TERRITORIAL INEQUALITIES: THE THEORY OF URBAN LIFE CYCLE APPLIED TO SUB-MUNICIPALITY DEMOGRAPHIC DYNAMICS

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Abstract. Depopulation is a widespread process in Italy, a country where the population reached its peak around 2014, according to demographic forecasts by Istat. However, it is known that this process follows different spatial patterns: alongside areas characterized by systematic depopulation, there are others where the phenomenon appears as a new event, along with few territories where the population is conversely increasing. Generally, depopulation is observed at the municipal level; in this contribution, instead, the phenomenon is captured by distinguishing, within the municipal unit, the inhabited centre (the main one) from the periphery, a detail rarely considered in studies carried out on the topic. This is indeed a territorial partition for which the data is little used, not available except during census surveys, and difficult to adopt as it is often subject to territorial variations that are hard to manage. The objective of the work proposed here is to verify whether the demographic trend of the two sub-municipal partitions referred to - the main centre of a municipality and its periphery - in two regions, Latium and Umbria, both in the centre of the country and characterized by very different dynamics regarding sub-municipal demographics, follows the pattern of the *city life cycle* theory. For each municipality we built a path inside the theoretical spatial scheme. To our knowledge, this framework is being used for the first time to identify a typical trend in sub-municipal demographics. Starting from the analysis of the population trend from 1991 to 2021 in the main inhabited centre and in the periphery of the 470 municipalities of the two regions, results are obtained that partially confirm the sequentiality of the population dynamics, in the last period especially in Latium, less so in Umbria, at least according to the life cycle theory that identifies the phases of centralization, decentralization, depopulation, and re-population.

1. Introduction

Depopulation process is among the top concern topics in current debates (Reynaud & Miccoli, 2018; Del Panta & Detti, 2019), as the need for a transition towards more balanced territorial patterns is evident.

From the Istituto Nazionale di Economia Agraria big research in the ‘30 of the ‘900, to the various contributions by Sonnino and his school many authors faced this phenomenon. Nowadays many scholars (Benassi *et al.*, 2023; Dalla Zuanna & Gargiulo 2021; Del Panta & Detti, 2019; Reynaud *et al.*, 2020; Reynaud & Miccoli, 2018 and 2023) devoted themselves to this theme, placing this phenomenon inside the general

process of population decline started in Italy since 2014. According to Sonnino (1979), a territory is defined as depopulated if it experiences a decrease in the resident population over the course of one or more intercensal period.

At present, in Italy depopulation process follows different spatial patterns: alongside areas characterized by systematic depopulation, there are others where the phenomenon appears as a new event, along with territories where the population is conversely decreasing after robust increasing.

Depopulation process is generally observed at municipal level. However, an effective description of the depopulation process cannot be limited to an analysis conducted at the municipal level, considering the strong heterogeneity that often characterizes these administrative units. Therefore, in this research, the analysis contrasts the main central area with the rest of the municipality (the "periphery")[1].

The aim of this research is to analyze whether the demographic trends of the centre and the periphery of a municipality are different, assuming the City Life Cycle Model (CLCM) as theoretical framework. Territorial patterns theories have largely evolved in recent years thanks to various approaches. In this work we adapted the well-known CLCM used to describe the dynamics of metropolitan areas (contrasting the core with the ring composed of the municipalities that are part of the metropolitan perimeter).

However, following this theoretical scheme here, for each municipality we observe the path followed by the two sub-municipality areas, the main centre and the ring. To our knowledge, it is the first time that the life cycle theory is used to detect typical trend in sub-municipal demographic dynamics.

The analysis concerns two regions of Central Italy, Latium and Umbria. The first is characterized by the presence of a strong hub (the municipality of Rome accounts for 55% of the region's population), which exerts a significant influence on the observed flows across the regional territory (that's why in the following analysis Rome is excluded). The second is distinguished by the presence of various historical centres and the absence of a major main hub (the municipality of Perugia represents 10% of the region's population).

The work is organized as follows. Section 2 provides some background material on the CLC model. In Section 3, we introduce the research questions, and the CLCM version adopted to reach the work's aims. Section 4 presents the main data features and results from the analysis, while Section 5 gives some concluding remarks.

[1] A distinction is drawn between the municipal centre, often the historical area (a part of the municipal territory of older formation) - primarily characterized by contiguous housing and, most notably, by essential public services such as the Town Hall, schools, and the main square - and the remainder of the municipality (the "periphery" or the "ring"), which is sometimes located beyond the urban boundary and typically consists of smaller hamlets (settlement nuclei), scattered dwellings, and extensive agricultural or industrial areas.

2. Conceptual framework: the City Life Cycle Model revised

In this chapter, the theoretical framework is presented, illustrating its main features as well as some critical points identified by certain authors (section 2.1). Subsequently, a modified framework is introduced to adapt it to the territorial classification adopted in this research, which incorporates the centre-periphery dichotomy within a municipality rather than framing it—as in the classic CLCM scheme—in a metropolitan area (section 2.2).

2.1 The City Life Cycle model

The City Life Cycle Model (CLCM) is one of the most widely applied models used to explain the urban dynamics. Originally developed by Norton (1979), this model was subsequently applied in Europe by Hall and Hay (1980) and Van den Berg *et al.* (2013) and many other authors (see, for instance, Salvati and Carlucci, 2012; Wolff, 2017; Xue *et al.,* 2025).

The original model includes the following key concepts. The dynamics of the area follows a certain cyclical pattern. The CLCM theory posits that urban development progresses through distinct stages. These stages are closely related to population movements between urban cores and peripheral areas (the ring) (Van den Berg *et al,* 1982). In short according to the changes in the population of the urban core and the rings - where the core is typically viewed as some economic or social focus, while the ring represents the territory surrounding the core - the urban spatial evolution process consists in four stages (Salvati *et al.,* 2020): (i) an expansion of population of the urban cores (*urbanization*); (ii) growing rings (i.e., commuter belt) and declining urban cores (*suburbanization*); (iii) population loss in the core exceeding the population gain in the ring, resulting in total population decline (*counter-urbanization*); (iv) urban cores start re-attracting population and rings still experience a demographic decline (*re-urbanization*).

During the urbanization phase population gravitate towards city centres drawn by economic opportunities and expansion of urban infrastructure. In the suburbanisation phase individuals follow urban sprawl into suburban areas seeking improved living conditions while maintaining proximity to the city's benefits. Counter-urbanization marks a reversal of this trend, as people actively choose to move from urban to rural areas in response to the urban lifestyles. Finally, the re-urbanization phase is characterized by the revitalization of urban centres driven by redevelopment initiatives that encourage populations to return to urban core areas (Xue *et al.*, 2025).

These stages are held to exist in an ordered sequence to form a cycle, through which an area is expected to proceed over a specified time horizon. A feature of the standard version of the CLCM is that the progress of any area through the stages of the cycle will occur in an *anti-clockwise* direction (Parr, 2012).

Some criticisms of the model have been raised in the past by various authors (Salvati, 2022; Xu *et al.*, 2025). In summary, a problem arises from the fact that the model overlooks important structural elements such as the effect of age structure, the

issue of changing configurations between cities and processes beyond city borders, and the failure in many cases to reach the fourth and final phase (that of re-urbanization). A common opinion is that CLCM provides an important narrative background to spatial change, as well as a simple accounting structure for describing it. Additionally, it offers an efficient means of organizing and presenting data on population changes across different areas and over various time intervals.

2.2 A CLC model applied to the sub-municipality dynamics

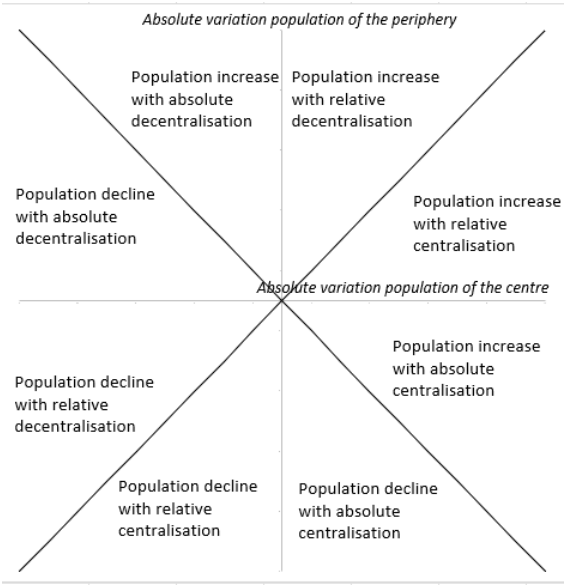
To analyse the evolution of the population in the municipalities of the two regions selected, in our research the attention is devoted to the different dynamics in a municipality by using the CLCM. For each municipality we observe the path followed by each sub-area, taking into account the crucial distinction between the two sub-areas:

a) the population - and its dynamics - in the main centre (or pole) of one municipality;

b) the population - and its dynamics – in the rest (the periphery) of a municipality.

As far as we know, it is the first time that the CLCM is used to detect typical trend in sub-municipal demographic evolution. The *revised model* can be described in an usual way by taking into account that we don't observe metropolitan areas but municipality.

Figure 1 – *The Revised City Lyfe Cicle Model.*



Source: figure adapted from Wolff, 2017

In the model the *xy* axes host the absolute variation in a certain period of time either of the population of the main centre (horizontal axis) or the population in the periphery (y-axis): see Figure 1. The revised model involves eight stages, as each of the four stages of the classic model is further divided into two sub-stages: the first, called *absolute*, in which the evolution of the two sub-areas follows contrasting trends (one decreases, the other increases; for example, the population of the center declines while that of the periphery increases: these correspond to sectors III, IV, VII, and VIII - see Figure 1); the second, called *relative*, in which the signs of demographic evolution are consistent but of different intensities (sectors I, II, V ad VI in Figure 1).

In the phase I both the centre and the periphery of a municipality experience a population growth phase, with the increase in the first case outweighing that of the second: this is a period characterized by a positive demographic dynamic of the municipality, accompanied by a *relative centralization*. In phase II, instead, the increase in the peripheral area prevails, leading the municipality into a phase called *population growth and decentralization*. Phase III describes an *absolute decentralization*, as the municipality's population increases due to a positive dynamic in the periphery that counterbalances the negative trend in the centre. In phase IV, the whole municipality enters a depopulation phase (absolute decentralization), caused by an increase in the periphery that cannot offset the further decline of the population in the main pole. Phase V marks a further and more pronounced phase of depopulation, where both sub-areas are in decline, with a stronger decrease in the centre (which can be described as *decentralization*). This is followed by a period of further decrease (phase VI), where the contraction of the centre is less intense than that of the periphery, leading to a period of population *centralization* in the municipality. In the phase VII the main centre regains its demographic vitality, even though the periphery experiences a more substantial decline (the phase of absolute depopulation and centralization). Finally, in phase VIII, the municipality's population enters a positive phase, as the more robust increases in the centre more than compensate for the weakness of the periphery.

In this article, the CLC model is therefore applied in a way that differs from its traditional use (Benassi & Salvati, 2020). Adopting a different territorial approach, the comparison between the periphery (ring) and the municipal core is carried out within a single municipality. The aim is to provide a linear interpretation of expansion at the sub-municipal scale, thereby highlighting the differences in the evolutionary dynamics of its two components.

This approach outlines a process that identifies cycles shaping a typical pattern of relationships between the municipal core and its surrounding ring, in line with the logic of centralization–decentralization sequence. This revised model captures a

series of specific population changes in both the core and the ring, which together define a sequence of stages in spatial transformation (Parr, 2012). These stages are understood to unfold in an ordered progression, forming a cycle through which an area is expected to evolve over a given time horizon.

Nevertheless, the model should be simply regarded as an empirically based attempt to characterize long-term spatial population change, rather than as a comprehensive theory of spatial development. In this perspective, the model could even be adopted in a predictive framework, allowing for the formulation of future scenarios for both the core and its ring.

3. Modelling the dynamics of the sub-municipality

This work exploits data collected through the population censuses. In our analysis we consider a very long period, from 1951 to 2021, that is 70 years of history of the population dynamics. With reference to each of the years involved, we estimate the population in the main centre of each municipality and then we obtain the estimation of the population of the periphery by subtracting the first estimate from the size of the whole population of the municipality.

As in the classic model, a feature of the revised version is that the progress of any area through the stages of the cycle will occur in an *anti-clockwise* direction.

Two main assumptions led this research work:

RQ1: Can the CLC revised model properly describe the sub-municipality dynamics?

RQ2: Are there any difference between the two regions, Latium and Umbria, in terms of pattern across population growth and territorial dynamics?

4. Results

In this section, the dynamics of the two territorial partitions in which the municipalities of Latium and Umbria were classified between 1951 and 2021 are presented[2]. Subsequently, the results of the analysis are illustrated, focusing on the transitions that occurred during the observed periods, identifying those consistent with the model's statements.

[2] The analysis covered all the municipalities of the two regions. Only in a few cases the amounts of the population used for the analysis are not very significant: in 26 municipalities (out of a total of 470) the population of the periphery drops — though only for certain years — below 20 inhabitants. All municipalities were retained in the analysis essentially in order to preserve the general scope of the findings.

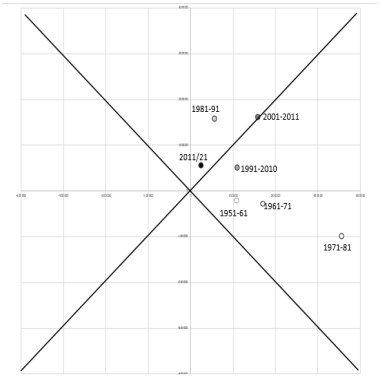
4.1 Regional level

In the thirty-year period from 1951 to 1981, Latium is characterized by a phase of population growth with *absolute centralization* (see figure 2): when looking at the total of 377 municipalities, the increase in population in the city centres more than compensates for the demographic loss in the peripheral areas. As a result, the region's population shows an overall increase. The proportion of the population residing in the city centre during this period increases significantly (from 57% in 1951 to 73% in 1981). Subsequently, a phase of significant *relative decentralization* (see figure 2) of the population in municipalities begins: during the decade from 1981 to 1991, the suburbs of the region experience a strong increase in resident population, while the main centres see a much more modest growth. In the following three decades, the regional average value consistently remains in the first quadrant with slight fluctuations, indicating a slow phase of relative decentralization of the population (see figure 2A). The suburbs of the municipalities absorb a significant share of the region's demographic growth: the percentage of residents in the city centre gradually decreases, from 73% in 1981 to 66% in the most recent census.

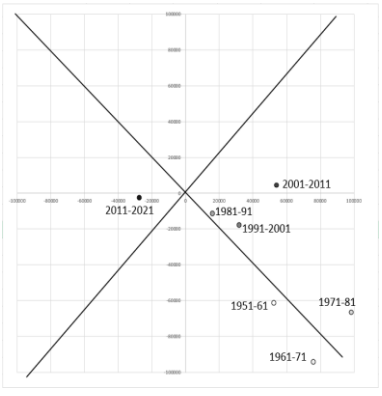
The case of Umbria is different: during the first four decades, the process of decline in the resident population in the suburbs of the 91 municipalities of the region continued. The positive variation in the population of the main centres in the first twenty years (1951-1971) was not enough to counterbalance the strong demographic decline in the suburbs, resulting in the region appearing depopulated during that period. The outcome was a significant increase in the level of population concentration in Umbria, which rose from 51% in 1951 to 66% in 1971.

Figure 2 - *The evolution of the sub-municipalities (main centre and periphery) in the 1951-2021 years. Latium and Umbria.*

A. Latium



B. Umbria



Between 1971 and 1991, also, the phase of strong *absolute centralization* of the Umbrian population persisted (see figure 2B), with the urban centres accounting for over 80% of the population. In the new century, the situation changed radically: the suburbs halted the depopulation process, and a phase of demographic growth began. During the decade 2001-2011, even the main towns experienced an increase in population. Subsequently (2011-2021), there was a slight decline (phase of *absolute decentralization*). The result is that the percentage of the population residing in the city centre stabilized around 18%, roughly the level from 30 years earlier.

4.2 Trajectories followed by municipalities

The model adopted here, as previously mentioned, assumes that the transitions from one stage to the next generally follow a specific order: a municipality can move from the centralization stage to the depopulation stage, even skipping or quickly passing through the other stages, but a reverse path is not foreseen (Cecchini, 1989).

Table 1 - *The transition sequence in the 1951-2021 period: Latium municipalities.*

Period/ The transition sequence	1951-61/ 61-71	1961-71/ 71-81	1971-81/ 81-91	1981-91/ 91-01	1991-01/ 01-11	2001-11/ 11-21
			%			
A. Same sector	46.4	26.5	28.4	27.3	28.4	21.2
B. In order (anti-clockwise direction)	14.1	16.7	19.1	15.9	17.2	18.8
C. In "skipped" order	7.4	14.9	17.8	17.2	13.8	26.5
In reverse order (clockwise): reversion to the previous stage	20.7	15.6	13.8	14.6	17.8	6.6
In "skipped" reverse order: reverse to two (or more) previous stage	8.0	18.0	14.1	16.7	15.4	11.9
Undefined trajectory (symmetrical transition)	3.4	8.2	6.9	8.2	7.4	14.9
% coherent with the CLC revised model	**70.3**	**63.3**	**70.1**	**65.9**	**64.2**	**78.2**

Source: own elaborations on Istat Data

Additionally, transitions are defined as "indefinite" when the municipality, between one period and another, is exactly in a sector symmetric to the previous phase, making it impossible to determine whether it arrived by traversing the quadrant anti-clockwise (as predicted by the model) or clockwise.

In the decades considered, in Latium very different transitions are observed. The first phase appears to be one of immobility: municipalities that remain in the same sector account for almost 50% of the total. Immobility is an important characteristic, even if its weight diminishes in the periods after 1961-71, when the percentage of municipalities remaining in the same sector ranges from 21% (in the last period) to 28% (between the decades 1971-81 and 1981-91: see Table 1).

Throughout the entire period considered, the sequences consistent with the model make up about 70% of the total; this value was calculated by considering the percentage weight of the first three sequences (A plus B plus C) listed in the table out of the total sequences considered as defined (excluding "undefined trajectories").

In Umbria, the sub-municipalities generally show more coherent sequences with the model throughout most of the considered period (coherence percentages ranging from 71% to 90%). In the most recent period, between 2001-2011 and 2011-2021, the percentage of sequences consistent with the model drops to 57%. This phenomenon seems to be related to the high mobility characterizing the latest period for Umbrian municipalities—an instability that becomes evident when looking at the low value of the weight assigned to municipalities that remain in the same sector over the years considered (Table 2). In short it emerges over time in both regions that the stability of municipalities – particularly in Umbria - tends to decrease.

Table 2 - *The transition sequences in the 1991-2021 period: Umbria municipalities.*

Period/The transition sequence	1951-61/1961-71	1961-71/1971-81	1971-81/1981-91	1981-91/1991-01	1991-01/2011-21	2001-11/
A. Same sector	48.9	40.2	40.2	32.6	33.7	7.6
B. In order (anti-clockwise direction)	19.6	34.8	21.7	25.0	20.7	7.6
C. In "skipped" order	3.3	15.2	15.2	12.0	21.7	31.5
In reverse order (clockwise): reversion to the previous stage	22.8	9.8	10.9	9.8	6.5	12.0
In "skipped" reverse order: reverse to two (or more) previous stage	5.4	0.0	8.7	18.5	10.9	22.8
Undefined trajectory (symmetrical transition)	0.0	0.0	3.3	2.2	6.5	18.5
% coherent with the CLC revised model	**71.7**	**90.2**	**79.8**	**71.1**	**81.4**	**57.3**

Source: own elaborations on Istat Data

The distribution of transition sequences among municipalities changes over the years. Moreover, a quite high percentage of municipalities still follows the pattern

predicted by the CLC model (either in order or skipped order). In the most recent period, there is a prevalence of skipped order transitions, where the centre or peripheral area shifts by two or more sectors. Additionally, symmetric shifts among municipalities increase over time. Overall, only a minority of municipalities has not necessarily followed the pattern predicted by the CLC model.

5. Concluding remarks

CLC revised model provides an important narrative background to spatial change, as well as a simple accounting structure for describing this. In addition, it offers an efficient means of organizing and presenting data on population changes across different areas and over various time intervals. The CLC revised model cannot be regarded as a strict theoretical framework. However, it is important to analyse the dynamics of the municipalities using the proposed framework, which we believe proves to be extremely useful. Without this framework, it would be difficult to capture, in summary, the high heterogeneity that emerges when examining phenomena at this territorial level. Once the framework is established, of course, there is a need to deepen the analysis to understand the influence of structural factors (for example, the effect of age structure on demographic dynamics and vice versa) and other factors related to the coexistence of different populations (for example, the role of foreign immigration in mitigating rural depopulation), which are not addressed here. Further insights will concern at least three different aspects: a) analysis of the individual trajectories of the municipalities by identifying two sets, that is, distinguishing municipalities that are consistent or not with the pattern suggested by the model; b) the use of the "Depopulation Tables" (Sonnino, 1979) in which following the framework of the life table, the decline of the population is analysed to assess the intensity of the process and to study, for example, the probability of transition from a depopulated state to a stationary state; c) the use of models taking into account the variation in population over time related to demographic size and to other information such as the altitude zone, the accessibility indicator from the SNAI (National Strategy for Inner Areas), other socioeconomic covariates.

The findings of this analysis can inform the design of targeted policy interventions. For local administrators, understanding the intensity and pace of depopulation is crucial in order to implement effective and context-specific strategies. In this study, the demographic evolution of the centre was examined separately from that of the periphery, with the objective of enabling policymakers to adopt differentiated measures in response to possibly diverging trends between the two contexts.

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