Paper

Since the postwar period, many Italian and European cities were characterized by urban sprawl and chaotic and fragmented expansion, so as to give rise to large urban agglomerations [1, 2]. In Italy, these phenomena have affected all the largest cities, such as Milan, Rome and Naples. The expansion started from the old historic center

and has progressively invested suburbs, semi-rural and rural areas, leading to a mixture of residential, commercial and productive functions [3–6].

The evolution of the territory anyway tends to respect economic laws, albeit sometimes conditioned by unclear speculative logics. They respond to the pursuit of differential rents in land use [7–9]. Thus, by invoking a principle of David Ricardo, we tend to cultivate at first the most fertile lands and gradually the less fertile, favoring a differential rent of the first than the others. More, as proposed by agricultural economist Johann Heinrich von Thünen, we proceed in order to create positional differential rents, because the shortest distance from the market of production areas produces lower costs for moving goods, and thus a higher income against the soils further away. Similarly, in Urban Economics, the shortest distance from the business center generates extra income and, consequently, higher merchant appreciation compared to what happens for properties located in peripheral areas [10].

The present study intends to conduct diachronic analysis of the built in a metropolitan area, which is that of Naples and its surrounding municipalities. In the same area, properly circumscribed, the values of urban property for residential purposes are recognized. These values are examined both with reference to their specific spatial distribution and with regard to the age of construction which characterizes each micro-zone in which the entire area is divided. This aims to establish the existence of functional relationships between the identified parameters.

Given that the urban growth is strongly related to income distribution in the territory, or – diametrically – to its unemployment rate, the urban sprawl and the spatial sequence of real estate values are read in the light of income and unemployment maps. These maps are built by developing spatially ISTAT dataset with GIS.

2 Methodology of Analysis and Data Processing

With regard to the methodology of study and numerical elaborations, the diachronic analysis on the built up areas are developed on the basis of the National Information Institute of Statistics (ISTAT) at the Census units scale. However, this scale is redefined both because of errors that may occur in the geo-coding of ISTAT data [11] and because these should be compared with the corresponding real estate values taken by the Observatory of the Real Estate Market (OMI) of Territorial Agency, which adopts a different reference scale.

So, the OMI micro-zone is assumed as spatial units of analysis, expressing uniform levels of the local real estate market and thus of urban, socio-economic and environmental characteristics, and of service facilities. Spatial processing of large datasets allow the conversion from ISTAT Census scale to that of OMI microzones.

The following Table 1 summarizes the elaborations developed on the datasets.

The investigation area is divided according to the age of edification, distinguishing between the buildings before the 1919, those realized in the periods 1919–1945, 1946–1960, 1961–1970, 1971–1980, 1981–1990, 1991–2000, 2001–2005, and finally those of a later period to 2005.

Table 1. Extracted from dataset of the study area.

OMI zones	Area (km ²)	Unemploy. rate		Before 1919	Age of construction of the buildings					After 2005	Values 2013
		2001	2011		1919– 1945	1946– 1960	1961– 1970	...	2001– 2005		
ACERRA - D1	42.57	11.9%	11.4%	30	39	34	62	...	44	5	710
ACERRA - B1	1.12	17.8%	12.7%	186	321	270	316	...	36	18	980
ACERRA - C1	11.21	14.5%	11.3%	21	81	171	438	...	395	196	860
AFRAGOLA - D1	1.61	17.9%	11.9%	0	3	26	65	...	52	19	700
AFRAGOLA - B2	0.66	27.7%	13.4%	953	151	60	65	...	63	50	800
AFRAGOLA - C2	3.57	28.0%	12.5%	30	46	221	380	...	78	113	620
AFRAGOLA - B1	0.14	24.5%	9.2%	112	30	15	11	...	10	8	980
AFRAGOLA - C1	2.70	17.0%	10.8%	145	218	860	760	...	87	74	830
AFRAGOLA - D3	2.55	16.4%	9.9%	0	2	5	10	...	3	2	595
AFRAGOLA - D2	6.75	19.2%	10.4%	0	0	0	6	...	19	1	595
ARZANO - D1	0.80	36.4%	11.9%	1	0	0	3	...	0	1	1,300
ARZANO - B2	0.53	17.4%	13.5%	552	98	124	200	...	0	0	1,425
ARZANO - B1	0.85	15.9%	11.9%	63	25	115	165	...	3	1	1,520
ARZANO - C1	2.14	15.8%	13.0%	1	15	32	129	...	0	1	1,110
ARZANO - C1	0.35	18.0%	10.4%	0	1	0	12	...	0	0	1,110
BACOLI - D1	2.20	12.1%	10.1%	11	8	19	88	...	1	0	875
BACOLI - B2	2.99	13.2%	9.3%	36	201	351	336	...	14	0	1,010
BACOLI - C2	0.55	14.9%	10.4%	8	17	50	46	...	2	0	960
BACOLI - C2	5.17	15.8%	10.6%	108	119	187	160	...	36	16	960
BACOLI - B3	0.03	17.0%	11.1%	4	2	3	7	...	0	0	1,110
BACOLI - B3	0.31	11.7%	12.4%	13	9	14	68	...	3	0	1,110
BACOLI - B3	0.24	12.7%	11.5%	8	12	19	28	...	2	4	1,110
BACOLI - C3	0.11	10.7%	11.3%	2	15	12	4	...	0	0	875
BACOLI - C4	1.40	15.5%	11.3%	33	18	55	70	...	1	0	725
BACOLI - B1	0.11	11.1%	13.3%	4	9	8	6	...	2	0	1,295
BACOLI - C1	0.36	9.6%	8.2%	3	4	11	34	...	0	0	1,160
CAIVANO - D1	0.26	25.5%	14.4%	1	1	0	4	...	0	0	535
CAIVANO - D1	1.48	22.3%	15.7%	2	3	1	26	...	10	1	535
CAIVANO - B2	0.18	33.4%	14.9%	30	12	19	38	...	2	0	770
CAIVANO - B2	0.14	13.4%	18.8%	16	21	222	71	...	0	0	770
CAIVANO - C2	0.28	35.6%	10.5%	1	2	6	14	...	1	0	680
CAIVANO - C3	1.79	26.7%	15.4%	51	113	7	128	...	4	0	680
CAIVANO - B1	1.43	19.4%	16.1%	232	148	654	580	...	11	3	1,010
CAIVANO - C1	2.54	17.1%	13.8%	18	27	36	158	...	91	20	710

(continued)

Table 1. (continued)

OMI zones	Area (km ²)	Unemploy. rate		Before 1919	Age of construction of the buildings					After 2005	Values 2013
		2001	2011		1919– 1945	1946– 1960	1961– 1970	...	2001– 2005		
CAIVANO - D3	15.79	23.2%	13.3%	3	6	3	11	...	18	1	420
CAIVANO - D2	3.20	18.6%	17.3%	31	9	10	10	...	4	0	480
CALVIZZANO - D1	2.11	20.0%	14.6%	5	1	3	1	...	6	2	670
CALVIZZANO - C2	0.97	17.2%	12.4%	33	4	16	60	...	4	0	620
...

For each age and for the i -th micro-zone, the third quantile $Q(3/4)$ of the distribution is represented (1):

$$Q\left(\frac{3}{4}\right) = \left| \frac{Built_{\Delta t}}{Built_{Tot}} \right|_i \quad (1)$$

It is the distribution of the ratio between the number of buildings constructed in the micro area i -th in a given period Δt and the total number of buildings realized there.

3 Urban Growth on a Metropolitan Area

The study area is the «Napoli *de facto*», which includes a less large area of the whole metropolitan cities but more homogeneous regarding the territorial functions [12, 13]. It goes from Monte di Procida to Giugliano and from Acerra up to Herculaneum (cfr. Fig. 2 below), forming an urban area which differs from the excluded areas of Nola, Vesuvius, Castellammare di Stabia and Sorrento peninsula. These areas gravitate around other centroid, i.e. Nola, Torre del Greco or Castellammare.

The age of construction of the built for each of the 313 micro-zones is reflected in the nine synthesis thematic maps (Fig. 1).

The urban growth process that, from the historic center of Naples progressively engages the outside areas, is immediately evident. In particular, before 1919, the city is concentrated in the strip that goes from Herculaneum to Chiaia Posillipo, to a portion of Fuorigrotta and up to Poggioreale. Settlements are found in Frattamaggiore, Afragola, Pomigliano d'Arco, Arzano, Marano, Pozzuoli and Monte di Procida.

In the following period, until 1945, the buildings extend around Herculaneum, Pomigliano d'Arco, Caivano and Monte di Procida. A strong development was also recorded in Bagnoli and Fuorigrotta. Here, during the Fascism, important urban interventions redefine the urban setting, with the realization of the Avenue of Augustus and the Mostra d'Oltremare (headquarters of Neapolitan exhibition company).

The metropolitan area of Naples by age of construction

Age of construction prevalence in each OMI micro-zone (Scale 1:500'000)

Buildings built before 1919
Buildings built between 1961 and 1970
Buildings built between 1991 and 2000

Buildings built between 1919 and 1945
Buildings built between 1971 and 1980
Buildings built between 2001 and 2005

Buildings built between 1946 and 1960
Buildings built between 1981 and 1990
Buildings built after 2005

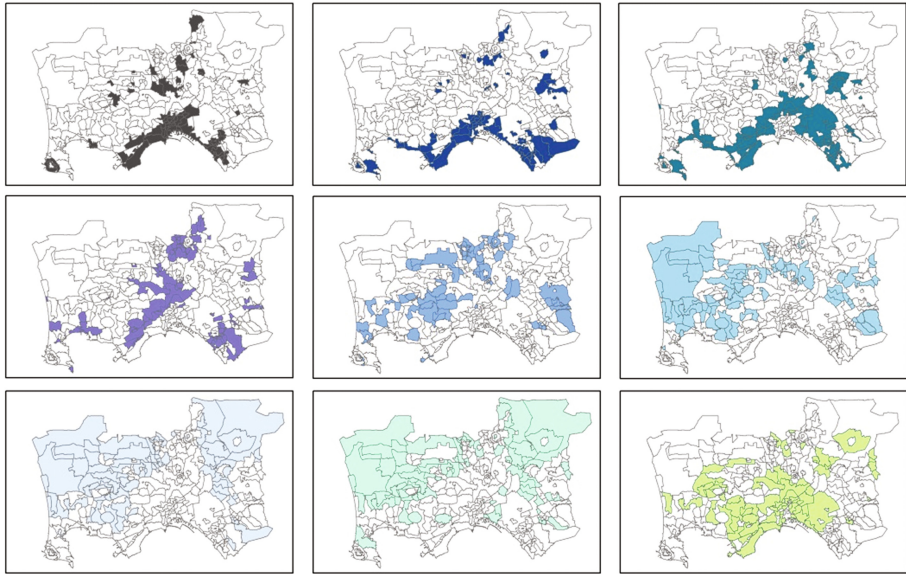


Fig. 1. The metropolitan area of Naples by age of construction.

The Fig. 2 shows the evolution of the built in the metropolitan city of Naples.

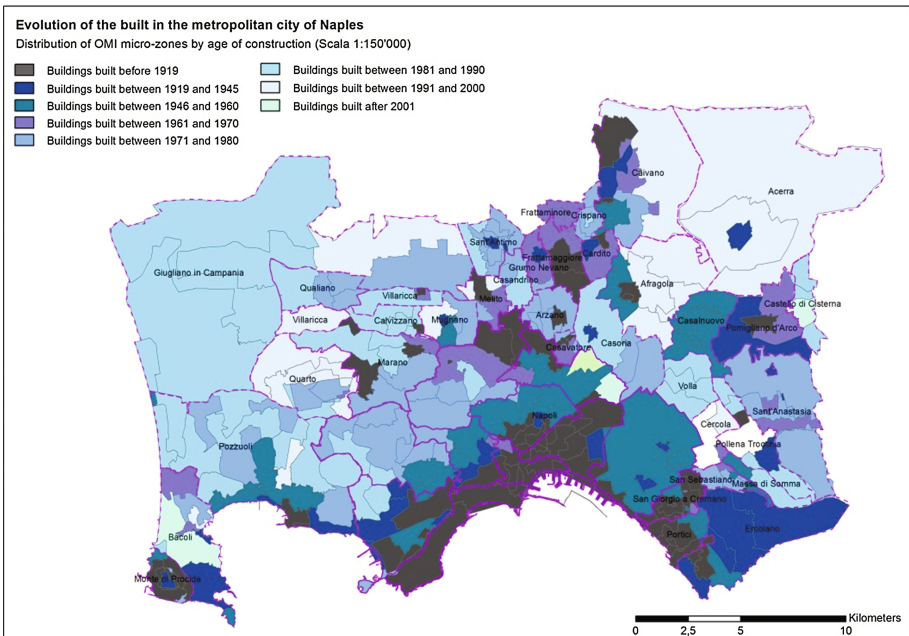


Fig. 2. Evolution of the built in the metropolitan city of Naples.

Thus, a profound transformation of the neighborhood placed «outside the Mergellina cave» is manifested.

In the neighborhoods of Fuorigrotta and Bagnoli urban transformation continues after 1946. In 1959 the San Paolo stadium is opened. In 1963, the RAI Production Centre of Naples is opened. Then, in 1964, the School of Engineering moved from Mezzocannone Avenue in Fuorigrotta, alongside the National Institute of motors, existing since 1940. This redevelopment plan for the neighborhood, promoted by Engineer Luigi Cosenza, definitely marks the transformation of the suburb area of Fuorigrotta in the new centrality and area of services. At the same time, in Bagnoli, the establishments of Cementir, Montecatini and Eternit are realized, alongside the Italsider existing since 1905.

In the 15 years between 1946 to 1960, Naples is in a phase of strong urban expansion and connection to the national infrastructure system. In its boundary the city concentrates services for the province and for the region and proposing itself as the connector of all the development of Southern Italy. In 1964, the «highway of the Sun» was inaugurated, joining Milan at the center of Naples.

Since the fifties, economic and territorial planning documents were beginning to highlight the strategies of rebalancing the regional territory [14–17]. The city was expanding disorderly in the hills, generating neighborhoods with very different characteristics from the urban core. It transships by the same hills and completely fills all those areas that are the current suburbs, without form and without a urban design, in a large agglomeration. The neighborhoods of Pianura, Soccavo, Vomero, Arenella, Stella, San Carlo Arena, Secondigliano, Ponticelli, Barra and San Giovanni in Teduccio were born. Furthermore, the urban centers of Casalnuovo, Afragola Caivano are expanded [18–20].

In the decade 1961–1970 the already invested by the post-war urbanization areas are densified and the urban fabric spreads out to the foot of Vesuvius, to San Giorgio a Cremano and in the north to Chiaiano, Piscinola, Marinella, Scampia and Melito di Napoli. In addition, the built of Frattamaggiore, Frattaminore, Cardito, Caivano, Grumo Nevano, Pomigliano and Castello di Cisterna expand.

In 1972, Naples has its own urban plan. However, the Plan fails to contain the reckless expansion of the city, on the contrary it becomes the impetus for the creation of other suburbs marked by complex social problems, as Scampia.

After the age of industrialization, the already highly urbanized City of Naples enters its full phase of suburbanization. In 1971, the City records the maximum number of inhabitants (1 million and 226 thousand), and the process of emptying the center in favor of the many new suburbs began. The agglomeration process starts, so all the existing towns form a single metropolitan area, which extends from Pozzuoli to the Vesuvian towns, from Giugliano up to Caivano. The city lives the cholera in 1975 and the earthquake of 1980, which will have prolonged effects.

Between 1980 and 1990 further densification of the formed metropolitan area is manifested, with significant effects in Volla, Casoria, Villaricca, Calvizzano, Marano and Astroni area. During this period, Naples begins to address the waste problem, which adversely affects a lot of territory. The dump in Pianura, located just 50 m from the natural reserve of Astroni and the Regional Park of Campi Flegrei, is transformed from urban to regional landfill. And, above all, in the decade 1980–1990 the

metropolitan area expands to the Domitian Coast, where the construction of holiday homes was replaced by a widespread and illegal housing, which has devoured natural areas [21].

After 1990 further densification occurs in Giugliano, Villaricca and Quarto and to the east in Acerra. More recently, the first suburbs are again involved by densification associated sometimes to urban regeneration. These processes involve Naples, Pozzuoli, Quarto, Villaricca, Sant'Antimo, Afragola e Acerra.

So, the temporal evolution of the built can be read in relation to the spatial distribution of the market value of urban residential properties.

4 Spatial Distribution of Real Estate Values

The collection and processing of data provided by the Observatory of the Real Estate Market (OMI) for the entire province of Naples, allow to draw the map of the values of the residential units in the area of study. Figure 3 shows the average unit value of the housing market for each OMI micro-zone.

Most profiles of interest result. At first we observe that the highest market values are recorded in the core of ancient construction age. In Fig. 3 the areas with the most pronounced red color, with corresponding values between 6,151 and 10,300 €/m², or between 4,151 and 6,150 €/m², refer to the ancient center of Naples (Chiaia, Posillipo, San Ferdinando, Avvocata, Montecalvario, Fuorigrotta) or even to the first post-war

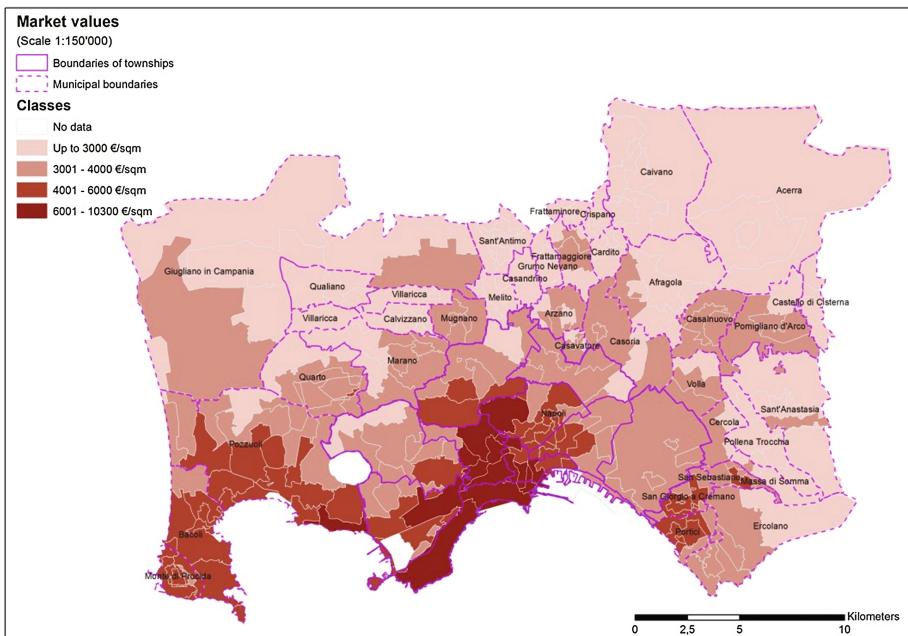


Fig. 3. Market value of urban residential properties for each OMI zone. (Color figure online)

build, until 1960 (Vomero, Arenella, Stella, San Carlo all'Arena). It means that the ancient heart of Naples remains the center of business and professional activities, so with higher incomes, benefiting from positional advantages, with corresponding higher market prices.

This condition occurs not only in Naples, but also in many cities and metropolitan areas, both Italian and European, which have an ancient foundation and which preserve the old town, often surrounded by peripheral and semi-peripheral areas. It appears that urban real estate values highlight the centers with the oldest buildings.

Figure 3 shows that the distribution of property values tend to gradually cluster going from the old center of the city of Naples to the outside¹, with a temporal sequence of building phases that responds to the economic criterion of maximizing the urban rent in building activities. So if the ancient urban centers are characterized by optimal location and with top ratings by market players, gradually less profitable soils are gradually built up, according to the economic principles of Ricardo and Von Thunen – among others – that arise in agricultural economics but obviously are valid even in urban economics. So that, the urban real estate values are able to explain the logic of spatial distribution of urban income.

As argued, the displayed spatial distribution of property values retraces the phenomena of urban growth. By an analysis on the population, taking the entire Naples *de facto* as a single urban system, the study area is affected by contemporary disurbanization and suburbanization [22–25]. So, the survey area is divided into three areas (core, first and second ring), as already been demonstrated [12]. To these areas, respectively characterized by stability, reduction and increase in the number of inhabitants, related variations of values and rental income correspond.

5 Labor or Capital Income, Unemployment Rate and More

The conclusions on logical and quantitative connections between the age of buildings, the urban growth and the real estate values are confirmed by the analysis on the spatial distribution of two important economic indicators, i.e. the labor or capital income and the unemployment rate. The implementation of Geographic Information Systems enables to display the relative maps in Figs. 4 and 5.

We can observe that the areas with the old building, characterized by higher real estate values, show the highest labor or capital income and, as a logical consequence, the lowest unemployment rates. In fact, the direct correlation between house prices and income levels of residents clearly emerges from the graphical representations, with a tendency to decline in values in those areas where a reduction in the incomes and an increase in the unemployments are recorded.

But, as the evolution of the buildings follows economic logic that lead to decrease in marginal profits resulting from additional investments in new construction, the urban sprawl tend to go to the areas less valuable, less remarkable in positional terms, with

¹ The only exception is given by the ancient agglomerates of Bacoli and Monte di Procida on one hand, of Portici and San Giorgio a Cremano on the other, both with a unique characters and in the coastal area.

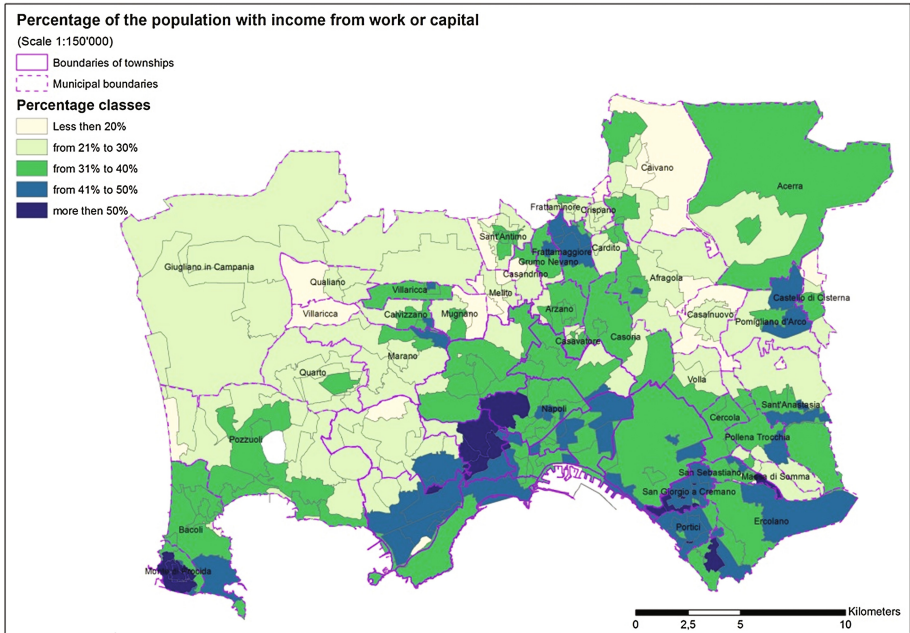


Fig. 4. Distribution of labor or capital income in Naples *de facto*.

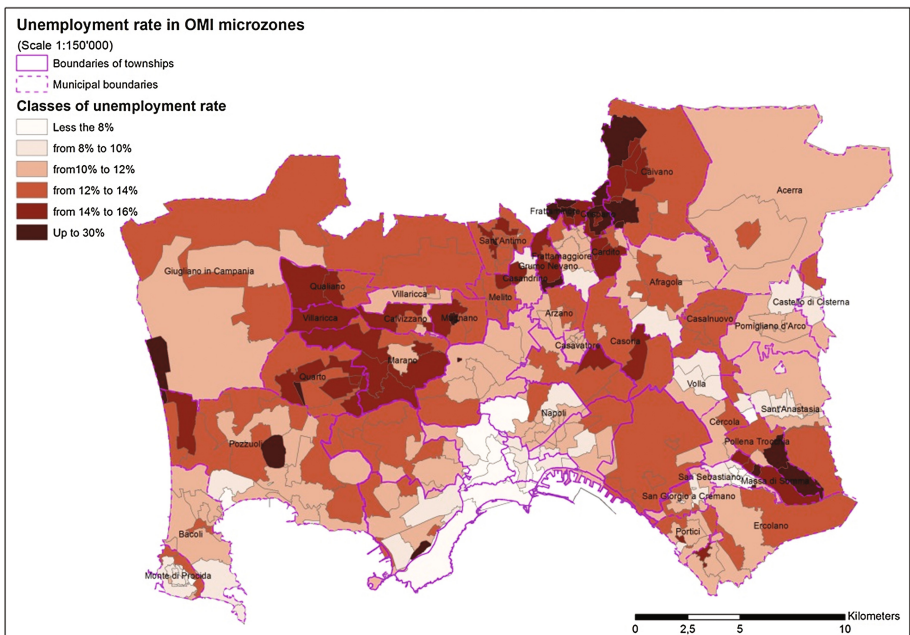


Fig. 5. Unemployment rate for each OMI zone.

more accentuated unemployment rates and, thus, with a resident population with the lowest incomes.

Useful indications also come from the study of other characteristic parameters of urban edification as the density of residential buildings, the capacity of buildings and the population density in OMI zones. Even here thematic maps are constructed and shown in the Figs. 6, 7 and 8.

Regardless of singularities that require analysis of specific urban regeneration interventions put in place [26–32] or of actions engendered by other socio-economic variables at the district level or at the municipality level [33–41], a comparison of the maps shows that the older construction areas, more favorable for location and urban revenue, resulted in the time stratifications with higher density of residential construction and higher capacity of buildings, as well as higher density of population.

These results are not obvious, especially if the complexity of a large urban system as the metropolitan area of Naples is taken into account.

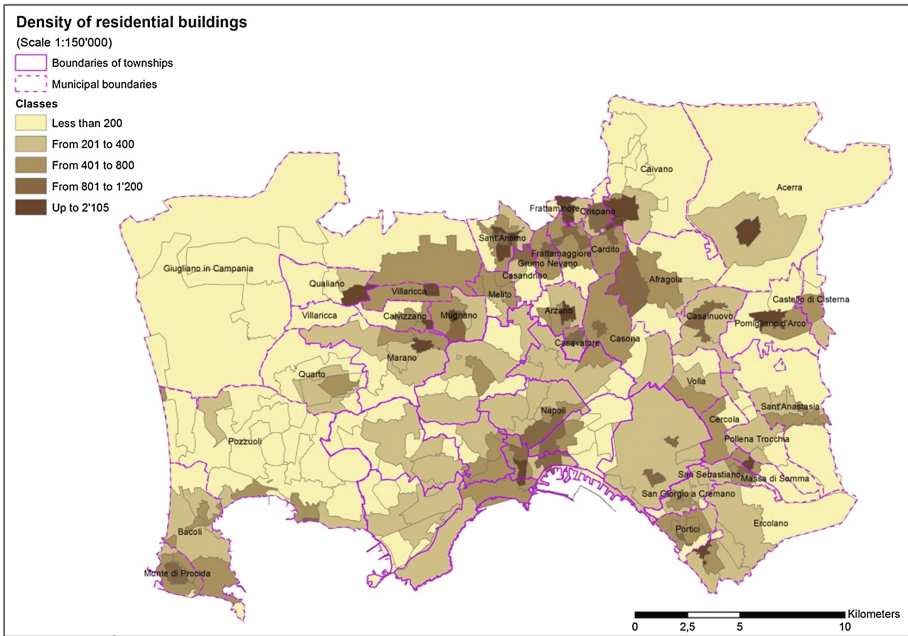


Fig. 6. Density of residential buildings.

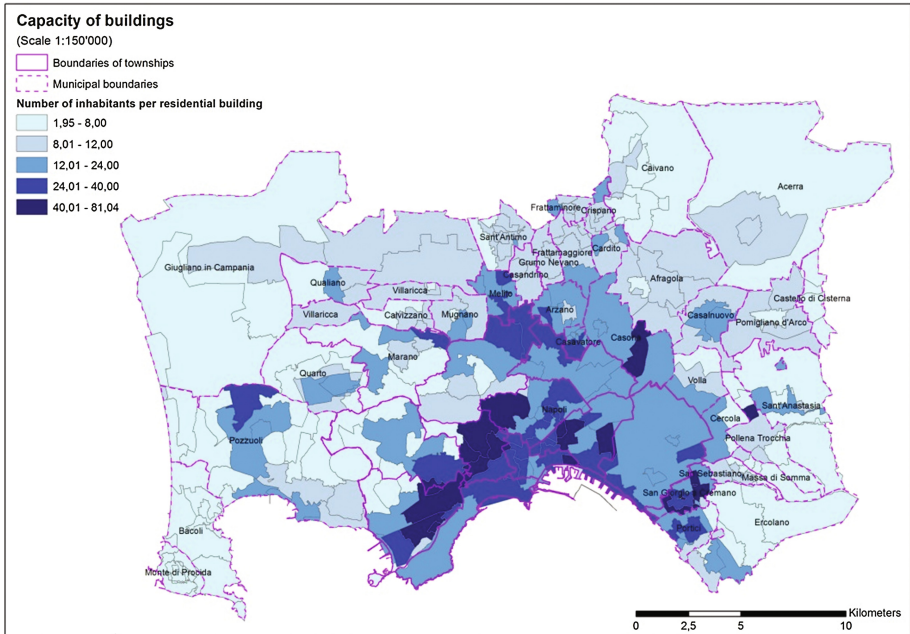


Fig. 7. Capacity of buildings for each OMI zone.

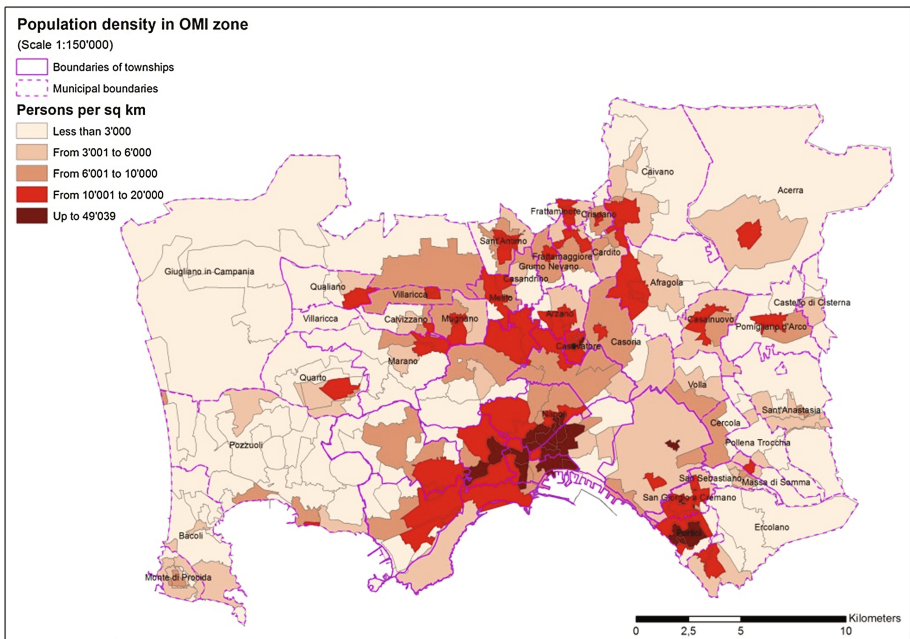


Fig. 8. Population density.

6 Conclusions

The time evolution of the economic and socio-demographic variables that characterize an extended metropolitan area is highly complex and difficult to predict. First of all, the study appears to confirm that the market value of urban real estate can synthesize the effects of the transformation of a city. If it has already been shown that urban growth models can be read through the changes over time in house prices [12], the present work points out that the expanding of built up areas takes place along spatial directions connoted by decreasing marginal profitability, in keeping with the more general Keynesian economic model that returns a decreasing marginal efficiency of committed capital for new investments. The use of Geographic Information Systems allows to build thematic maps for the study area, i.e. for a consistent portion of the large metropolitan fabric of Naples. The comparison between the quantitative data that are detected by the representations returns what is here exhibited.

Then, interesting functional correlations are descended from the analysis of maps that relate to the distribution of labor or capital income, and the unemployment rate. The direct correlation with the price of housing is recorded, likewise logical connections with the price variable are deduced from spatial representation of the density of residential buildings and the capacity of buildings, as well as the population density in OMI zones.

Making synthesis between the identified parameters and other various variables, with the intent to deduce a single function of the urban property value, constitutes the purpose of future research.

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