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Demographic Changes and Real Estate Values. A Quantitative Model for Analyzing the Urban-Rural Linkages

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Abstract: Vast metropolitan areas include both urban areas and rural outskirts. Between these areas, there are strong links to the point which they cannot be examined separately. There is a contemporary presence of residential function and working activity in the rural outskirts, as well as in the typical sector of agriculture. Therefore, the production of goods and services for the city requires a combined analysis, due to the large territory which it has to consider. The evolution of the population of such a large territory can be studied in great detail, with reference to the single census area and with the use of Geographic Information Systems (GIS). This means that such a demographic development produces an effect on the values of the urban real estate. This work demonstrates the existing interconnections between urban areas and rural outskirts. Data collection on trends of the population living in the Naples metropolitan area and the house prices associated with this area, and the post spatial processing of such data, allows for the establishment of thematic maps according to which a model capable of interpreting the population development is defined. A study of the statistical correlations shows the consequences that the population dynamics produce for property prices. In addition, the diachronic analysis of the sales prices of residential buildings demonstrates that economic functions, exclusive of certain urban or rural territories, end up distributing and integrating.

Keywords: urban areas; rural outskirts; demographic dynamics; urban real estate values; territorial planning; Geographic Information Systems; urban growth models

1. Critical Issues in Urban Planning

Urban planning must consider all of the factors that characterize the socio-economic, productive, and environmental fabric of the city, and also the correlations that subsist among these factors [1–3]. It is therefore important:

(1) to define, at first, the extension of the geographical area in which the main dynamics take place;
(2) to then identify the variables that can express the behaviour of the urban system;
(3) to create a functional relationship between the selected parameters through a suitable analysis model, with the ultimate aim of providing public and private operators with useful tools for selecting actions that are more opportune for the territory [3–8].

With regard to the first point, the question that must be answered is: "What is border of the city?" The phenomenon of urban sprawl, i.e., the expansion of the city in the peri-urban buffer zone to the detriment of agricultural and natural land, has long been known. This phenomenon was born in the

Western city during the nineteenth century and continued until the mid-twentieth century, linked to population growth. It goes well beyond, though not connected to, the real residential or productive needs [9]. Therefore, the necessity for a correct delimitation of the urban fabric emerges. In fact, large metropolitan areas currently include both urban environments and rural outskirts [10–17]. Extended interconnections are identified across these two areas, and therefore, there is a need for a unitary study of the territory, but also a single system of the government. Considering this, in Italy, the Law No 142/1990 has founded the metropolitan areas, which gather the principal municipalities of the metropolitan city, as well as other municipalities that have a cold integration with them because of economic activities, essential services, and the social and cultural life. After the consequent debate on what the real limits of the metropolitan areas must be, Law No 56/2014 has reaffirmed the necessity to give a new definition to the metropolitan cities, but also to the provinces and unions of municipilities. Nevertheless, the law doesn't clarify exactly what the limits of a "wide spread city" are and it shows the contemporary presence of urban areas and rural outskirts.

In this work, the functions and territorial competence are seen as the main elements for a delineation of the relevant survey area [18,19]. According to this, with reference to the case of the metropolitan city of Naples, which is the regional authority for large areas that replaced the Province of Naples on 1 January 2015, the optimal analytical area of study is found in the "Napoli de facto" [18], which is less wide than all metropolitan partenopea cities, but more uniform in the socio-economic and cultural interconnections. In fact, the municipilities in question, extending from the Mountain of Procida to Ercolano, form a territorial set that is different in the population density and functional characterisation from the excluded areas, which are the territory of Nola, the band of Vesuvius, the city of Castellamare of Stabia, and the Sorrento peninsula (see Figures further on). Such areas gravitate around other centroids (Nola, Torre del Greco, or Castellammare) or are characterized by different markets (cfr. Sorrento coastline).

With regard to the second point in the list, it is necessary to establish which variables are able to represent the competitiveness of the urban system. The theme of the competitiveness is investigated by Camagni [20], through the concept of territorial capital, which is separated into the four macro-classes of natural and cultural capital, settlement capital, cognitive capital, and social capital.

As is well-known in the assessment literature, in a predefined temporal instant, the market value of the urban business, which is the prevailing rate of settlement capital, is the summary of the effects produced by: (1) locate features attributable to the territorial reference context; and (2) specific features of the individual asset [21]. When focusing on the locate features, it is necessary to consider the location of the property and the presence of collective facilities and retail outlets, but also the external ambient quality in terms of the availability of public green and the level of air pollution. Instead, the inherent characteristics of the building unit are the building typology, the age, the height above the road plan, the decorations, the presence of the plants, and so on. However, the location parameters, which have a very significant impact on the merchant appreciations, are not greatly affected by the spatial planning policies and technical-economic significance of the investment projects, which in their turn, depend on the social-demographic factors and financial resources, both public and private, that characterize the urban area [22–24]. Considering the above, it follows that the market value of the residences is a valid parameter for summarising the urban system and explaining the evolutionary mechanism of a city.

The ability of the real estate prices to represent the urban competitiveness concerns, not only includes an analysis at one point in time, but also analyses over time. When focusing on the third and last point in the list, it is noted that the changing values in time depend on the change of the tracking characteristics and those typical of the single object, but also the variation in the macroeconomic nature, first and foremost, the demographic trends. It is possible to observe that an rise in resident populations determines an increase in the demand for housing, with the effect of raising the rental prices and real estate values. However, flows of population in and out of the city have the opposite effect, on account of a contraction of demand. In fact, the link in quantitative terms between population development and property prices is rarely investigated in the literature, although it is widely recognised qualitatively.

The present work aims to analyze the correlation between population changes and the consequent temporal variation of the real estate values. The subject of the study is the vast metropolitan area, specifically that of Naples. The quantitative investigation starts from the collection and elaboration of demographic and merchant information. A numerical dataset is built and cartographic representations through GIS are produced. The maps on the population dynamics, which are examined in the light of the principal models of urban evolution recognised in the literature, are compared to the tables on the sales prices for urban businesses, in order to highlight the logical and causal connections. Moreover, the co-existence of urban areas and rural outskirts makes it possible to identify the existing interactions among ambits with different functions.

Where the various data refer to different territorial bases, instructions pertaining to the resolution of typical problems in the implementation of cartographic processing take place.

2. Methodology and Operational Phases for the Demographic Analysis

Once the reference area has been identified, an analysis of the demographic changes is carried out, in order to capture the settlement dynamic.

It is important that the methodological and operational pathway underpins the analysis and some digging into the scale of analysis is required. In fact, despite moving from the database of the Italian National Institute of Statistics (ISTAT) to the scale of the census districts, it is necessary to identify a new analytical scale for two reasons of equal importance. *In primis*, as already emphasised in other contexts [25], some mistakes concerning the geo-coding of the ISTAT data to the scale of the census fractions don't provide a proper reliability to the diachronic analysis. *In secundis*, a scale should be defined for comparing ISTAT and market data, the latter of which are available from the Real Estate Market Observatory (OMI) of the Italian Revenue Agency, which deals with the recognition and drawing up of the technical and economic data concerning the property values, rental fees, and annuity rates for all of the municipalities of Italy.

Considering this, the scale of the OMI micro-zones is chosen, each of which expresses a similar level of local real estate market on the basis of town-planning, socio-economic characteristics, the equipment of services, and so on. This choice allows one to resolve both problems relating to geographical encoding and the comparability of data, although downstream of complex numerical operations. In fact, the conversion of ISTAT data from the scale of census fractions to the scale of the OMI micro-zones is not easy. In fact, all of the ISTAT polygons contained in the same micro-area should be identified, in order to assign the population data in each polygon of the OMI micro-zones.

However, some functions of spatial analysis must be implemented because the boundaries of the two territorial bases are not coincident (Figure 1).

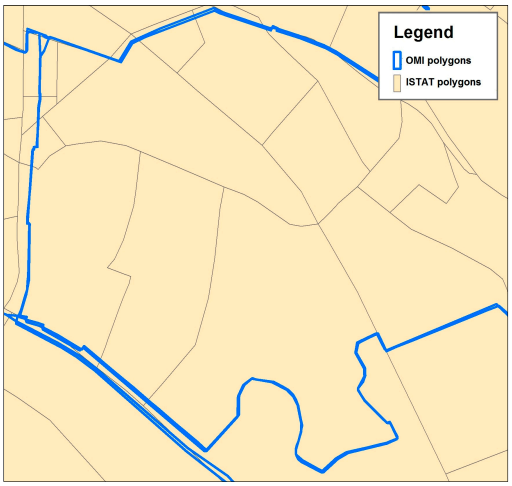


Figure 1. Discrepancies between the polygons.

In this way, a parameter of punctual population density is obtained from vectorial ISTAT information (shown by the grey lines in Figure 1) with the purpose of obtaining the proportional value corresponding to the vectorial polygon of the Real Estate Observatory (represented by the blue colour in Figure 1).

The spatial analysis is not without errors, but an ex-post test on the total area population reflects an extremely contained average error, of about 0.005%. It should be noted that a pattern congruence operation allows a comparison between not only the ISTAT database and the data of the Real Estate Observatory, but also between the same ISTAT data from the two surveys of 2001 and 2011, because—as we know—the ISTAT polygons change between temporally different surveys.

The result of the processing is expressed in Figures 2 and 3. The absolute change in population to the level of OMI micro-zones is represented in Figure 2. The values of percentage change in the population are shown in Figure 3.

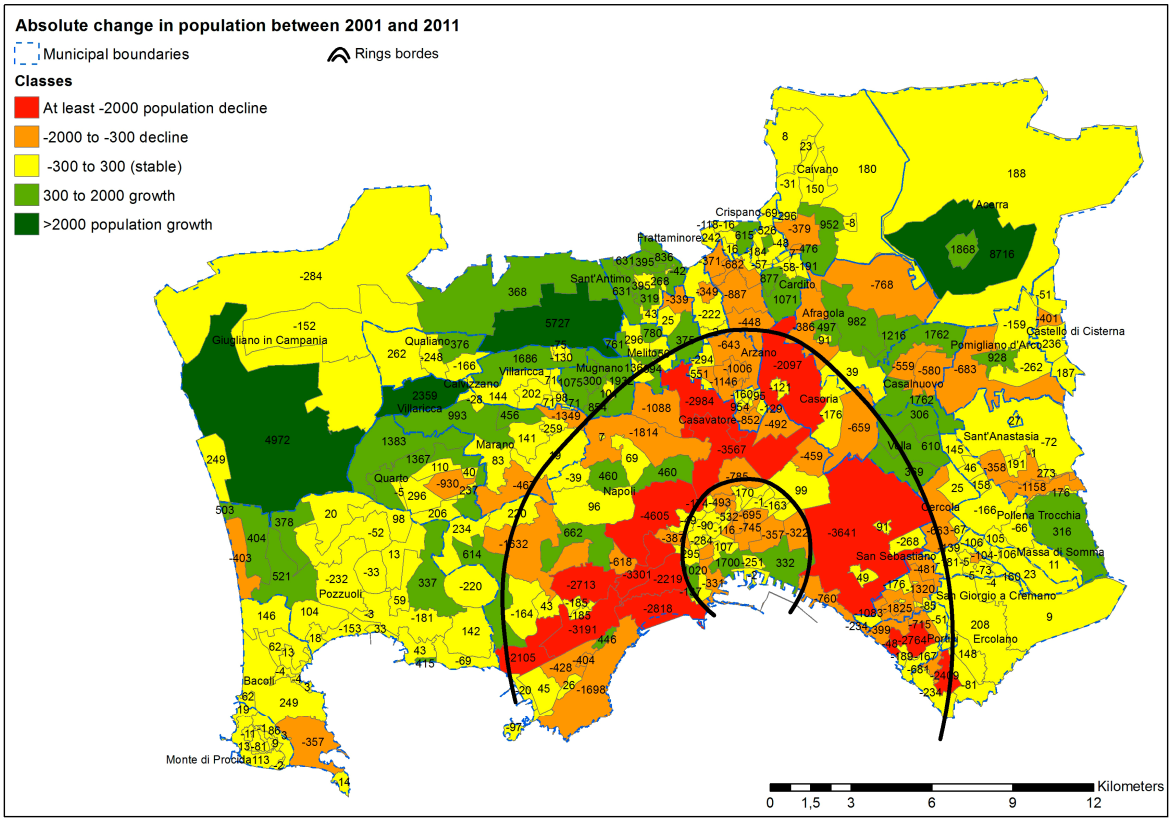


Figure 2. Absolute change in the population between 2001 and 2011.

The analysis shows that it is possible to lock down different areas of population variation, thus identifying the specific phase of urban growth, as schematized in the Van den Berg model [26].

Like most Western cities, Naples has been marked by a long process of suburbanization since the 1970s, and a disurbanization process has also been seen during the last decade, confirmed by the negative variance of population throughout the area [27]. This overlap of phases is consistent with the scenery of "over the urbanization" theorized by Champion [28], in which the actual urban systems evolve according to a range of overlapping processes, rather than according to a single progressive line.

According to the phase of growth of the city, the evidence of depopulation areas and densification areas allows one to graphically draw three concentric rings, each with a homogeneous demographic behaviour (Figure 4):

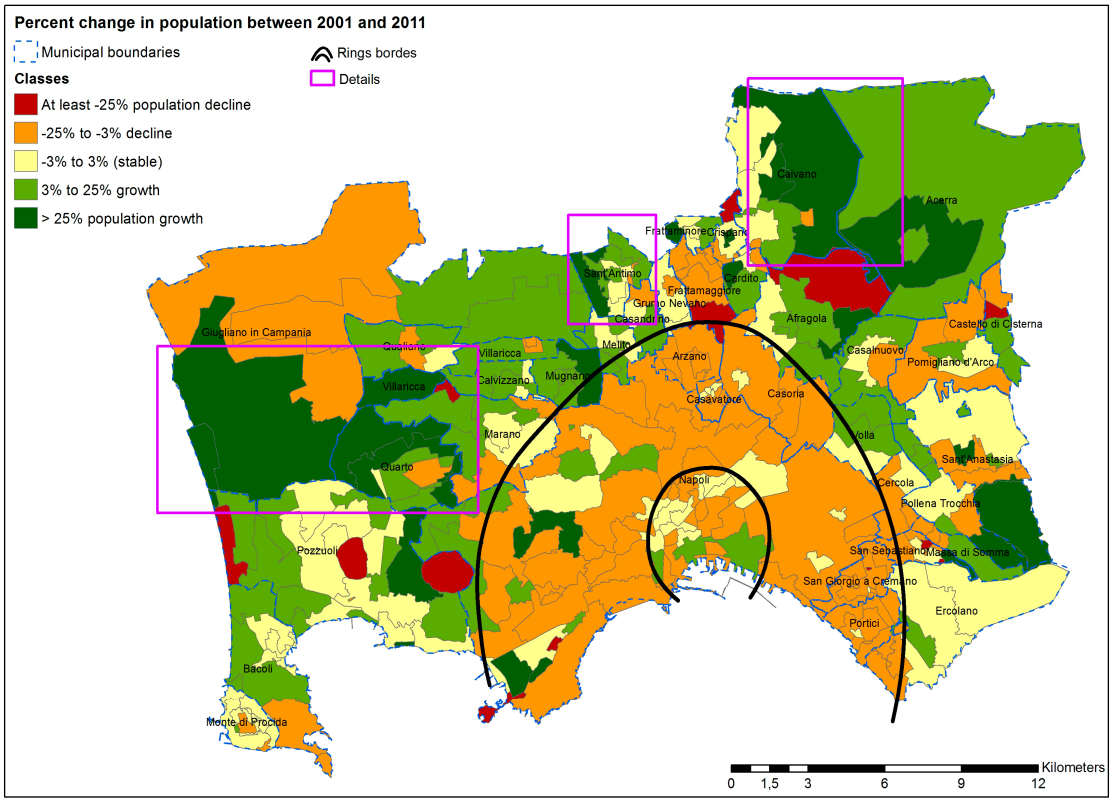


Figure 3. Percentage change in the population between 2001 and 2011.

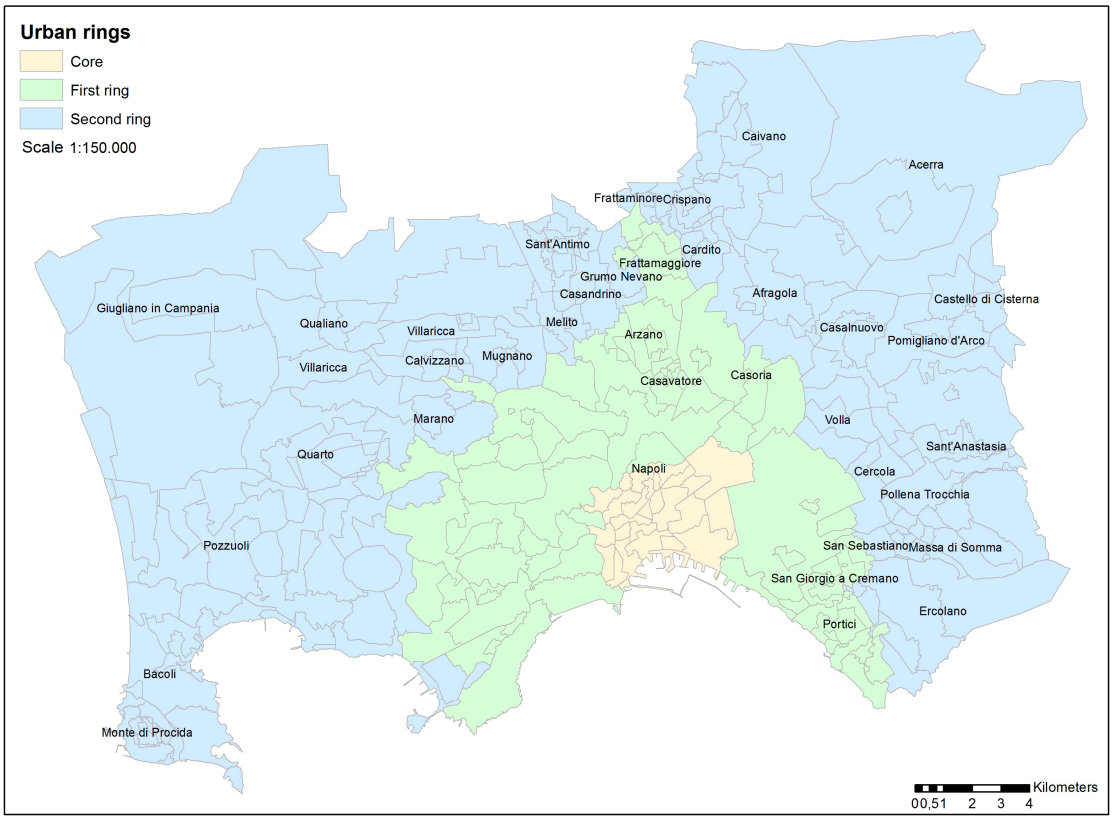


Figure 4. Urban rings.

- a *central core*, corresponding to the historic town centre of Naples, in which there aren't significant changes in the population;
- a *first inside ring*, that consists of the more peripheral municipality and the municipalities of Portici, S.Giorgio a Cremano, San Sebastiano, Cerola, Casoria, and Arzano, in which there is a decided reduction in the population (of around 65,000 inhabitants and −6.1%);
- a *second external ring*, consisting of all remaining municipalities (from Monte di Procida to Giugliano up to Acerra and Massa di Somma), in which, on the contrary, there are important population growths (about 48,000 inhabitants, corresponding to +5.3%).

Therefore, in the third ring, there are areas in which the population growth is most notable (more than 25%). These areas, which include the municipalities of Giugliano, Villaricca, Quarto, Saint Antimo, Caivano, and Acerra, are highlighted in Figure 3 with a purple frame.

3. A Diachronic Spatial Model for the Analysis of the Correlation between Property Values and Population Dynamics

It has already been shown that the sales prices of the urban residential buildings are capable of synthesizing the effects of socio-economic processes in the metro area [29–33]. This price analysis is undertaken with regards to the decade 2003–2013 and each of the 313 micro-zones according to which the Real Estate Observatory divides the investigated territory. The change in prices over the period 2003–2013, in which the OMI doesn't modify the spatial distribution of the micro-zones, unlike before 2003 and after 2013, can be reasonably compared with the variation of population in the decade 2001–2011; references to which show the last two ISTAT statistical representations.

The results of the study on merchant appreciations shall be expressed as the percentage change of the value in 2013 compared to that in 2003, as indicated in Figure 5.

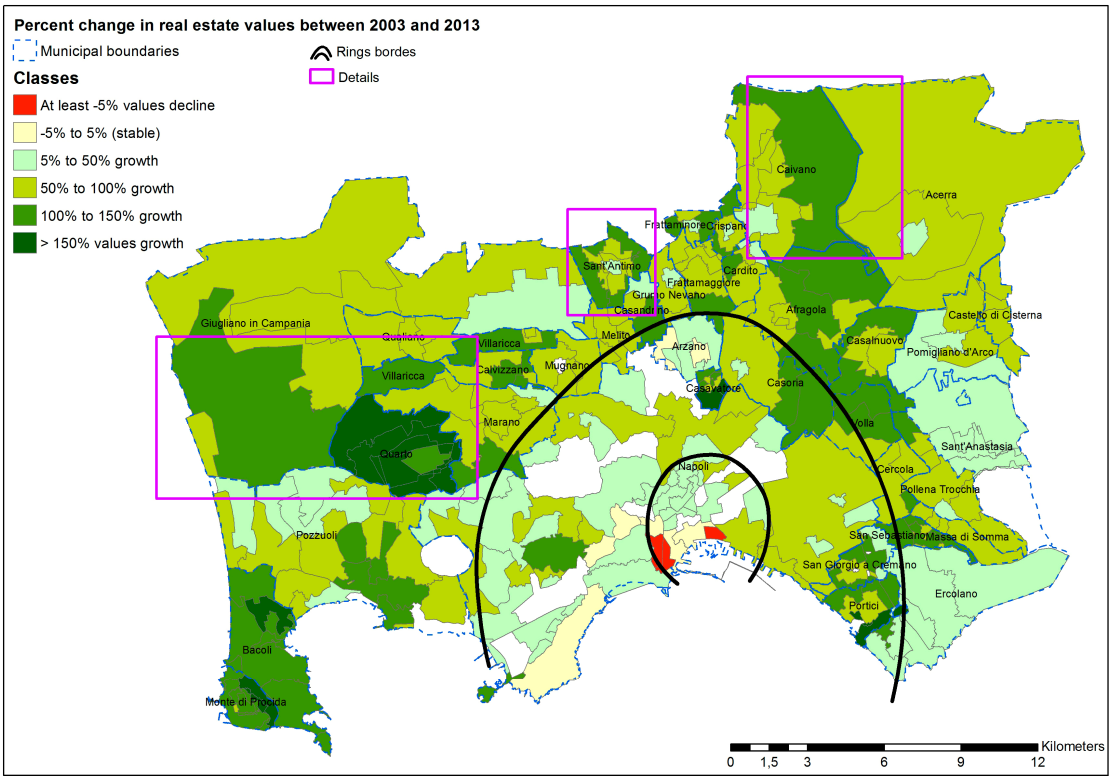


Figure 5. Percentage change in real estate values between 2003 and 2013.

When moving from the core, corresponding to the historical center of Naples, to the first and then to the second ring, a progressive increase in the percentage emerges.

Precisely, in the core, a tendency for the invariance of nominal house prices is recorded, with the presence of limited portions of territory that show reduced values (areas in red in Figure 5), of other areas characterized by price stability (with variations between −5% and +5%), and of some other zones where the increases in the decade were fairly contained. Instead, in the first ring, a prevalence of surfaces with light green and green is shown, which indicates a higher increase of the percentage values (these represent a range from 5% to 50% and 50% to 100%, respectively). Finally, in the second ring, the increases of commercial value become more severe (with a growth of over 100%) and extended, highlighted by a larger number of micro-zones in darker green, including those in the municipalities of Bacoli, Monte di Procida, Giugliano in Campania, Quarto, Villaricca, Sant'Antimo, Caivano, Afragola, Casalnuovo, and Volla.

Therefore, the analysis results on the change in property values are compared with the demographic dynamics.

In Table 1, an excerpt from the geo-database built for GIS processing is shown. As expected, a trend of direct proportionality between the population growth and the increase in property values can be seen. This correlation is significantly respected both in the central core of the metropolitan area, where a substantial stability in real estate prices corresponds to light variations in the population, and in the second ring, where the strong growth of residents generates an increase in property values (especially in the areas highlighted in purple in Figures 3 and 5). The connection between the variables is less evident in the first ring, where several micro-zones are affected by a contraction of the residents and a simultaneous increase of values, although in some micro-zones—such as the neighborhood of Posillipo—the real estate prices do not increase as the number of inhabitants rises. This is due to the specific features that characterize certain neighborhoods, which were affected by punctual interventions of urban regeneration during the past decade, exhibiting variation in the available volumes and the quality of infrastructure, so as to produce a distorting effect in the investigated functional relationship.

In order to weigh the impact of real estate values V compared to the capital settlement in the i-th micro-zone, and thus in the single ring, the population of the same micro-zone (Pop_i) is taken as a proxy of the buildings, undetectable on the territory. Therefore, the real estate value variation for each ring (ΔV_{ring}) is calculated by the following formula:

$$\Delta V_{ring} = \frac{\sum_{i=1}^{n} (\Delta V_i \times Pop_i)}{P_{ring}} \quad (1)$$

Table 1. Geo-database of comparative analysis.

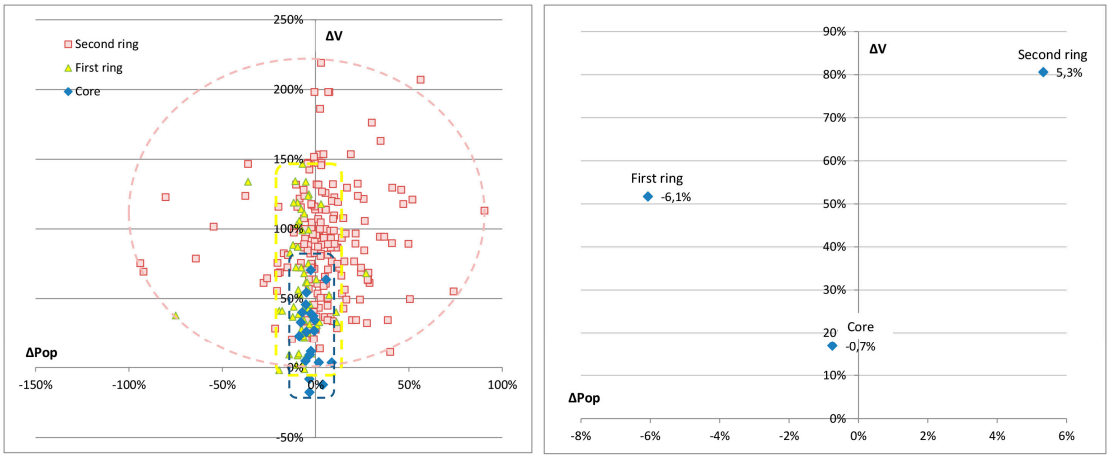
NAME	Population							Values				
	Area [km^2]	**Zone**	**Ring**	**POP_2001**	**POP_2011**	**ΔPOP**	**ΔPOPPERC**	**FID_OMI_1**	**PREZZI13**	**PREZZI03**	**VAR1303**	**VARPERC**	**ΔVxP**
ARZANO–Zone OMI D1	0.80	D1	F	1505	1211	−294	−19.6%	10	1275	1300	−25	−1.9%	−23
ARZANO–Zone OMI B2	0.53	B2	F	9854	8848	−1006	−10.2%	11	1450	1425	25	1.8%	155
ARZANO–Zone OMI B1	0.85	B1	F	11,839	10,694	−1146	−9.7%	12	1650	1520	130	8.6%	915
ARZANO–Zone OMI C1	2.14	C1	F	10,680	10,037	−643	−6.0%	13	1600	1110	490	44.1%	4431
ARZANO–Zone OMI C1	0.35	C1	F	4702	4151	−551	−11.7%	14	1600	1110	490	44.1%	1832
CASAVATORE–Zone OMI B2	0.22	B2	F	3284	3378	94	2.9%	51	1525	700	825	117.9%	3982
CASAVATORE–Zone OMI C2	0.27	C2	F	3085	2925	−160	−5.2%	52	1450	620	830	133.9%	3915
CASAVATORE–Zone OMI B1	0.06	B1	F	1228	1232	4	0.3%	53	1400	855	545	63.7%	786
CASAVATORE–Zone OMI C1	0.17	C1	F	4004	3519	−485	−12.1%	54	1650	875	775	88.6%	3117
CASORIA–Zone OMI D1	3.50	D1	F	18,457	17,798	−659	−3.6%	56	1575	700	875	125.0%	22,247
CASORIA–Zone OMI B1	0.34	B1	F	6677	6556	−121	−1.8%	57	1575	1135	440	38.8%	2542
CASORIA–Zone OMI C1	6.23	C1	F	53,010	50,914	−2096	−4.0%	58	1725	985	740	75.1%	38,250
CASORIA–Zone OMI D2	1.97	D2	F	2287	2112	−175	−7.7%	59	1275	595	680	114.3%	2413
ERCOLANO–Zone OMI B2	0.90	B2	F	19,701	17,292	−2409	−12.2%	72	1950	1425	525	36.8%	6371
ERCOLANO–Zone OMI B1	0.36	B1	F	7780	7099	−681	−8.7%	75	1575	765	810	105.9%	7517
FRATTAMAGGIORE–Zone OMI D1	1.57	D1	F	1239	791	−448	−36.2%	77	1450	620	830	133.9%	1058
FRATTAMAGGIORE–Zone OMI C2	0.71	C2	F	3868	3497	−371	−9.6%	78	1450	775	675	87.1%	3046
FRATTAMAGGIORE–Zone OMI B1	1.85	B1	F	16,702	15,815	−887	−5.3%	81	1875	1160	715	61.6%	9748
FRATTAMAGGIORE–Zone OMI C1	0.87	C1	F	9539	8857	−682	−7.2%	82	1700	855	845	98.8%	8753
GRUMO NEVANO–Zone OMI B1	0.41	B1	F	5657	5308	−349	−6.2%	95	1250	930	320	34.4%	1826
MARANO DI NAPOLI–Zone OMI B1	0.88	B1	F	14,972	13,624	−1348	−9.0%	101	1650	1500	150	10.0%	1362
MARANO DI NAPOLI–Zone OMI D2	2.58	D2	F	4689	4221	−468	−10.0%	105	1575	775	800	103.2%	4357
NAPOLI–Zone OMI D13	2.51	D13	F	22,914	20,808	−2106	−9.2%	133	2900	2090	810	38.8%	8064
NAPOLI - Zona OMI D1	1.65	D1	F	12,874	12,089	−785	−6.1%	135	2250	1845	405	21.9%	2653
NAPOLI - Zona OMI D12	0.36	D12	F	4938	4753	−185	−3.7%	136	1975	990	985	1.0%	4729
NAPOLI - Zona OMI E6	1.36	E6	F	6140	5681	−459	−7.5%	137	1500	1115	385	34.5%	1961
NAPOLI - Zona OMI B6	5.76	B6	F	28,409	26,711	−1698	−6.0%	139	5150	5210	−60	−1.1%	−307
NAPOLI - Zona OMI E3	1.22	E3	F	10,847	10,354	−493	−4.5%	140	1750	1115	635	56.9%	5897
NAPOLI - Zona OMI E8	16.40	E8	F	85,436	81,795	−3641	−4.2%	141	1750	1115	635	56.9%	46,583
NAPOLI - Zona OMI E10	5.81	E10	F	53,649	52,017	−1632	−3.0%	146	1825	1250	575	46.0%	23,928
NAPOLI - Zona OMI C15	0.23	C15	F	3301	3116	−185	−5.6%	147	2275	1800	475	26.4%	822
NAPOLI - Zona OMI E17	1.40	E17	F	12,381	11,621	−760	−6.1%	152	1825	1085	740	68.2%	7926
NAPOLI - Zona OMI B3	1.96	B3	F	38,927	36,708	−2219	−5.7%	155	4400	4125	275	6.7%	2447
NAPOLI - Zona OMI E4	6.01	E4	F	41,435	37,868	−3567	−8.6%	156	1900	1240	660	53.2%	20,155
...													
SANT'ANASTASIA - Zona OMI D2	0.50	D2	IRA	493	684	191	38.7%	297	1325	985	340	34.5%	7

The values assumed by ΔPop_{ring} and ΔV_{ring} are summarized in Table 2 and are also shown in Figure 6 through the dispersion of the data for each micro area in the Cartesian plane.

Table 2. Table of correlation between urban rings.

Urban Rings	ΔPop [%]	ΔV [%]
Core	–0.7%	+16.9%
First ring	–6.1%	+51.7%
Second ring	+5.3%	+80.6%

In the first ring, a weak correlation between ΔPop_{ring} and ΔV_{ring} is identified, due to the already highlighted distortions generated by urban projects at a neighborhood level in the decade, and also, as already reported, because of the inherent nature of the real value function that manifests a complexity that cannot be expressed only in relation to the independent variable ΔPop. Therefore, in order to gain a better definition of the connection between the two parameters involved, the presence of purely residential areas and rural areas in the reference area will be investigated. How the different destination of these territorial ambits affects the function f: $\Delta Pop \rightarrow \Delta V$ is investigated in the following section.



(**a**) (**b**)

Figure 6. (**a**) Distribution of values for each of the 313 micro-zones; (**b**) Representation by area.

4. The Effects of the Coexistence of Urban Centers and Rural Areas in the Analysis Model

The detected correlation between ΔPop_{ring} and ΔV_{ring} presupposes the territorial homogeneity. In other words, the vast area in question is considered as a *continuum*, and it is not possible to distinguish between degraded and requalified areas at that scale, or between areas of greater or lesser functional value, and even between purely residential areas and industrial ones.

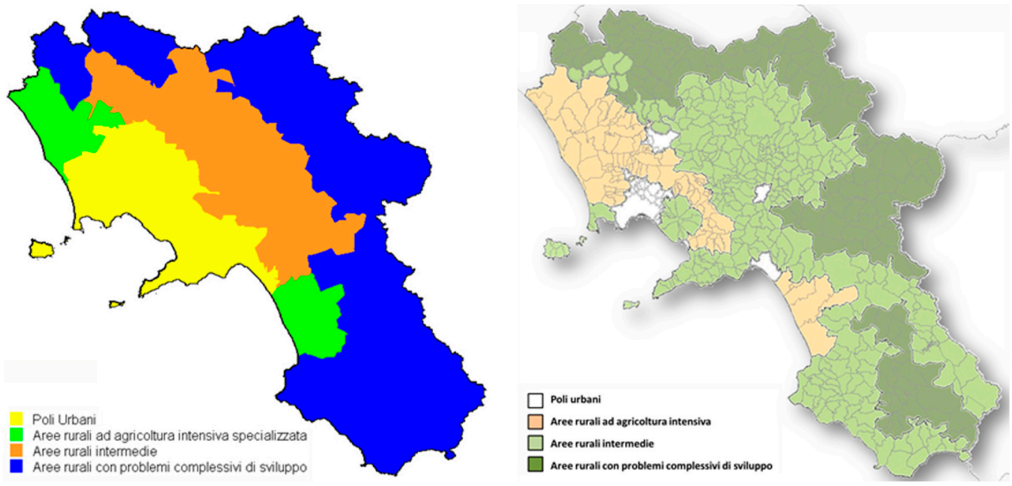
However, it is possible to discern: (a) urban center; (b) rural areas with specialized intensive agriculture, (c) intermediate rural areas, and (d) rural areas with complex development problems.

This classification is produced for Italian municipalities by the Italian Ministry of Agriculture and Forestry (MiPAAF), in consultation with the regions, in order to territorialise the politics, as part of both the Rural Development Programme (PSR) of the Campania Region and the National Strategic Framework [34]. It's a very detailed classification, which revises and corrects the OECD classification, based only on the population density and the size of the urban centres located within a region [35]. The correction of the MiPAAF is conducted by introducing other parameters, such as altitude and the weight of the agricultural areas of the total municipal surface, in order to better describe the complexity and heterogeneity of the Italian territory. Figure 7a shows the initial classification in Campania, which is then changed—as in Figure 7b—in the context of Ministry-Region Partnership Agreements for the 2014–2020 programming period, to take into account the Territorial Development

Systems (STS) defined in the Regional Territorial Plan (PTR) and the forestry land or land of particular environmental value.

Therefore, with regard to the urban-metropolitan area of Naples, 20 municipalities remain in the urban area, but nine municipalities fall into rural areas with intensive agriculture (Acerra, Caivano, Calvizzano, Castello di Cisterna, Giugliano in Campania, Marano di Napoli, Qualiano, Quarto, Villaricca) and the same number fall into the intermediate rural areas (Bacoli, Monte di Procida, Pollena Trocchia, Pozzuoli, Procida, Ercolano, San Sebastiano al Vesuvio, Sant'Anastasia, Massa di Somma). This subdivision is shown in Figure 8.

Therefore, in the second ring, the rural areas with intensive agriculture (blue dashed line in the figure) and the intermediate rural areas (black dashed line) are distinguished, in addition to the municipalities in the purely urban area. Looking at the maps on the percentage change of population ΔPop (Figure 3) and real estate values ΔV (Figure 5), it is noted that in rural areas with intensive agriculture, there is strong population growth and an equally strong increase in property values. Conversely, in the intermediate rural areas, the population grows to a lesser extent and, correspondingly, the growth of merchant appreciations is less pronounced.



(**a**) (**b**)

Figure 7. Classification of municipalities in the Campania region in four areas of intervention. (**a**) Initial study of the MiPAAF [34]; (**b**) Revised version in the Partnership Agreements with the Campania Region [36].

Therefore, the application of the model defined in this article to the territory represented in the new five correlation classes appears extremely interesting. In fact, the model better captures the functional relationship between the ΔPop and ΔV, given that the qualification of agricultural production is introduced as a new interpretative parameter.

This classification, which derives from the altitude and the percentage of the agricultural areas in each municipality, affects the production and employment capacity and, consequently, has a direct impact on both the demographic flows and the value of real estate.

This result is also shown by the processing of statistical data. Table 3 shows the ΔPop and ΔV recalculated for the five new areas. Figure 9 shows its distribution on the Cartesian plane. Then, if the first ring is excluded from the calculation, for the reasons already given, the correlation index R^2 is worth 0.3357. However, even if the intermediate rural areas are discarded, where a less pronounced ΔPop-ΔV correlation is highlighted, the R^2 rises to 0.6713.

Lastly, this index expresses the ability of the study model to interpret the logical and functional link between population change and the variation of the prices of the residential units, and the dependence of the urban or rural nature of the individual areas.

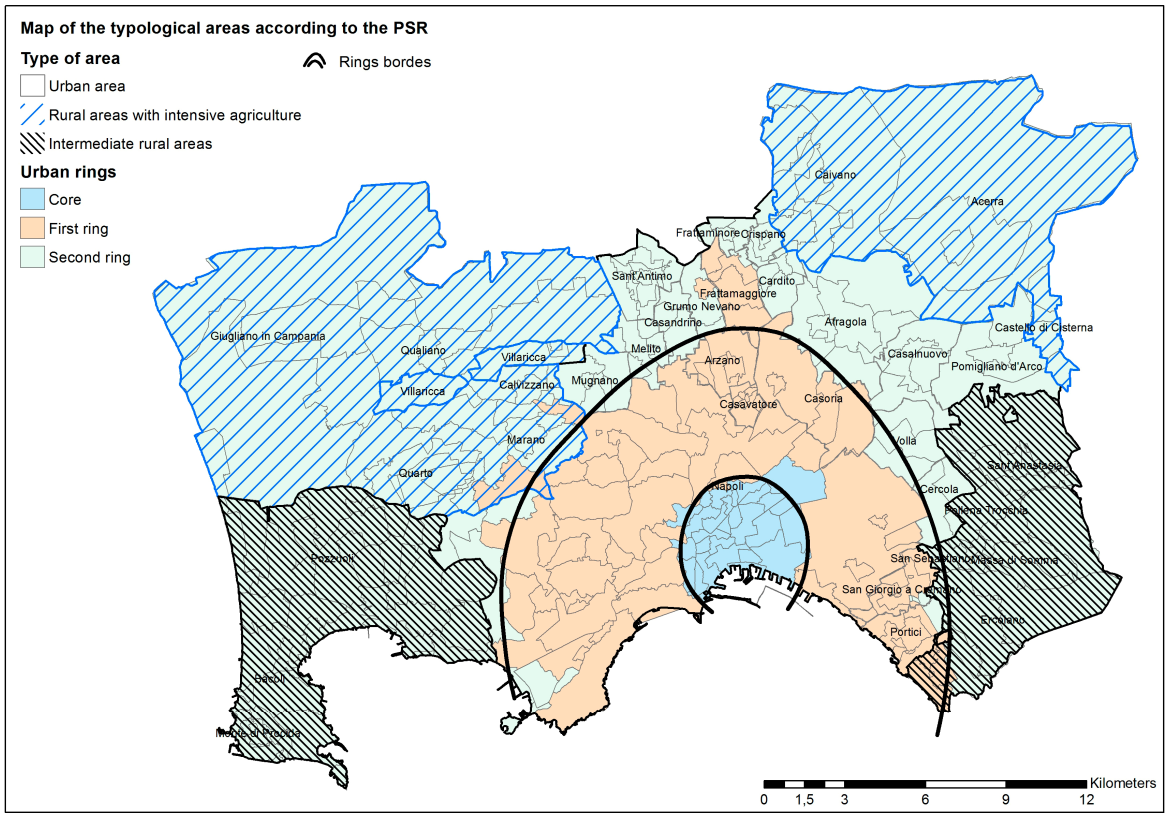
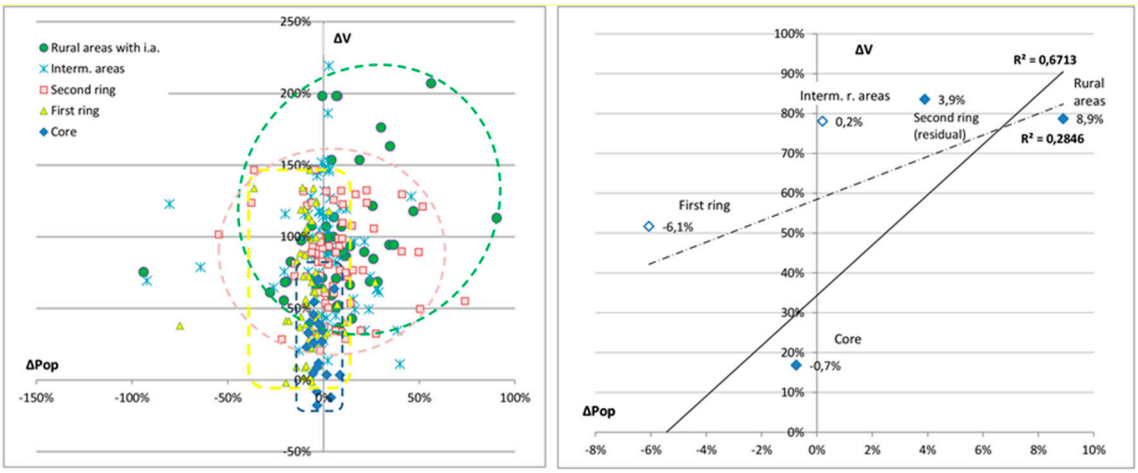


Figure 8. Map of the typological areas according to the PSR.

Table 3. Table of correlation between urban and rural areas.

Urban Rings	Δ*Pop* [%]	Δ*V* [%]
Core	–0.7%	+16.9%
First ring	–6.1%	+51.7%
Second ring (residual)	+3.9%	+83.6%
Intermediate rural areas	+0.2%	+78.1%
Rural areas with i.a.	+8.9%	+78.7%



(**a**) (**b**)

Figure 9. In this figure, the values of each micro-zone (**a**) and the average values of the five areas in which the territory is classified (**b**), are represented.

5. Conclusions

Demographic flows produce not only financial, but also social, cultural, and environmental impacts on the region. Therefore, a multi-criteria approach, especially with regard to the interventions on the territory, is required. It consists of rationalizing choices driven by conflicting objectives and transforming the heterogeneous aspects of different alternatives into assessments and forecasts on the level of the well-being of a community. According to the predetermined purposes, logistics which are able to highlight the benefits and drawbacks must be defined. The behavior of complex territorial systems must be converted to simplified models, because of the many parameters that influence its evolution.

Therefore, the identification of a few variables that can represent one or more developmental aspects of the investigation area becomes essential.

In this work, a vast urban area is considered for analysis. It demonstrates the presence of different functions and, specifically, of work activities in both agriculture and in the production of goods and services for the city. The use of GIS resolves operational issues concerning the management of large databases characterized by different territorial units, as occurs in this case study. Here, ISTAT demographic data and the purchase prices of residential units with the spatial reference of the OMI micro-zones are compared.

The diachronic analysis of "Napoli *de facto*" points out that the independent variable of real estate value variation ΔV is able to explain the division of the territory, according to models of economic growth. In particular, the Van den Berg model can express the correlation between demographic flows (ΔPop) and the change in property values (ΔV), according to a territorial partition in the concentric rings.

It is noted that the distinction between urban centers and rural areas is able to improve the effectiveness of the spatial correlation model. The implementation of the statistical model shows that, in rural areas with intensive agriculture, a strong population growth and an equally strong increase in property values occurs; while in the intermediate rural areas, the population grows to a lesser extent and, correspondingly, the growth of merchant appreciation is less marked. Finally, the study shows that the different nature of the rural area is able to affect the correlation between ΔPop and ΔV in the ring. The statistical information contained in the paper provides the measure of correlation indices.

This study is replicable for other regions, and could be used to establish the evolutionary logics and implemented with the introduction of additional variables that can affect the mercantile values of the settlement capital, provided that the numerical information required to build the database exists.

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