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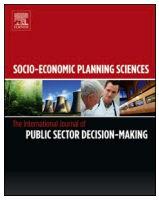

Inner areas matter: A place-sensitive approach for the identification of the Daily Life Spaces in the Italian Abruzzo region

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ABSTRACT

Despite the institutionalization of the issue of inner areas with the National Strategy for Inner Areas (Strategia Nazionale per le Aree Interne, SNAI), a reflection on their spatial organisation is still missing. Our paper aims at filling this gap by providing a methodology for identifying the citizens' Daily Life Spaces (DLS) in the Italian Abruzzo region, which can be used as the spatial unit of analysis of cohesion policies. Their identification results from a multi-step algorithm based on an original definition of central places and on the notions of geographical and organised proximity which consider both citizens' isochrones and commuting flows. Our methodology is able to provide the internal spatial organisation of both Labour Market Areas and Project Areas and is consistent with a historical perspective. Finally, it questions the SNAI classification, calling for a revision of its methodology of identification.

1. Introduction

The identification of the appropriate spatial unit of analysis is a key challenge in regional science, especially when planning cohesion policies, which are aimed at discovering and exploiting the untapped local potentialities, finally enhancing the well-being of European citizens. As noted by Iammarino et al. [1] "promoting the development of places requires an integrated place-based approach" (p. 2) which further implies "adopting a view on territorial development perspectives of places beyond their administrative borders" (p. 3). In so doing, it will be possible to increase interconnections and interdependencies finally leading "to maximise their development potentials and achieve critical mass through joint initiatives" (p. 3).

Based on these considerations, the aim of this paper is to provide a place sensitive methodology to identify the Daily Life Spaces (DLS) of the Abruzzo region which can account for the presence of both urban and inner areas.

With DLS we intend clusters of neighbouring and interrelated municipalities surrounding centres with different level of centrality, according to a Christallerian perspective [2], where citizens carry out most of their daily functions. With place-sensitive, we refer to a strategy which calls for a distributed development, both "sensitive to the need for agglomeration and the need for it to occur in as many places as possible" [3] (p. 17). This perspective is expected to counter the potential negative effects related to the people-based and place-based approach. The former, focusing on efficiency through agglomeration, risks exacerbating territorial inequity, whereas the latter, focusing on equity through place-based support, can, in some cases, weaken its economic efficiency at large.

The suggested methodology considers multiple functions carried out at the local scale in order to understand the territorial complex identity, that is contingent across time and space [4], and to support the planning of more effective policies. This approach is place-sensitive because it considers the place, which is framed by a specific space and a peculiar time [5], but also because it grabs local identity, connected with places' functional links and their historical legacy (i.e., habits, traditions, existing infrastructure) [6].

The definition of inner areas[1] is that provided by the SNAI (*Strategia*

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[1] The Technical Committee for Inner Areas identifies six types of municipalities based on their capacity to provide or to access essential services: 1) service provision centres/poles as single municipalities, or 2) as a set of neighbouring municipalities which provide: a) the full range of secondary education, b) at least a first level DEA hospital and c) at least a Silver railway station; 3) peri-urban areas which can access essential services in 20 min maximum; 4) intermediate areas with accessibility time between 20 and 40 min; 5) peripheral areas with accessibility time between 40 and 75 min; 6) ultra-peripheral areas with accessibility time over 75 min. Municipalities from 1) to 3) are considered urban areas, from 4) to 6) inner areas (https://www.agenziacoesione.gov.it/wp-content/uploads/2021/01/Nota_metodologica_Aree_interne-2-1.pdf).

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Nazionale per le Aree Interne - National Strategy for Inner Areas), launched in 2013 by the Italian government. The SNAI is a public policy for territorial cohesion financed by national and European funds, such as FESR, FSE, and FEASR [7]. It represents a crucial step within the realm of public policies: inner areas were finally considered a national issue, deserving targeted strategies aimed at improving their accessibility to essential services and spurring local development, hopefully leading to counter or, at least, to mitigate the long-term process of socioeconomic marginalisation they suffer from.

Despite the institutionalization of inner areas in the policy agenda, their functional representation remains almost unexplored so far. They are, at best, considered as the peripheries of urban areas or industrial districts, whose core centres are in most cases too far in terms of travel time and, subsequently, in terms of accessibility. This stigmatising, urban-centric representation of territorial interdependencies prevents the possibility to consider the emerging spatial relationships within inner areas which, although at a lower order, are able to organise that territory as well.

Our paper focuses on the Abruzzo region which, because of its territorial characteristics and recent history, is a well-suited case study to support this kind of investigation. To assist regional and local government in coping with the physical, social, and economic disruption caused by the 2009 earthquake (and the 2008 crisis), the OECD [8] prepared the report "Making after Disasters: Helping Regions Become Resilient".[2] This report provided some policy recommendations based on several key priorities. Among these, it is worth recalling the strategic pillar "Improve the regional governance system", and, in particular, the need "to enhance inter-municipal co-operation schemes for small-sized municipalities" [8] (p. 86). To address the governance issue, the identification of the spatial unit of analysis represents an inescapable preliminary step. This is even more important with respect to peripheral settings, especially considering the ongoing process of redefinition of inner areas for the 2021–2027 program.

The paper is organised as follows. Section 1 discusses the spatial representation of the socioeconomic process, followed by a theoretical description of DLS based on individuals' isochrones and low-order centres. Section 3 proposes a multi-step algorithm based on geographical and organised proximity aimed at identifying the DLS of the Abruzzo Region, whose results are discussed in Section 4. Section 5 concludes.

2. Territory matters: the spatial representation of the socioeconomic process

With the 2008 Lisbon Treaty, territorial cohesion became part of the EU competences along with economic and social cohesion, already included with the Single European Act of 1986. Disparities among regions, and, most importantly, within regions, became one of the main tasks of EU policies, with a specific focus on industrial transition areas and rural areas, often affected by "slow burn" [11], a process of permanent demographic shrinkage and prolonged socioeconomic decline. Finally, the principle that geography matters had been formally enshrined, implying the necessity for the Member States to pay attention to peculiar, local geographical facts when developing programmes and allocating the available resources on specific priorities.

By incorporating the territorial dimension within the notion of cohesion, EU institutions on the one hand were willing to exploit the untapped territorial capital to improve and enhance regional competitiveness [12]. On the other hand, they were aimed at bringing Europe closer to its citizens through local initiatives of sustainable and integrated development regarding urban, rural, and coastal areas [13], stressing the necessity for a place-sensitive strategy which must ground on an appropriate target area.

Accepting this principle implies the necessity to consider sub-regional spatial categories. Empirical evidence shows the importance of addressing the territorial question. Niebuhr and Stiller [14] demonstrate that the existence of a high level of heterogeneity in terms of productivity and competitiveness between regions depends on the prevailing internal settlement structure (urban or rural). Furthermore, as demonstrated by Straubhaar et al. [15], the lower the selected spatial level, the greater is the divergence: imbalances are substantially higher when considering NUTS 3 than NUTS 2 regions. Subnational (and sub-regional) units allow a better matching than national (and regional) units between their socioeconomic characteristics and cultural, historical, and ecological dimensions [16]. To this regard, OECD argues that "in a number of policy domains, administrative boundaries often do not constitute the appropriate geographic scale to fully understand local economies and citizens' economic reality" [17] (p. 12). In addition, the Committee of the Regions notes that city and non-city dwellers move beyond administrative boundaries, since their daily urban system are based on functional areas (including commuting, shopping, education, and recreational flows of people) larger than their sole place of residence. Based on this evidence, the creation of networks of neighbouring municipalities should be encouraged, since they are reputed to be the appropriate territorial level on which not only traffic and transport, but also the economy, spatial planning, and green spaces should be organised [18].

These considerations are reflected in the increasing recognition about the inadequacy of administrative (formal) regions as the spatial target of policy making [19–21] and the subsequent necessity to use Functional Regions (FR) to this purpose. As Martínez-Bernabeu et al. [22] note, these latter, in fact, have flexible boundaries that are not constrained by institutional sets, history, and morphology as in the case of administrative regions. FR can thus be adapted to the changing patterns of spatial socioeconomic interactions upon which they rely, representing a continuously up-to-date tool for territorial analysis and policy.

According to Karlsson and Olsson [23], FRs can be broadly defined as systems "of highly connected smaller and larger places" (p. 2). They argue that larger places usually coincide with the areas where economic activities are concentrated, dominating the relationships with their hinterland. For most households and firms these relationships are predominantly short distance-based and dependent on intraregional economic interaction, mainly consisting in labour commuting and shopping for households and in intra-regional trade in goods and services for firms. In other words, FRs are the spatial expression of the correspondence between the proximity of households' and firms' activities and the frequency of their spatial interactions. As suggested by Klapka and Halás [21], these localized patters of spatial interactions are based on two main principles, namely the principle of external separation and the principle of internal cohesiveness, which both account for the autonomy and self-containment of FRs. In particular, the number and intensity of relationships are "maximised within a functional region and minimised across its borders, which ensure a high degree of functional regional autonomy (self-containment) for each respective functional region" [22], p. 4.

However, although "FRs are increasingly used within research and policy, how FRs are best defined is an unresolved issue" [22], p. 739, due to the multitude of methods which have been proposed so far. An exhaustive overview of them has been recently discussed by Klapka and Halás [21]. They argue that FRs can be split into three main groups of functional areas by complementing the basic principle of self-containment with further characteristics, such as: 1) the spatial organisation around an urban or nodal core towards which most flows are headed, in the case of Functional Urban Region – FUR; 2) the individuals' circadian cycles, in the case of the Daily Urban System - DUS;

[2] Resilience, here, is intended in adaptive terms, referring to the capacity of a region to adjust its economy, society, and institutions in response to the changed contextual conditions caused by a shock, thus maintaining the same or taking a different development trajectory [9,10].

3) the home-to-work commuting, in the case of Local Labour Market Area (LLMA). Moreover, the authors propose four criterion which underpin their identification process. The class formation can result from: 1) the grouping or subdivision of territorial units; 2) a clustering rule which can be single- or multi-step; 3) a non-hierarchical or hierarchical method, depending on the fact the number of final clusters is not known in advance or it is; 4) the interaction matrix, which reports the considered flows which are resumed in a graph or in a numerical expression accounting for dissimilarity among territorial units.

LLMAs, which have different labels, such as Travel-to-Work Areas, Labour Market Regions, Employment Zones, Commuting Zones, Working Catchment Areas [22], and Functional Urban Areas (FUAs) [25,26] are the most extensively used type of FR in the EU.

LLMAs have a common root in the identification of the US Standard Metropolitan Areas (SMA). The regionalisation algorithms of LLMAs basically ground on home-to-work commuting data which are widely available and regularly updated. Moreover, since labour relationships are crucial in social and economic life, they can be considered a proxy of several other local horizontal flows which define local systems [27,28]. The main differences among LLMAs depend on the primary goal their respective identification algorithms pursue. If autonomy is considered crucial, then the algorithm will tend to maximise the self-containment of both internal labour demand and supply. In case of policy aims, then the algorithm will tend to identify LLMAs with a similar size range (homogeneity principle) or where the ratio between labour demand and supply are more balanced (balance principle). Fourth, the algorithm will maximise the interaction intensity within LLMAs when cohesion issues are at stake (Martínez-Bernabeu et al., 2020). Finally, their identification process can result from a centre-based approach, where central or nodal places are defined according with specific features (in terms of population and employment density, size, built environment, etc.) or "travel to work" analyses that ignore predefined urban centres [29].

FUAs are defined on the basis of given thresholds regarding population density and commuting patterns, thus showing the constituent characteristics of both FUR and DLS, and aim at providing a representation of the internal spatial organisation of urban areas.

As for the Italian case, the official classification of functional areas is that of the "Sistemi Locali del Lavoro" (SLL) (Local Labour Systems), provided by Istat [29], which has been recently updated with the aim to provide a harmonised methodology and standardised definitions, to be used and replicable in the whole EU. The main difference between SLL and FUAs applied to the Italian case is that the latter cover only part of the national space: they focus on urban and metro areas and consider the rest of the territory, namely non-urban areas, as "peripheries" which are not investigated in functional terms [30]. Focusing solely on cities lies on the necessity to study the phenomenon of polycentricity at the EU level [25] and to make comparisons among urban areas.

SLL, on the contrary, by providing a full territorial coverage, can be considered "a broader concept that considers regions as a whole and is not specific to individual cities" [24] (p. 10). In these terms, SLL are more suitable than FUAs to support cohesion policies in Italy. Not by accident, Eurostat [24] stresses the importance to identify functional areas also in peripheral regions, which are organised on the basis of functional linkages just as urban and metropolitan areas.

However, as OECD [17] suggests, despite the number of national case-studies carried out, the functional organisation of space in marginal areas have to be deepened in order to recognize sound and reliable geographic unit of analysis for the implementation of effective regional development policies. The identification of appropriate territorial units requires objective and measurable criteria which should be spatially, and historically grounded.

From this perspective, cohesion policies should identify places where citizens carry out most of their economic, social, and family activities, be they localized in urban or rural/peripheral contexts. To this aim, we propose the notion of DLS, namely set of municipalities characterized by geographical and organised proximity [31], as the primary territorial unit of analysis reflecting the socioeconomic spatial organisation of the territory upon which cohesion policy should be based. Organised proximity facilitates relations between units and individuals which are share an organised space. It is based on both the logics of belonging (interaction facilitated by geographical proximity, but also by rules and routine sharing) and of similarity (closeness facilitated by the share of the same tacit knowledge).

The identification of DLS results from the merge of theoretical considerations from different fields: a) human and time geography, with respect to the constraints imposed to human circadian cycles by distance and time; b) the functionalist perspective adopted in regional economics and urban geography, regarding the role of centres in providing job opportunities and public and private services at a super local scale, and thus in creating catchment areas over surrounding municipalities.

3. The spatial organisation of the socioeconomic process: isochrones and sub-centres

Time-geography is a transdisciplinary perspective which focuses on the time-spatial embeddedness of human activities [32,33]. This framework dates to the 1960s thanks to the pioneering works of the Swedish geographer Torsten Hägerstrand and other scholars at the Lund University. They investigated the transformation of Sweden from a vertically linked, short-distance, rural society, to a horizontally linked, long-distance urban society [34,35]. Basically, according to Hägerstrand [36], daily life of people consists in a sequence of activities of production and consumption, which occur under several physical, institutional and socio-cultural constraints [37]. Hägerstrand specifically sets out three main types of spatial and temporal constraints: the capability to solve a problem (due to physiological needs, the availability of means of transportation or economic resources); the authority restrictions imposed through laws, economic barriers, and power relationships; coupling constraints regarding where, when, and for how long individuals join other people (or objects) in order to perform activities.

The individual path through time and space is summarized in the space–time prism, which depicts the potential sequence of activities and social interactions within a time budget. Scholars have therefore to investigate where, when and by whom the activities are performed [35]. Such diachronic analysis rests on the assumption that, even if subjectively perceived from different people, time is objectively measurable. This last argument allows a quantitative investigation of social evolution over time [33].

In recent years, time geography engages with several features of contemporary life that have arisen in the last decades. The increased mobility, the widening of the activity space of individuals [38], the rising differences in time budgets between sociodemographic segments of the population [37] call for a refining and updating of traditional time-geography framework. Examples of investigated topics are: 1) the impact of ICTs on the space–time constraints, with a particular reference to those affecting specific subgroups of people [37,39]; 2) the dichotomous classification of activities, as fixed or flexible in time and/or space, in order to determine if and how the space–time fixity of people's daily activities is affected by individual attributes (gender and employment status), built environment and policy factors [40]; 3) the effects of a local school closure in rural areas [41].

At a glance, the framework of time geography is particularly appropriate to understanding socioeconomic changes and to provide proper regional policies, especially in traditional, rural territories like inner areas [33]. Time geography provides a modern view to deal with the current challenges investigated in the present paper: it does not consider only commuting but distinguished among different uses of time, such as personal, committed and free time [38] which have a different hierarchy [35]. In addition, it proposes a multidisciplinary [35], long-term [33] investigation of daily life and social relations of people, which lie at the core of social changes. Time geography focuses on individual life, in the awareness that "regional science is about people

and not just about locations" [36, p.7].

On this background, to operationalise the investigation of daily life and social relations of people, we refer of the so-called "law of constant travel time" (LCTT) as a proxy of geographical proximity. This law states that the average total travel time per person is substantially constant and amounts to about an hour per day [42]. Yet at the beginning of the last century, Geddes [43] described English conurbations as the result of the overlapping commuting flows of their citizens, generally corresponding to about 1 h (round trip) from the place of residence. It is, however, with the pioneering work of Tanner [44], followed by Zahavi [45] and Hupkes [46], that the LCTT becomes generally accepted [47]. Even though travel time expenditures vary according with different individuals' socio-economic characteristics, such as income level, gender, and employment status [48], empirical evidence supports the hypothesis of a constant travel time of 1 h per person over time and space, "being a general characteristic of settled population" [42, p.3]. Hupkes [46] provides two reasonable, although partial, explanations for such a regularity. According to the bio-psychological approach, constancy of travel time results from the tendency of human beings to avoid stressful situations keeping habits. The 1-h travel time, thus, stems from habits which are "reinforced by past experiences of pleasure or displeasure" [46, p. 41]. The second explanation, known as the utility optimising approach, argues that the utility related to mobility initially increase (due to the change of environment, the fact of being in movement despite the trip purpose, etc.) but after a given point it turns into negative values (monotony, fatigue, etc.). Interestingly Eliasson [47] shows that, at least for the Swedish case, also average total travel time per person in different types of municipalities are strikingly similar: a little more than 50 min per day for smaller municipalities and around 60 min per day for urban and metropolitan areas.

Based on this intriguing law, Gueiros et al. [49] propose a definition of city based on the isochrones of their inhabitants, "defined as the line joining the equal travel time distances from any given location […] that answers the question: 'how far can you get from here in x amount of time?" [50], p. 402], thus considering a temporal frame of reference to access to the centre. This proposition was intended to contribute to the methodological debate about a harmonised delimitation of FUAs in Europe. The advantage of using isochrones instead of kilometric thresholds in determining the DLS of individuals lies in the greater stability of the former over time compared to the latter, which are more susceptible to transport improvements.

Along with the isochrones, which, however, are not used in functional regionalisation, the definition of consistent regional and sub-regional areas is achieved also through other methods. Some scholars employ the notion of distance-decay movement, by which they estimate individual functions for the daily travel-to-work [51]. However, if, from the one hand, the estimation of individual distance-decay functions is facilitated by the availability of the required data (generally employees and population, which are updated more frequently than decennial commuting data), from the other hand these functions are rather complex to manage, due to their non-linear character and pre-determined assumptions. Other studies share the strong criticisms of traditionally top-down approaches, grounded on daily commuting-to-work data which overestimates the importance of large centres [51]. Horňák & Kraft [52] introduce a bottom-up identifying method, which relies on the combination of the intensity of spatial interactions with the level of self-containment within a FR.

As for organised proximity, we consider the relationships between centres with different level of centrality and their hinterland. To this regard, it is worth noting that nor the identification of the SLL neither that of Project Areas[3] have been complemented by a reflection on inner areas' internal spatial organisation. While this lack can be considered a minor issue when aiming at delimitating labour markets, it can represent a major issue for the SNAI, since "economic linkages that define functional areas exist in all types of territories, urban and rural alike" [17], p. 12.

Table 1
Maximum access time (one way trip) in minutes and related kilometres in selected Abruzzo SLL.

SLL	Number of municipalities	Maximum access time	Maximum kilometres	Number of municipalities >20 min
Avezzano	29	35	51	14
Sulmona	28	36	41	11
L'Aquila	31	41	46	19
Teramo	21	31	41	7
Chieti	37	37	42	20
Atessa	37	42	42	29

Source: our elaboration on Istat origin-destination matrix, 2019

In both cases municipalities have been associated together or to the largest regional poles despite two main stylised facts: 1) in many cases they are too far according to the empirical evidence related to the LLCT, as Table 1 shows; 2) an analysis of the presence of low order centres has been neglected. As Sýkora and Mulíček [30] note, however, the conceptualization and delimitation of the territory must reflect its "formation on the micro-scale and detect the smallest complete, complex, organic territorial units where the daily life of the population is organised" […] without excessive need to travel for jobs and services to other areas or their urban centres" (p. 287–288). Even small towns, by providing "central functions" (job opportunities, private and public services, although at a lower scale than regional centres) can act as rural poles [53], contributing to the spatial organisation of inner areas. As ESPON [54] argues, in fact, not only education and health matter as main driver to cope with marginalisation, but also the presence of banks and shopping opportunities at large, which signal a relative level of centrality. The identification of these subcentres is a key issue since their decline importantly affects the wellbeing of local communities [55]. The incorrect accomplishment of this task implies providing a biased representation of the local socio-economic potentialities and constraints, with a subsequent negative impact on the design and implementation of cohesion policies.

To identify centres with different levels of centrality, we use further information than the sole work commuting flows. Home-to-work patterns, indeed, are only part of the total displacements that characterise citizens' DLS. As stressed by the Audimob Observatory on Mobility [56], in Italy in 2019 these flows cover only 32% of total movements, whereas education, leisure and family management respectively 4,6%, 26.2% and 37,2%. Moreover, the average length of journeys tends to be longer in the case of commuting to work and to school, compared to the shorter mobility that characterise family management and leisure (Table, 2). Commuting flows account for almost the half of total displacements within extra-urban mobility, whereas leisure- and family-oriented mobility takes the highest shares in case of travels that originate and terminate within the municipal borders, thus, with a shorter range.

In the lack of municipal data on family management and leisure commuting, we suppose that their spatial patterns are affected by the presence of centres providing public and private services. We propose a mixed method relying on both a centre- and a non-centre-based approach to identify these poles, using the following information.

1) As for the centre-based approach we consider the classification provided by the SNAI, which defines as "poles" those municipality able to supply specific services at a supralocal scale, such as: a) an exhaustive range of secondary schools (at least a scientific or classical high school and a technical or professional high school); b) at least a first level DEA hospital; c) at least a 'Silver-type' railway

[3] SNAI have identified for the period 2014–2020 seventy-two project areas (five in the Abruzzo region), which are clusters of neighbouring municipalities classified as inner areas upon which a development strategy has been implemented. For a detailed review of the methodology see Ref. [7].

Table 2
Citizens' displacements in percentage according to their purpose and range (urban or extra-urban), 2019.

	Work and school	Family management	Leisure	Total
Urban mobility	34.1	27.4	38.6	100.0
Extra-urban mobility	44.7	22.4	32.9	100.0
Total	36.6	26.1	37.2	100.0

Source: our elaboration on Isfort data

station (RFI) in 2020. This classification, however, suffers from two main limits. As noted by Vendemmia [57], it considers within the same category of inner areas (for example, peripheral or ultra-peripheral areas) places with very different territorial and socio-economic conditions. In addition, and to some extent related to the first point, the identification of central places is limited to the highest part of the poles' hierarchy, since the three conditions must be simultaneously met. Although assessing needs is a complex task since it involves both personal [58] and local communities' preferences [59], we suggest articulating this definition based on two considerations. First, we propose to rank education, mobility, and health according to the essentiality of the service provided. In general, health services can be considered relatively more important than education and railway mobility for their direct effects on basic subsistence needs; education can be considered relatively more important than railway mobility. This latter, indeed, can be substituted by public bus services or private mobility (of course with a higher impact in environmental and social terms), upon which inner areas do largely rely [60]. Secondly, also lower order centres offering only a partial combination of these essential services must be considered, since they substantially contribute to the spatial organisation of the socioeconomic process at the local level.

2) As for the non-centre-based approach we focus on the physical presence of lower order services and of specific economic activities (in terms of employees) which signal a relative level of centrality.

In the next paragraph we propose the methodology aimed at identifying the DLS organised around an urban core, a town or a village.

4. Data and methodology

Abruzzo region has a complex polycentric structure, which covers a range of physical, historical, socio-economic environments, encompassing urban poles and rural areas, industrial districts, a touristic coastline characterized by territorial coalescence phenomena and shrinking mountain environments, historical towns, and small villages at risk of depopulation. Most of its municipalities fall into the category of inner areas (respectively 66,2% against the Italian average of 48,5%), a context which is highly vulnerable and exposed to natural disasters [61], fragile from the socio-economic point of view and poor in infrastructural endowment [62].

Abruzzo, in addition, has been repeatedly struck by important shocks, which worsened an already stagnating economic performance [8]. On April 6, 2009 L'Aquila, the regional capital of Abruzzo, and its surroundings, were hit by a disruptive earthquake. The seismic event added up to further relevant exogenous shock: the 2007–2008 Great Crisis and the 2011-12 Sovereign Debt Crisis, whose effects have been particularly severe in Italy along with the so-called PIGS (Portugal, Ireland, Greece, and Spain) countries [63], followed by two almost overlapping and devastating earthquakes in 2016–2017. Natural disasters pose the challenge of reconstruction but even of regeneration of shrinking areas: they may represent a turning point to undertake institutional reform and to design new territorial borders aimed to break structural backwardness [64].

To address this issue, we propose the identification of DLS based on a multistep algorithm which implements the theoretical considerations discussed in the previous section. In a nutshell, it seeks to identify poles, by grasping different level of centralities based on some specific functions they provide, and their hinterlands, based on geographical and organised proximity. Specifically, the algorithm can be framed according to the following steps.

1. Rank the Abruzzo's municipalities according with their different level of centrality;
2. Select municipalities to be associated with poles (Rank 1, 2, 3) and potential poles (Rank 4) on the basis of a given isochrone;
3. Control for the intensity of commuting flows among the selected municipalities and the poles;
4. Consolidate the results.

4.1. Rank the Abruzzo municipalities according with their different level of centrality

The aim of the first step is to obtain a more detailed picture of the regional centralities than that provided by the SNAI, following at once a centre- and non-centre-based approach. Unlike SNAI, which identifies only high-order central places (Pescara, L'Aquila, Teramo, Chieti, Avezzano) (Fig. 1), we are also interested in highlighting low-order centralities. This is particularly important when attempting to realise the spatial organisation of inner areas which, lacking by definition of high-order poles, rely on low order local centralities.

To this end, Step 1 ranks municipalities according with the physical presence of specific facilities providing essential services and economic activities,[4] which are used to approximate their level of centrality (Table A1, Statistical Appendix).

- Rank 1: High-order centres. Municipalities that host simultaneously a DEA hospital, a scientific or classical high school and a technical or professional high school, and at least a bronze railway station (Pescara, L'Aquila, Teramo, Chieti, Avezzano, Vasto and Lanciano).
- Rank 2: Medium-high-order centres. Municipalities that host simultaneously a first aid health facility, a scientific or classical high school and a technical or professional high school, and at least a bronze railway.
- Rank 3: Medium-order centres. Municipalities that host simultaneously a first aid health facility, a scientific or classical high school and a technical or professional high school, without direct access to the railway system.
- Rank 4: Low-order centres. All the other municipalities whose level of centrality is based on the presence of a wider range of facilities and on the possible specialisation in specific economic activities. As for the facilities we consider: first aid hospitals, railway stations, primary schools, first- and second-level secondary schools, and a post

[4] Data about the presence of physical facilities related to health, education and railway mobility come from the SNAI (https://www.agenziacoesione.gov.it/strategia-nazionale-aree-interne/la-selezione-delle-areeItalian Territorial Cohesion Agency), further integrated with those from the Ministry of Health (https://www.salute.gov.it/portale/documentazione/p6_2_8_1_1.jsp?lingua=italiano&id=17), RFI (the Italian railway infrastructure manager) (https://www.rfi.it/it/stazioni.html), Abruzzo Region (http://opendata.regione.abruzzo.it/content/anagrafe-delle-scuole-abruzzesi), and Poste Italiane (the Italian postal service provider) (https://www.poste.it/uffici-postali-abilitati-servizio-consulenza.pdf). LQs regarding employees at the 3-digit level have been computed on data from the 2011 Census on Industry and Trade (http://dati-censimentoindustriaeservizi.istat.it/Index.aspx).

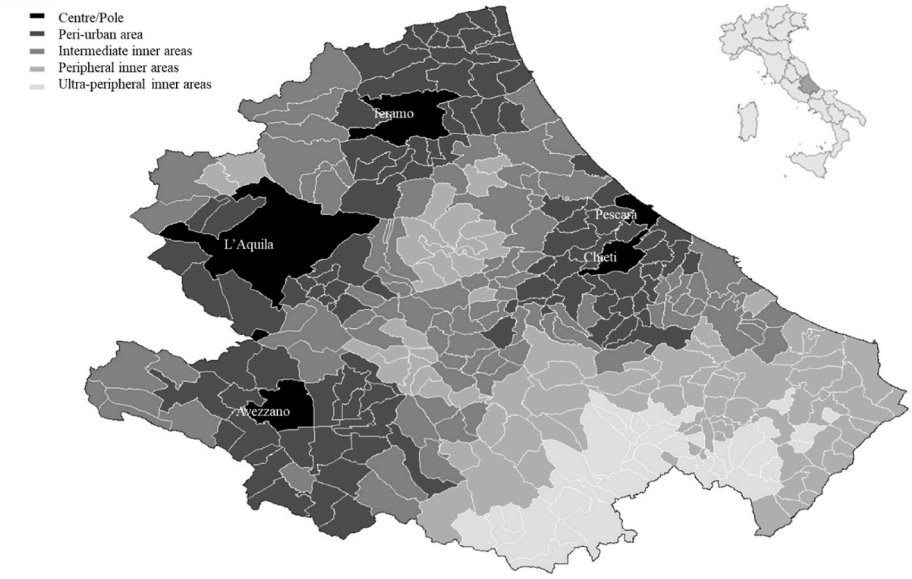

Fig. 1. Inner and urban areas in the abruzzo region (2020).
Source: our elaboration on SNAI data

offices with consultancy service. As for the economic activities, we computed the Location Quotients (LQ)[5] of the following economic sectors: Public administration and defence and compulsory social security; Manufacturing; Medical and dental practice activities; Wholesale trade; Retail trade. When higher than 1, LQ suggests that a municipality has a share in that sector greater than the regional average, and thus it specializes in that sector attracting employees from its surroundings. Each time a municipality has a LQ higher than 1 and hosts one of the facilities previously outlined, it gets one point. The sum of the points they got results in their final ranking which ranges from 0 (the lowest value) to 11 (the highest value) (variable "Points Rank 4", last column in Table A1, Statistical Appendix).

Municipalities with Rank 1, 2 and 3 are directly considered as poles (centre-based approach) due to the highest order of services supplied. Municipalities with Rank 4, on the contrary, will be classified as poles only in the case they exert a centripetal force over a given catchment area (non-centre-based approach).

4.2. Select municipalities to be associated with poles on the basis of a given isochrone

The 305 municipalities of Abruzzo are subsequently ordered by rank (from 1 to 4), population size (from the largest to the smallest) and points they got in the previous step (only for Rank 4 municipalities, in decreasing order). Starting from Pescara (the municipality with the highest rank and the largest population), we select all the municipalities whose time travel to the pole is lower or equal to 15 min, thus granting geographical proximity. The choice of this threshold is based on the work of the Audimob Observatory on Mobility [56], according to which in the period 2000–2015, the average time spent for mobility during a working day was equal to 60,5 min, a value almost identical to that arising in the theoretical section. In detail, the average for work-related trips was 48,2 min, for leisure 38,2 min and for family and personal management 31,6 min. Since commuting is the individuals' modality of mobility more time-consuming, its value corresponds more to a daily maximum rather than an average transport time [49], further suggesting that DLS should be searched within this time range.

We thus propose a time range of 15 min (30 min for a round trip) based on the Istat origin-destination matrix between all Italian municipalities,[6] which allows the replicability of the experiment. In this matrix the time travel has been calculated under ideal conditions, relying on the average allowed speed of each arc constituting the road graph used, without considering traffic congestion. This implies that actual travel times will be inevitably higher, as the use of Google maps has shown, even though within the average of 48,2 min (Table 3), a threshold that covers most of mobility related to family and personal management, leisure, and work commuting.

In the case of Pescara, there are seven municipalities within the 15 min thresholds which could be associated with the pole, forming together a potential DLS. These municipalities are subsequently excluded from the list. The process is then repeated with the following municipalities belonging to poles of Rank 1, 2, 3 and 4. At the end of the process we have a list of potential DLS which must be validated in the next step.

Having followed the basic Christallerian logic regarding the relationships among different sized settlements, the kind of services they supply and the distance among them [2] has prevented the association of poles of Rank 1, 2 and 3 with municipalities of their respective rank. Running the algorithm has indeed shown that under no circumstances they fall in the 15 min catchment area of another pole with the same rank. As for Rank 4 municipalities, if this was the case, that with the smallest population has been associated with the largest one (considered as a pole).

4.3. Control for the intensity of commuting flows among the selected municipalities and the poles

Step 3 responds to the necessity of considering the second dimension of proximity, the organised proximity [31]. After having identified the hinterland of the first pole, we control for the commuting flows it

[5] The Location Quotient is computed as the ratio between the number of employees of municipality j in sector i with the total number of employees of municipality j divided by the ratio between the number of employees of Abruzzo region in sector i and the total number of employees of Abruzzo region.

[6] https://www.istat.it/it/archivio/157423.

Table 3
The DLS of the Abruzzo region.

DLS	Pole	Number of municipalities	Population 2011	Population 2020	Area (km2)	Furthest municipality - Istat origin-destination matrix (minutes)	Furthest municipality - Google Maps (minutes)
1	Pescara	11	274,042	282,535	323	19	23
2	L'Aquila	11	83,955	86,686	907	18	33
3	Teramo	10	94,868	90,896	492	17	24
4	Chieti	8	84,687	82,389	220	16	16
5	Avezzano	9	65,473	64,890	465	16	19
6	Vasto	9	78,717	79,554	300	21	25
7	Lanciano	10	64,061	62,478	218	13	18
8	Giulianova	6	78,323	79,820	220	15	25
9	Sulmona	16	46,381	43,039	560	19	28
10	Ortona	6	33,956	32,065	141	17	18
11	Popoli	3	8213	7198	80	10	15
12	Penne	7	26,920	24,419	270	18	28
13	Atessa	8	26,037	24,424	270	22	30
14	Castel di Sangro	7	11,973	12,411	325	15	15
15	Atri	3	28,333	27,081	174	14	23
16	Tagliacozzo	3	8698	8109	197	11	15
17	Carsoli	4	8143	7881	186	10	15
18	Martinsicuro	5	37,989	39,895	91	14	18
19	Sant'Egidio alla Vibrata	6	28,924	28,373	161	12	14
20	Manoppello	6	18,937	17,845	127	15	16
21	Casoli	9	17,763	16,103	279	16	25
22	Pescasseroli	5	4336	4062	278	18	24
23	Villa Santa Maria	14	5932	4973	184	19	24
24	Guardiagrele	10	23,308	21,217	242	16	22
25	Pescina	7	14,736	13,330	333	19	30
26	Balsorano	4	8587	7689	184	18	28
27	Torre de' Passeri	7	9229	8295	116	15	20
28	Gissi	6	6853	5908	139	14	25
29	Montereale	4	5461	4545	248	21	31
30	San Demetrio ne' Vestini	7	4569	4415	140	16	20
31	Palena	6	3477	3008	194	19	36
32	Catignano	7	7572	6766	118	13	25
33	Miglianico	4	8981	8412	56	11	14
34	Castiglione Messer Raimondo	6	9675	8564	152	15	23
35	San Valentino in Abruzzo C.	6	5984	5482	204	17	22
36	Castiglione Messer Marino	6	6107	4969	197	16	27
37	Rocca di Mezzo	2	1972	1873	118	5	9
38	Castelvecchio Subequo	7	3401	2908	168	9	11
39	Isola del Gran Sasso d'Italia	5	10,210	9277	197	14	17
40	Navelli	6	2583	2341	183	20	27
41	Palmoli	5	3532	3047	124	13	21
42	Crognaleto	4	2757	2230	268	23	38
43	Scanno	2	2537	2226	168	6	13
44	Valle Castellana	2	1598	1361	194	13	22
45	Celenza sul Trigno	3	2108	1714	55	7	11
46	Calascio	5	939	905	161	9	14
47	Trasacco	3	8393	7952	179	15	23
48	Celano	5	16,079	15,452	226	11	18

Source: our elaboration on data from Istat and Google Map.

attracts from the municipalities selected in step 2. Specifically, the outgoing flows of work commuters from these latter towards the pole must be the greatest. Municipalities that fulfil this threshold give rise to a DLS. Otherwise, they will be relisted as candidates to be a pole or to be associated to another pole.

The previous condition must be respected in case of DLS organised around a Rank 1 pole. The threshold required are, however, relaxed to consider the decreasing capacity of poles to attract commuters along the ranking. Rank 2, 3 and 4 poles, in fact, can be sub-centres located within wider SLL where commuting flows, which, it is worth remembering, are a minority of total displacements, are mainly directed towards a higher order pole. We thus consider different thresholds according with the different rank of poles: at least the second flow towards Rank 2 poles, at least the fourth flow towards Rank 3 poles and at least the sixth flow towards Rank 4 poles. At the end of Step 3, 44 DLS have been identified including 251 municipalities, whereas 54 municipalities remain not assigned.

4.4. Consolidating the results

Step 4 raises the time-distance threshold to 25 min in order to identify other DLS or to assign these latter municipalities to those resulting from Step 3. This results in further 4 DLS around the Rank 4 poles of Scanno, Valle Castellana, Celenza sul Trigno, and Calascio. As for the reassignments, if a municipality can be associated with two or more DLS, the nearest or that attracting the highest flow of commuters (in this order) will be chosen.

Finally, we control for the condition of contiguity among all the

Box 1
Scheme of the methodology to identify the DLS

Step	Criterion	Threshold
Step 1: Rank municipalities according with their different level of centrality	Centrality depends on the provision of specific services and the presence of specific economic activities	**Rank 1**: DEA hospital, whole range secondary schools, at least bronze railway station **Rank 2**: first aid health facility, whole range secondary schools, at least bronze railway station **Rank 3**: first aid health facility, whole range secondary schools, no railway station **Rank 4**: first aid health facility railway station, primary, first level secondary school, second level secondary school, post office with consultancy service. LQ of selected economic activities > 1
Step 2: Select municipalities to be associated with poles (Rank1, 2, 3) and potential poles (Rank 4)	Time travel to access the potential pole	Select municipalities ≤ 15 minutes
Step 3: Control for the intensity of commuting flows	Intensity of commuting flows towards the poles	**Rank 1**: first outgoing commuting flow **Rank 2**: at least second outgoing commuting flow **Rank 3**: at least fourth outgoing commuting flow **Rank 4**: at least sixth outgoing commuting flow
Step 4: Consolidate the results	Assign the remaining municipalities to a DLS, controlling for contiguity, fine tuning	Relaxing thresholds: time travel ≤ 25 minutes, at least 1 person commuting towards the pole

municipalities belonging to a same DLS. When this condition is not met, related municipalities are reassigned to another DLS based on travel time and commuting conditions as before. This is the case of Scafa and Turrivalignani, which according to the algorithm should be part of the DLS of Chieti, but because of the lack of spatial contiguity, are assigned to the DLS of Manoppello. The only major intervention on the results of the algorithm regarded the DLS of Avezzano, which in the last step was split in two DLS. In addition to Avezzano, in fact, we considered as a lower-order pole also the municipality of Celano, which hosts also manufacturing and wholesale trade activities, a bronze station and one high school. The eastern edge municipalities of Avezzano have thus been included in the Celano DLS, as well as the municipality of Ovindoli, previously attributed to the DLS of Rocca di Mezzo. The other minor fine-tuning interventions are reported and discussed in the Statistical Appendix. Finally, it is worth highlighting that the analysis covers solely the municipalities of the Abruzzo region. It follows that some DLS located at the borders of the region can be part of interregional DLS, a possibility which is not considered here but opens the avenues for future research.

5. Results and discussion

With Step 4 we obtain 48 DLS, which are reported in aggregate in Table 3, disaggregated in Table A1 (Statistical Appendix) and depicted in Fig. 2.

Rank 1 DLS are Pescara, L'Aquila, Teramo, Chieti, Avezzano, Lanciano and Vasto. Apart from that of Pescara (282,535 dwellers and 11 municipalities), the other six DLS have a quite similar number of inhabitants, which range from the 64,061 of Lanciano (10 municipalities) to the 90,896 of Teramo (10 municipalities).

Our methodology, thus, identifies a higher number of poles than SNAI. According to the SNAI, in fact, Vasto and Lanciano fall within the category of inner areas ("intermediate" and "peripheral" inner areas), because of their bronze railway station, lower than the required silver one to be considered a pole. However, their inclusion within the category of inner areas is quite puzzling given the essential services they provide (a DEA hospital and the complete range of secondary schools) but also the economic structure they have. The Location Quotient of the so-called Knowledge Intensive Services,[7] which are preferably located in urban environments [65], are higher than 1 in almost all their breakdowns.[8] These considerations support the idea that Vasto and Lanciano (and their surroundings) should be considered urban DLS and not inner area, further opening to a revision of the albeit crucial SNAI classification of Italian municipalities.

Rank 2 DLS are Giulianova, Sulmona, Ortona, Popoli, with a population ranging between 7,198 (Popoli) and 79,820 (Giulianova) units. Again, our results highlight a sharp difference with those of the SNAI which includes Sulmona (and its surroundings) between the inner areas ("intermediate" and "peripheral" inner areas). Sulmona, however, although without a DEA hospital, hosts a first aid health facility, along with a silver station and seven types of high schools. Despite the absence of a DEA service correctly prevents the possibility to include Sulmona among the first rank cities, the presence of the other kinds of essential services hardly allows us to consider it as an inner area. The case of Sulmona is a further example of the necessity to propose a more detailed classification of the peripherality gradient of the Italian municipalities. Popoli, finally, although its limited and shrinking demographic size, even today hosts medium-level essential services which importantly affect the wellbeing of the citizens of its surroundings.

Rank 3 DLS are Penne, Atessa, Castel di Sangro and Atri, whose population ranges between 12,411 (Castel di Sangro) and 27,081 (Atri) units. Despite these DLS have no access to the railway system, they couple the capacity to provide essential services at a lower scale, such as a first aid hospital and at least a scientific and a professional high school, with the presence of manufacturing activities concentrated in their poles (except for Castel di Sangro, their LQ in manufacturing activities is higher than one), signalling a relative level of "centrality". Even Castel

[7] For a detailed description of the Knowledge Intensive services see https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Knowledge-intensive_services_(KIS).

[8] Lanciano has a LQ higher than 1 in Knowledge-intensive market services, Knowledge-intensive financial services, Other knowledge-intensive services, Knowledge-intensive market services, Knowledge-intensive Hi-Tech services, whereas Vasto misses solely these latter (our elaboration on Istat 3-digit data - 2011 Census on Industry and Trade).

Fig. 2. The DLS of the abruzzo region.
Source: our elaboration on Istat and SNAI data

di Sangro, which according to the SNAI is composed by "ultra-peripheral" municipalities, hosts a first aid hospital and four types of high schools. It follows that its level of peripherality greatly differs from that of Rank 4 DLS, where this kind of services are not provided.

Finally, Rank 4 DLS are 33. They are usually small-sized local systems: except for Martinsicuro and Sant'Egidio alla Vibrata, their population ranges between 905 (Calascio) and 21,217 (Guardiagrele). None of these DLS hosts a hospital, a few of them have high schools or a bronze station. Nonetheless, considering these kinds of DLS contributes to outline a map of the territorial organisation of inner areas, filling an important gap in the SNAI strategy.

In addition to the puzzling inclusion of some municipalities into the category of inner areas, a second stylised fact arising from the algorithm regards the relationships between DLS and SLL. As discussed in section 3.1, some SLL are too large to grant an acceptable accessibility time to their core municipalities. Table 1 shows that in the SLL of L'Aquila, Avezzano, Chieti, and Atessa, more than 50% of municipalities are farther than 40 min from their cores in terms of round-trip. Our algorithm, on the contrary, identifies shorter-range local systems. This obviously is mirrored in a more homogenous spatial extension of DLS than SLL: as a result, some largest SLL (along with Project Areas) contain two or more DLS (Figs. 3a and 3b and Figs 4a and 4b). This empirical evidence can be useful in terms of public policies planning.

Finally, the discussion of results considers the historical dimension, which importantly matters in terms of persistence of territorial development trajectories. As remarked by Christaller [2], territory retains

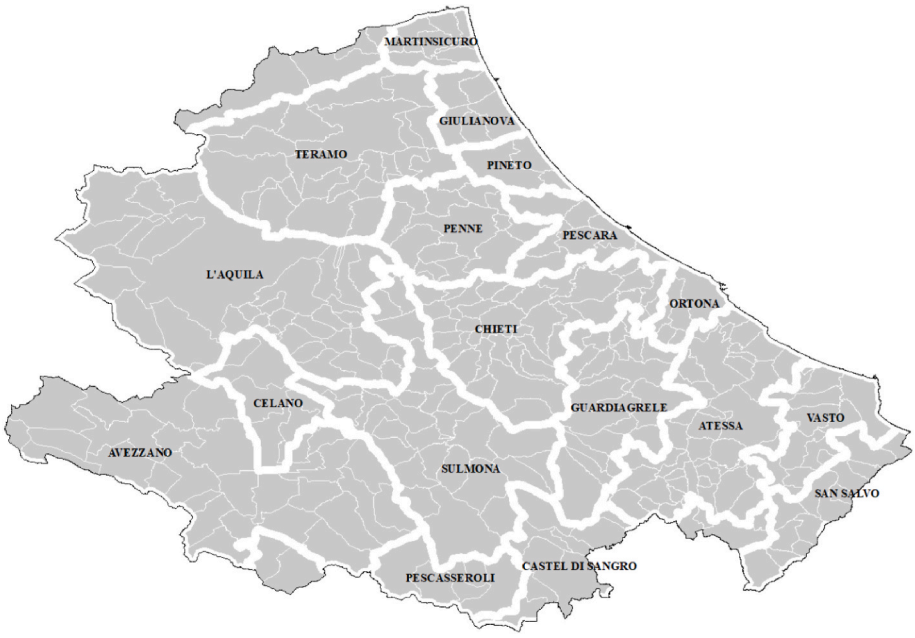

Fig. 3a. SLL (thick white border) of the Abruzzo Region.
Source: Our elaboration on Istat data

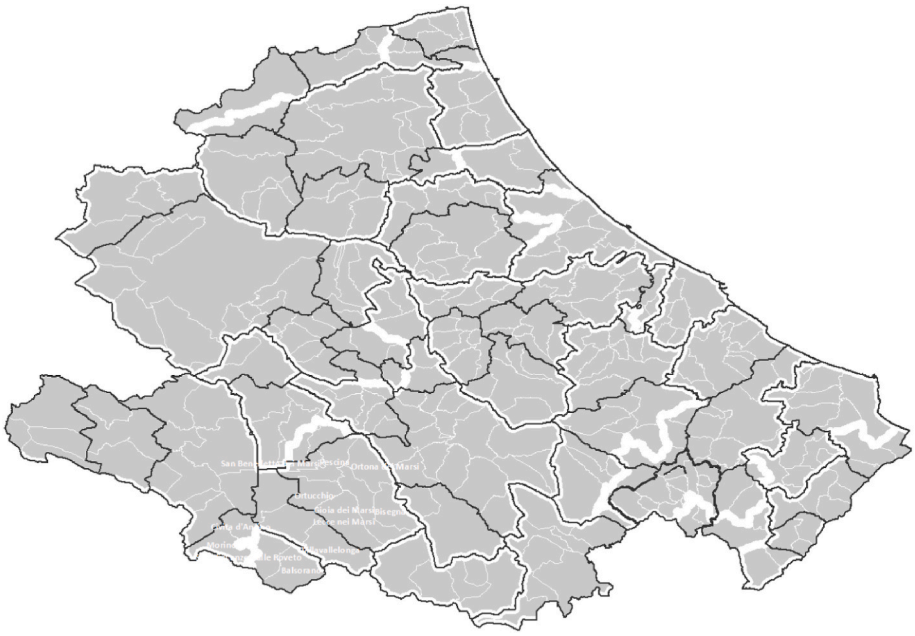

Fig. 3b. LMAs (thick white border) and DLS (black border) of the Abruzzo Region.
Source: Our elaboration on Istat and SNAI data

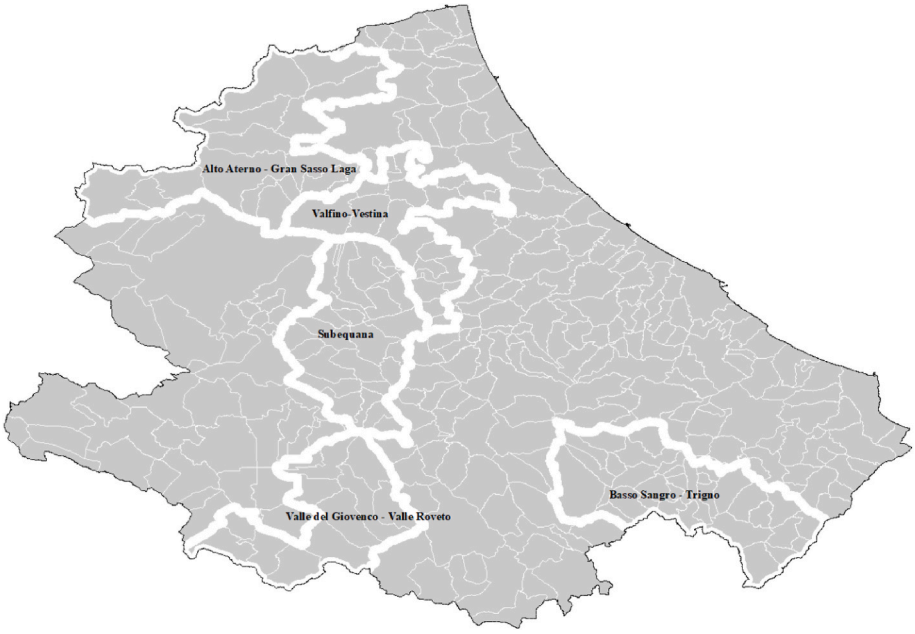

Fig. 4a. Project Areas (thick white border) of the Abruzzo Region.
Source: our elaboration on SNAI data

memories of previous spatial organizations. Several centres continue to play essential (and changing) functions, both for inhabitants and the surrounding municipalities, even once they loss their historical relevance, following the changing interactions with surroundings spaces [66]. Territorial borders may be considered "time written in space" [67], because they still embed traces of past spatial orders, symbolic meanings, functions [68]. The Abruzzo's spatial organisation in 1951 is inferred from data sourced from the "Official Dictionary of Municipalities and inhabited centres" [69] and is reported in Table A2 and A3 (Statistical Appendix), which shows the municipal distribution of ten kinds of services and their catchment areas. Apart from the role of historical nodes as Lanciano and Sulmona (both district capital until 1927), only 6 out of the 48 identified poles provided few functions in 1951 (excluding the centres located along the regional borders such as Valle Castellana or Balsorano, which refer to peculiar, smaller local systems).

On the contrary, 17 municipalities with at least 5 kinds of services in 1951 are not included in the list of current centres. Most of them, however, are close to higher order poles (i.e., Pratola Peligna, Civitella, Campli, Montorio al Vomano, or Bisenti) and were attracted by their centripetal force due to the advancements in mobility. In some other cases there was a shift in the hierarchical relations (i.e., the shift from Nereto to Sant'Egidio alla Vibrata as local centre).

The spatial organisation arising from our algorithm is consistent with the 1951 geography of district court and local tax offices, both aimed at

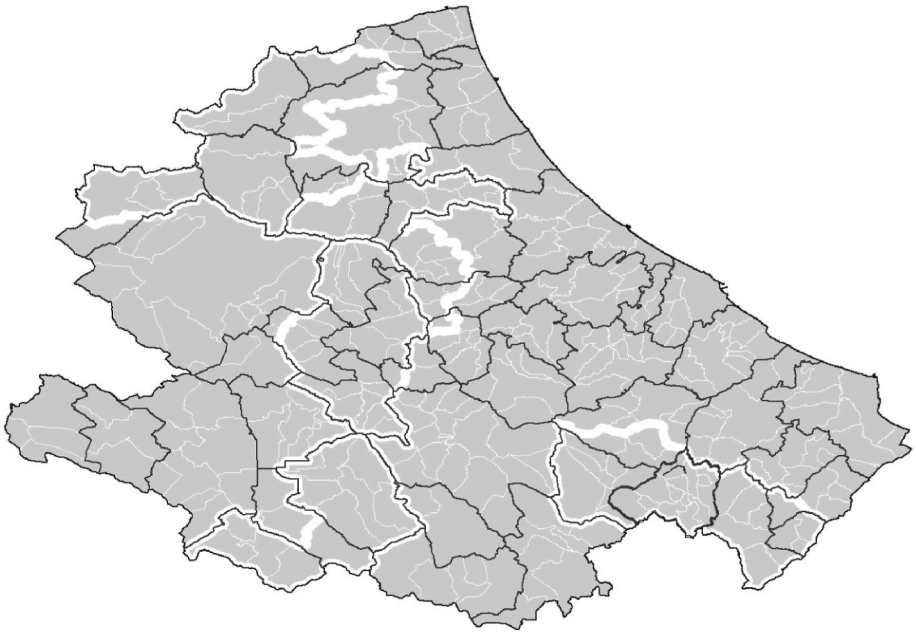

Fig. 4b. Project Areas (thick white border) and DLS (black border) of the Abruzzo Region.
Source: our elaboration on Istat and SNAI data

controlling the territory at a super local scale [56] (Bonini et al., 2016), but also with some second order districts, such as Torre de' Passeri, Gissi, Montereale, Castelvecchio Subequo. The legacy of the past is less strong along the coastline because of a more dynamic development process.

Finally, the output of the algorithm is consistent with some Christaller's categories, such as shrinking centres, due to an unfavorable location in terms of accessibility and economic activities (Sulmona, Castel di Sangro); long term auxiliary centres (Calascio, Navelli) relegated in remote valleys without close municipalities; local markets with low-order functions (Palena, Scanno); former administrative centres (Guardiagruele, San Demetrio) and territorial capitals (Vasto, Lanciano, Atri).

6. Conclusions

This work contributes to the issue of the spatial representation of the socioeconomic process at large and of inner areas in particular. There are obviously some limitations which must be considered. First, the need to use somehow arbitrary thresholds, such as those related to the isochrones and commuting flows. This necessity is, however, a constant when dealing with the functional representation of space. In addition, their choice is based on consistent theoretical considerations and empirical results. Secondly, although the Abruzzo region is an interesting study case given the simultaneous presence of urban, manufacturing, and peripheral areas, the algorithm must be tested on the whole Italian territory to assess its soundness at a national scale. Furthermore, the replicability of the methodology in other EU national contexts could require some adjustments to take into account their territorial peculiarities (i.e., the level of polycentrism), although building on the same theoretical foundations.

Among the main contributions of our paper, the first one refers to the theoretical aspects underlying the identification of functional areas, which, currently, provides a stigmatising spatial representation of inner areas, considered as peripheries of urban areas or part of SLL without a peculiar local identity. However, as above argued, FUAs were introduced by ESPON to identify and compare urban areas, while the Italian SLL were introduced experimentally in 1981 to account for the phenomenon of industrial districts [70]. Applying these spatial categories to inner areas can generate bias. These places, indeed, have not urban features and their labour markets are different from those pertaining to the industrial districts, due to an economic structure in which primary activities still play an important role. Since usually agricultural activities couple in the same place the residence and the workplace, a delimitation of functional areas based solely on commuting flows limits our understanding of inner areas' spatial organisation. Adopting the metric of DLS based on geographical and organised proximity, on the contrary, can help in providing spatial identity to inner areas.

Secondly, understanding how inner areas are internally organised around lower order centres is particularly important considering the 2021-27 SNAI program. As previously stressed, in fact, Project Areas are in most cases composed by more than one DLS. The knowledge of the internal organisation of Project Areas, and thus the spatial scale at whose level the direct and indirect impact of cohesion policies can be assessed both ex-ante and ex-post, should allow implementing more effective policies. It would make it possible, for instance, to consider and enhance the territorial capital already present at local level in terms of economic activities, private and public services; and to plan the location of other missing intermediate public services, such as high schools or health centres, thus improving the wellbeing of local communities. An issue which should be also addressed by the National Recovery and Resilience Plan in relation to the need raised by the recent Covid-19 pandemic for a more territorialised healthcare system.

Thirdly, our analysis shows that, despite its importance in institutionalising the question of inner areas, the SNAI classification suffers from an excessively rigid definition of peripherality. The lack of only one of the services required to label a municipality as a pole (even when lower order services are present) lays in the same category local administrative units with a completely different capacity to organise the territory. A revision of the modality of the identification of the poles/centres would allow considering different degrees of peripherality, providing a clearer vision of territorial constraints and needs, thus channelling public resources in a more effective way.

Fourthly, the adoption of DLS as spatial unit of analysis could help improving the culture of the multilevel governance, preventing fragmentary, ineffective strategies implemented by single municipalities [71]. Despite being at present one of the hardest challenges cohesion policies must cope with, intermunicipal governance, in this view,

represent a "place-sensitive" tool because it allows to exploit agglomeration forces without suffering diseconomies of scale in service level provision [72].

Finally, the theoretical foundations of our work, considering citizens' "sustainable" daily travel times, open to a notion of functional regionalisation more focused on "the fate of the individual human being in an increasingly complicated environment, or, if one prefers, [.] the quality of life" [36, p. 7], closer to her/his needs and, thus, possibly conducive to a higher level of well-being.

Author statement

The authors have contributed equally to the writing of the paper.

Data availability

Data will be made available on request.

Statistical Appendix.

Some inconsistencies arising from the DLS map analysis have been fixed through a fine-tuning step. Specifically.

1) The municipality of Campostosto, initially included in the DLS of Crognaleto, has been subsequently attributed to that of Montereale. Crognaleto and Montereale, actually, are in the same side of the Gran Sasso Mountain and, furthermore, checking on Google Maps, it arises that the travel time to Crognaleto is 52 min against the 32 of Montereale.
2) The municipality of Cortino, initially included in the DLS of Teramo, has been subsequently assigned to the DLS of Crognaleto. Here again, controlling on Google Map, we found out that the distance from Cortino to Teramo is 36 min whereas that to Crognaleto is 11 min.
3) The municipality of Collepietro has been shifted from the DLS of Popoli to that of Navelli because they are closer (12 min and 7 min respectively) and located in the same plain (the Navelli Plain).
4) The municipality of Barrea, initially assigned to the DLS of Castel di Sangro, has been subsequently attributed to the DLS of Pescasseroli. The distance is the same, but Pescasseroli and Barrea are both located in the same geographical context (Alto Sangro Valley).
5) The municipality of Castilenti, initially assigned to the DLS of Atri, has been subsequently attributed to the DLS of Castiglion Messer Raimondo (8 and 15 min, first and second flow of commuters respectively).
6) The municipality of Tocco da Casauria, initially assigned to the DLS of Popoli, has been subsequently attributed to the closer DLS of Torre dé Passeri (7 and 9 min, fourth and second flow of commuters respectively).
7) The municipality of Abbateggio, initially assigned to the DLS of Manoppello, has been subsequently attributed to the DLS of San Valentino in Abruzzo Citeriore (4,7 and 14 min respectively and the same flow of commuters).
8) The municipality of Arielli, initially assigned to the DLS of Lanciano, has been subsequently attributed to the DLS of Ortona (same travel time, second and first flow of commuters respectively)

Table A1
Municipalities by Pole and Daily Life Space

Municipality	Pole	Daily Life Space	Population 2020	Accessibility to the pole (minutes)	Accessibility to the pole (kilometres)	Commuting flow to the pole*	Assignment Step	Municipality Rank	Points Rank 4
Pescara	Pescara	1	118,766	0	0	1	3	1	–
Montesilvano	Pescara	1	53,344	11	9	1	3	4	9
Francavilla al Mare	Pescara	1	25,677	9	9	1	3	4	9
Città Sant'Angelo	Pescara	1	14,799	19	20	1	4	4	8
San Giovanni Teatino	Pescara	1	14,174	6	8	1	3	4	7
Spoltore	Pescara	1	18,996	7	6	1	3	4	6
Silvi	Pescara	1	15,251	14	14	1	3	4	6
Pianella	Pescara	1	8,494	18	19	1	4	4	6
Collecorvino	Pescara	1	5,990	19	19	1	4	4	6
Moscufo	Pescara	1	3,088	17	18	1	4	4	5
Cappelle sul Tavo	Pescara	1	3,956	11	11	1	3	4	4
L'Aquila	L'Aquila	2	69,349	0	0	1	3	1	–
Pizzoli	L'Aquila	2	4,259	14	14	1	3	4	6
Tornimparte	L'Aquila	2	2,865	18	19	1	4	4	6
Barisciano	L'Aquila	2	1,678	16	19	1	3	4	6
Fossa	L'Aquila	2	695	12	13	1	3	4	6
Poggio Picenze	L'Aquila	2	1,055	13	14	1	3	4	5
Scoppito	L'Aquila	2	3,802	13	14	1	3	4	4
Ocre	L'Aquila	2	1,125	14	13	1	3	4	2
Lucoli	L'Aquila	2	873	16	16	1	3	4	2
Barete	L'Aquila	2	623	16	16	1	3	4	2
Sant'Eusanio Forconese	L'Aquila	2	362	15	16	1	3	4	2
Teramo	Teramo	3	52,476	0	0	1	3	1	–
Torricella Sicura	Teramo	3	2,497	9	7	1	3	4	8
Bellante	Teramo	3	6,852	15	18	1	3	4	6
Campli	Teramo	3	6,714	12	12	1	3	4	6
Cermignano	Teramo	3	1,493	17	22	1	4	4	6
Montorio al Vomano	Teramo	3	7,657	12	13	1	3	4	5
Castellalto	Teramo	3	7,426	12	13	1	3	4	5

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Table A1 (*continued*)

Municipality	Pole	Daily Life Space	Population 2020	Accessibility to the pole (minutes)	Accessibility to the pole (kilometres)	Commuting flow to the pole*	Assignment Step	Municipality Rank	Points Rank 4
Basciano	Teramo	3	2,345	13	16	1	3	4	4
Canzano	Teramo	3	1,768	15	17	1	3	4	4
Penna Sant'Andrea	Teramo	3	1,668	13	16	1	3	4	4
Chieti	Chieti	4	49,139	0	0	1	3	1	–
Cepagatti	Chieti	4	10,920	9	9	1	3	4	8
Bucchianico	Chieti	4	5,002	14	13	1	3	4	7
Torrevecchia Teatina	Chieti	4	4,165	8	7	1	3	4	5
Ripa Teatina	Chieti	4	4,002	10	10	1	3	4	5
Rosciano	Chieti	4	3,977	13	12	1	3	4	5
Casalincontrada	Chieti	4	3,004	16	14	1	3	4	5
Villamagna	Chieti	4	2,180	15	16	1	3	4	4
Avezzano	Avezzano	5	41,283	0	0	1	3	1	–
Civitella Roveto	Avezzano	5	3,068	15	18	1	3	4	8
Capistrello	Avezzano	5	4,889	9	10	1	3	4	7
Scurcola Marsicana	Avezzano	5	2,702	10	11	1	3	4	7
Castellafiume	Avezzano	5	1,050	16	17	1	3	4	7
Magliano de' Marsi	Avezzano	5	3,530	9	10	1	3	4	6
Luco dei Marsi	Avezzano	5	6,047	12	11	1	3	4	5
Massa d'Albe	Avezzano	5	1,385	11	10	1	3	4	4
Canistro	Avezzano	5	936	14	16	1	3	4	4
Vasto	Vasto	6	40,553	0	0	1	3	1	–
San Salvo	Vasto	6	19,445	13	12	1	3	4	7
Casalbordino	Vasto	6	5,808	15	14	2	3	4	7
Scerni	Vasto	6	3,022	21	20	2	4	4	6
Villalfonsina	Vasto	6	908	19	17	3	4	4	6
Cupello	Vasto	6	4,752	9	8	2	3	4	5
Monteodorisio	Vasto	6	2,342	10	8	1	3	4	5
Pollutri	Vasto	6	2,073	18	18	2	4	4	4
Lentella	Vasto	6	651	21	23	2	4	4	4
Lanciano	Lanciano	7	34,410	0	0	1	3	1	–
Fossacesia	Lanciano	7	6,215	11	10	2	3	4	7
San Vito Chietino	Lanciano	7	5,189	11	9	1	3	4	7
Frisa	Lanciano	7	1,634	10	8	1	3	4	6
Castel Frentano	Lanciano	7	4,268	7	7	1	3	4	5
Sant'Eusanio del Sangro	Lanciano	7	2,308	13	13	2	3	4	4
Rocca San Giovanni	Lanciano	7	2,301	8	8	1	3	4	4
Treglio	Lanciano	7	1,687	7	5	1	3	4	4
Mozzagrogna	Lanciano	7	2,412	6	5	2	3	4	3
Santa Maria Imbaro	Lanciano	7	2,054	7	6	1	3	4	3
Giulianova	Giulianova	8	23,464	0	0	1	3	2	–
Mosciano Sant'Angelo	Giulianova	8	9,101	9	8	1	3	4	7
Roseto degli Abruzzi	Giulianova	8	25,429	11	11	1	3	4	6
Tortoreto	Giulianova	8	11,810	10	9	1	3	4	6
Notaresco	Giulianova	8	6,433	15	15	6	4	4	5
Morro d'Oro	Giulianova	8	3,583	14	14	6	4	4	4
Sulmona	Sulmona	9	22,643	0	0	1	3	2	–
Pratola Peligna	Sulmona	9	7,187	9	9	1	3	4	8
Raiano	Sulmona	9	2,658	13	15	1	3	4	8
Roccacasale	Sulmona	9	611	9	11	1	3	4	6
Prezza	Sulmona	9	920	13	11	1	3	4	5
Introdacqua	Sulmona	9	1,981	7	7	1	3	4	4
Pettorano sul Gizio	Sulmona	9	1,343	10	11	1	3	4	4
Bugnara	Sulmona	9	1,058	9	9	1	3	4	4
Corfinio	Sulmona	9	984	11	14	1	3	4	4
Rocca Pia	Sulmona	9	181	16	20	1	4	4	4
Pacentro	Sulmona	9	1,101	8	7	1	3	4	3
Vittorito	Sulmona	9	836	15	17	1	3	4	3
Campo di Giove	Sulmona	9	780	19	19	1	4	4	3
Anversa degli Abruzzi	Sulmona	9	318	14	16	1	3	4	3
Cocullo	Sulmona	9	217	19	20	1	4	4	3
Cansano	Sulmona	9	221	14	13	1	3	4	2
Ortona	Ortona	10	22,287	0	0	1	3	2	–
Tollo	Ortona	10	3,948	11	10	1	3	4	6
Crecchio	Ortona	10	2,648	17	15	1	4	4	5
Arielli	Ortona	10	1,084	15	13	1	3	4	5
Canosa Sannita	Ortona	10	1,270	15	14	1	3	4	4
Poggiofiorito	Ortona	10	828	15	13	1	3	4	3
Popoli	Popoli	11	4,784	0	0	1	3	2	–
Bussi sul Tirino	Popoli	11	2,317	6	7	1	3	4	7
San Benedetto in Perillis	Popoli	11	97	10	8	2	3	4	1

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Table A1 (*continued*)

Municipality	Pole	Daily Life Space	Population 2020	Accessibility to the pole (minutes)	Accessibility to the pole (kilometres)	Commuting flow to the pole*	Assignment Step	Municipality Rank	Points Rank 4
Penne	Penne	12	11,470	0	0	1	3	3	–
Villa Celiera	Penne	12	571	17	18	2	4	4	6
Loreto Aprutino	Penne	12	7,164	7	8	2	3	4	5
Civitella Casanova	Penne	12	1,650	18	18	2	4	4	5
Farindola	Penne	12	1,363	15	15	1	3	4	4
Picciano	Penne	12	1,287	9	8	1	3	4	4
Montebello di Bertona	Penne	12	914	11	9	1	3	4	4
Atessa	Atessa	13	10,443	0	0	1	3	3	–
Tornareccio	Atessa	13	1,669	10	8	1	3	4	7
Paglieta	Atessa	13	4,157	14	14	1	3	4	5
Torino di Sangro	Atessa	13	2,971	22	21	1	4	4	5
Archi	Atessa	13	2,030	13	12	1	3	4	5
Perano	Atessa	13	1,523	13	11	1	3	4	5
Casalanguida	Atessa	13	876	13	9	1	3	4	3
Bomba	Atessa	13	755	14	11	1	3	4	3
Castel di Sangro	Castel di Sangro	14	6,533	0	0	1	3	3	–
Roccaraso	Castel di Sangro	14	1,548	10	12	1	3	4	5
Pescocostanzo	Castel di Sangro	14	1,106	14	17	1	3	4	5
Ateleta	Castel di Sangro	14	1,092	15	16	1	3	4	5
Alfedena	Castel di Sangro	14	917	7	9	1	3	4	4
Scontrone	Castel di Sangro	14	542	8	9	1	3	4	4
Rivisondoli	Castel di Sangro	14	673	12	15	1	3	4	3
Atri	Atri	15	10,179	0	0	1	3	3	–
Pineto	Atri	15	14,582	12	12	1	3	4	4
Cellino Attanasio	Atri	15	2,320	14	14	3	3	4	4
Tagliacozzo	Tagliacozzo	16	6,443	0	0	1	3	4	9
Sante Marie	Tagliacozzo	16	1,111	7	6	2	3	4	4
Cappadocia	Tagliacozzo	16	555	11	10	3	3	4	3
Carsoli	Carsoli	17	5,130	0	0	1	3	4	9
Oricola	Carsoli	17	1,256	10	8	1	3	4	5
Rocca di Botte	Carsoli	17	848	10	10	3	3	4	4
Pereto	Carsoli	17	647	9	8	1	3	4	4
Martinsicuro	Martinsicuro	18	16,198	0	0	1	3	4	8
Alba Adriatica	Martinsicuro	18	12,631	8	7	3	3	4	8
Corropoli	Martinsicuro	18	5,145	13	12	3	3	4	6
Colonnella	Martinsicuro	18	3,649	8	6	1	3	4	6
Controguerra	Martinsicuro	18	2,272	14	15	2	3	4	4
Sant'Egidio alla Vibrata	Sant'Egidio alla Vibrata	19	9,834	0	0	1	3	4	8
Nereto	Sant'Egidio alla Vibrata	19	5,296	12	10	6	3	4	8
Sant'Omero	Sant'Egidio alla Vibrata	19	5,185	10	7	2	3	4	5
Ancarano	Sant'Egidio alla Vibrata	19	1,886	5	4	1	3	4	5
Civitella del Tronto	Sant'Egidio alla Vibrata	19	4,649	11	9	1	3	4	4
Torano Nuovo	Sant'Egidio alla Vibrata	19	1,523	9	8	2	3	4	4
Manoppello	Manoppello	20	6,784	0	0	1	3	4	8
Scafa	Manoppello	20	3,542	10	9	3	4	4	7
Alanno	Manoppello	20	3,424	15	14	4	3	4	6
Lettomanoppello	Manoppello	20	2,767	6	5	1	3	4	6
Turrivalignani	Manoppello	20	791	7	5	4	4	4	6
Serramonacesca	Manoppello	20	537	7	7	1	3	4	2
Casoli	Casoli	21	5,305	0	0	1	3	4	8
Altino	Casoli	21	3,080	9	8	2	3	4	6
Torricella Peligna	Casoli	21	1,189	16	14	2	3	4	6
Lama dei Peligni	Casoli	21	1,102	15	17	3	3	4	6
Gessopalena	Casoli	21	1,261	10	9	2	3	4	5
Fara San Martino	Casoli	21	1,312	12	10	2	3	4	4
Roccascalegna	Casoli	21	1,082	15	14	2	3	4	4
Civitella Messer Raimondo	Casoli	21	797	11	9	3	3	4	4
Palombaro	Casoli	21	975	11	10	2	3	4	3
Pescasseroli	Pescasseroli	22	2,081	0	0	1	3	4	8
Barrea	Pescasseroli	22	720	18	21	2	4	4	5
Villetta Barrea	Pescasseroli	22	601	13	15	1	3	4	4
Opi	Pescasseroli	22	375	5	5	1	3	4	3
Civitella Alfedena	Pescasseroli	22	285	14	17	3	3	4	3
Villa Santa Maria	Villa Santa Maria	23	1,147	0	0	1	3	4	8

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Table A1 (*continued*)

Municipality	Pole	Daily Life Space	Population 2020	Accessibility to the pole (minutes)	Accessibility to the pole (kilometres)	Commuting flow to the pole*	Assignment Step	Municipality Rank	Points Rank 4
Pizzoferrato	Villa Santa Maria	23	1,000	19	15	5	4	4	6
Quadri	Villa Santa Maria	23	734	10	10	3	3	4	5
Borrello	Villa Santa Maria	23	313	15	16	4	3	4	5
Civitaluparella	Villa Santa Maria	23	297	12	13	3	3	4	5
Colledimezzo	Villa Santa Maria	23	440	10	8	2	3	4	3
Pietraferrazzana	Villa Santa Maria	23	131	6	5	2	3	4	3
Fallo	Villa Santa Maria	23	121	8	8	3	3	4	3
Roio del Sangro	Villa Santa Maria	23	95	14	13	–	4	4	3
Montebello sul Sangro	Villa Santa Maria	23	75	9	8	1	3	4	3
Monteferrante	Villa Santa Maria	23	119	16	16	3	4	4	2
Pennadomo	Villa Santa Maria	23	219	12	12	3	3	4	1
Rosello	Villa Santa Maria	23	202	13	13	1	3	4	1
Montelapiano	Villa Santa Maria	23	80	7	7	2	3	4	1
Guardiagrele	Guardiagrele	24	8,615	0	0	1	3	4	7
Orsogna	Guardiagrele	24	3,639	11	9	2	3	4	5
Roccamontepiano	Guardiagrele	24	1,573	16	15	2	3	4	5
Rapino	Guardiagrele	24	1,230	8	6	1	3	4	5
Casacanditella	Guardiagrele	24	1,174	8	8	2	3	4	5
Fara Filiorum Petri	Guardiagrele	24	1,936	10	10	3	3	4	4
Pretoro	Guardiagrele	24	866	12	13	1	3	4	4
Pennapiedimonte	Guardiagrele	24	435	9	8	1	3	4	4
Filetto	Guardiagrele	24	884	10	6	1	3	4	3
San Martino sulla Marrucina	Guardiagrele	24	865	5	4	1	3	4	3
Pescina	Pescina	25	3,851	0	0	1	3	4	7
Gioia dei Marsi	Pescina	25	1,738	10	10	3	3	4	7
San Benedetto dei Marsi	Pescina	25	3,761	6	4	2	3	4	5
Ortucchio	Pescina	25	1,766	10	9	2	4	4	5
Lecce nei Marsi	Pescina	25	1,569	12	12	5	3	4	4
Ortona dei Marsi	Pescina	25	437	9	10	3	3	4	3
Bisegna	Pescina	25	208	19	20	2	4	4	2
Balsorano	Balsorano	26	3,297	0	0	1	3	4	7
Morino	Balsorano	26	1,328	12	13	6	3	4	5
Civita d'Antino	Balsorano	26	944	18	19	6	4	4	5
San Vincenzo Valle Roveto	Balsorano	26	2,120	9	8	2	3	4	4
Torre de' Passeri	Torre de' Passeri	27	2,905	0	0	1	3	4	7
Tocco da Casauria	Torre de' Passeri	27	2,459	7	6	4	3	4	7
Bolognano	Torre de' Passeri	27	1,041	7	7	2	3	4	6
Pescosansonesco	Torre de' Passeri	27	482	11	10	4	3	4	5
Pietranico	Torre de' Passeri	27	442	9	8	3	3	4	4
Corvara	Torre de' Passeri	27	218	15	13	4	3	4	3
Castiglione a Casauria	Torre de' Passeri	27	748	5	3	1	3	4	2
Gissi	Gissi	28	2,545	0	0	1	3	4	7
Furci	Gissi	28	851	7	7	1	3	4	6
San Buono	Gissi	28	891	7	7	1	3	4	5
Carpineto Sinello	Gissi	28	536	9	9	2	3	4	5
Liscia	Gissi	28	668	11	11	1	3	4	4
Guilmi	Gissi	28	417	14	14	2	3	4	3
Montereale	Montereale	29	2,262	0	0	1	3	4	7
Cagnano Amiterno	Montereale	29	1,190	14	12	3	3	4	4
Capitignano	Montereale	29	629	5	5	2	3	4	4
Campotosto	Montereale	29	464	21	23	2	4	4	2
San Demetrio ne' Vestini	San Demetrio ne' Vestini	30	1,880	0	0	2	3	4	7
San Pio delle Camere	San Demetrio ne' Vestini	30	671	12	11	5	3	4	6
Fontecchio	San Demetrio ne' Vestini	30	293	10	10	2	3	4	6

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Table A1 (*continued*)

Municipality	Pole	Daily Life Space	Population 2020	Accessibility to the pole (minutes)	Accessibility to the pole (kilometres)	Commuting flow to the pole*	Assignment Step	Municipality Rank	Points Rank 4
Villa Sant'Angelo	San Demetrio ne' Vestini	30	474	5	4	2	3	4	5
Fagnano Alto	San Demetrio ne' Vestini	30	381	6	6	3	3	4	3
Prata d'Ansidonia	San Demetrio ne' Vestini	30	441	6	6	4	3	4	2
Tione degli Abruzzi	San Demetrio ne' Vestini	30	275	16	14	3	3	4	2
Palena	Palena	31	1,268	0	0	1	3	4	7
Montenerodomo	Palena	31	617	19	19	5	4	4	4
Taranta Peligna	Palena	31	343	7	7	7	4	4	4
Lettopalena	Palena	31	325	6	4	4	3	4	2
Gamberale	Palena	31	289	18	17	–	4	4	2
Colledimacine	Palena	31	166	13	13	4	3	4	2
Catignano	Catignano	32	1,242	0	0	1	3	4	7
Carpineto della Nora	Catignano	32	573	13	12	6	3	4	5
Nocciano	Catignano	32	1,750	7	6	6	3	4	4
Civitaquana	Catignano	32	1,190	7	6	2	3	4	4
Vicoli	Catignano	32	381	7	6	3	3	4	4
Cugnoli	Catignano	32	1,366	9	7	12	4	4	3
Brittoli	Catignano	32	264	11	9	3	3	4	3
Miglianico	Miglianico	33	4,640	0	0	1	3	4	6
Giuliano Teatino	Miglianico	33	1,151	9	7	3	3	4	5
Ari	Miglianico	33	1,071	11	10	3	3	4	5
Vacri	Miglianico	33	1,550	11	9	5	3	4	3
Castiglione Messer Raimondo	Castiglione Messer R.	34	2,082	0	0	1	3	4	6
Bisenti	Castiglione Messer R.	34	1,707	9	9	3	3	4	6
Castilenti	Castiglione Messer R.	34	1,379	8	8	1	4	4	5
Elice	Castiglione Messer R.	34	1,644	13	13	6	3	4	4
Montefino	Castiglione Messer R.	34	965	6	5	2	3	4	4
Arsita	Castiglione Messer R.	34	787	15	12	5	3	4	4
San Valentino in Abruzzo Citeriore	San Valentino in Abr. Cit.	35	1,860	0	0	1	3	4	6
Caramanico Terme	San Valentino in Abr. Cit.	35	1,823	13	12	2	3	4	6
Roccamorice	San Valentino in Abr. Cit.	35	908	6	6	6	3	4	5
Abbateggio	San Valentino in Abr. Cit.	35	365	14	11	5	3	4	3
Salle	San Valentino in Abr. Cit.	35	268	11	11	3	3	4	2
Sant'Eufemia a Maiella	San Valentino in Abr. Cit.	35	258	17	17	–	4	4	2
Castiglione Messer Marino	Castiglione Messer Marino	36	1,575	0	0	1	3	4	6
Roccaspinalveti	Castiglione Messer Marino	36	1,208	15	14	5	3	4	5
Montazzoli	Castiglione Messer Marino	36	877	12	11	6	3	4	4
Castelguidone	Castiglione Messer Marino	36	327	16	14	3	3	4	3
Fraine	Castiglione Messer Marino	36	280	11	10	3	3	4	3
Schiavi di Abruzzo	Castiglione Messer Marino	36	702	11	9	1	3	4	1
Rocca di Mezzo	Rocca di Mezzo	37	1,387	0	0	1	3	4	6
Rocca di Cambio	Rocca di Mezzo	37	486	5	5	2	3	4	1
Castelvecchio Subequo	Castelvecchio Subequo	38	850	0	0	1	3	4	6
Goriano Sicoli	Castelvecchio Subequo	38	525	8	8	3	3	4	6
Secinaro	Castelvecchio Subequo	38	329	7	6	3	3	4	5
Molina Aterno	Castelvecchio Subequo	38	362	4	4	3	3	4	4
Castel di Ieri	Castelvecchio Subequo	38	298	3	3	2	3	4	4

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Table A1 (*continued*)

Municipality	Pole	Daily Life Space	Population 2020	Accessibility to the pole (minutes)	Accessibility to the pole (kilometres)	Commuting flow to the pole*	Assignment Step	Municipality Rank	Points Rank 4
Acciano	Castelvecchio Subequo	38	300	9	9	4	3	4	1
Gagliano Aterno	Castelvecchio Subequo	38	244	4	3	1	3	4	1
Isola del Gran Sasso d'Italia	Isola del Gran Sasso d'Italia	39	4,465	0	0	1	3	4	5
Colledara	Isola del Gran Sasso d'Italia	39	2,106	6	6	2	3	4	5
Tossicia	Isola del Gran Sasso d'Italia	39	1,253	7	7	4	3	4	5
Castelli	Isola del Gran Sasso d'Italia	39	990	14	13	1	3	4	5
Castel Castagna	Isola del Gran Sasso d'Italia	39	463	12	12	3	3	4	5
Capestrano	Navelli	40	858	8	8	3	4	4	7
Navelli	Navelli	40	518	0	0	1	3	4	5
Ofena	Navelli	40	454	13	13	4	4	4	5
Collepietro	Navelli	40	217	7	7	3	3	4	2
Caporciano	Navelli	40	202	6	7	2	3	4	2
Villa Santa Lucia degli Abruzzi	Navelli	40	92	20	20	2	4	4	2
Palmoli	Palmoli	41	836	0	0	1	3	4	5
Dogliola	Palmoli	41	323	7	6	4	3	4	5
Fresagrandinaria	Palmoli	41	908	13	13	6	3	4	4
Carunchio	Palmoli	41	610	9	9	5	3	4	4
Tufillo	Palmoli	41	370	9	8	4	3	4	4
Cortino	Crognaleto	42	596	23	24	–	4	4	4
Crognaleto	Crognaleto	42	1,146	0	0	1	3	4	3
Fano Adriano	Crognaleto	42	261	12	12	4	3	4	3
Pietracamela	Crognaleto	42	227	18	20	4	4	4	2
Scanno	Scanno	43	1,717	0	0	1	4	4	6
Villalago	Scanno	43	509	6	6	2	4	4	4
Valle Castellana	Valle Castellana	44	878	0	0	1	4	4	6
Rocca Santa Maria	Valle Castellana	44	483	13	13	3	4	4	3
Celenza sul Trigno	Celenza sul Trigno	45	819	0	0	1	4	4	5
Torrebruna	Celenza sul Trigno	45	746	5	4	6	4	4	4
San Giovanni Lipioni	Celenza sul Trigno	45	149	7	6	–	4	4	2
Calascio	Calascio	46	128	0	0	1	4	4	4
Castelvecchio Calvisio	Calascio	46	128	7	6	–	4	4	3
Castel del Monte	Calascio	46	450	9	8	–	4	4	2
Santo Stefano di Sessanio	Calascio	46	116	6	5	2	4	4	2
Carapelle Calvisio	Calascio	46	83	9	10	–	4	4	2
Trasacco	Trasacco	47	5,978	18	18	1	4	4	7
Collelongo	Trasacco	47	1,120	26	26	1	4	4	6
Villavallelonga	Trasacco	47	854	31	31	1	4	4	5
Celano	Celano	48	10,431	11	10	1	4	4	8
Cerchio	Celano	48	1,570	13	15	1	4	4	6
Collarmele	Celano	48	843	15	18	1	4	4	6
Aielli	Celano	48	1,437	16	17	1	4	4	5
Ovindoli	Celano	48	1,171	7	8	5	4	4	3

Source: our elaboration on data from SNAI, Ministry of Health, RFI (the Italian railway infrastructure manager), Abruzzo Region, Poste Italiane (the Italian postal service provider), Istat.

Table A2
Selected services provided in the Abruzzo municipalities (1 = yes; 0 = no). 1951

Municipality	Pole Rank	Pharmacy	Hospital	1st level secondary school	2nd level secondary school	Teather/ cinema	Magistrate's court	District court	Local tax offices	Stamp duties and registration taxes	Police	Total number of services
Avezzano	1	1	1	1	1	1	1	1	1	1	1	10
L'Aquila	1	1	1	1	1	1	1	1	1	1	1	10
Teramo	1	1	1	1	1	1	1	1	1	1	1	10
Pescara	1	1	1	1	1	1	1	1	1	1	1	10
Chieti	1	1	1	1	1	1	1	1	1	1	1	10

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Table A2 (*continued*)

Municipality	Pole Rank	Pharmacy	Hospital	1st level secondary school	2nd level secondary school	Teather/ cinema	Magistrate's court	District court	Local tax offices	Stamp duties and registration taxes	Police	Total number of services
Lanciano	1	1	1	1	1	1	1	1	1	1	1	10
Vasto	1	1	1	1	1	1	1	1	1	1	1	10
Sulmona	2	1	1	1	1	1	1	1	1	1	1	10
Ortona	2	1	1	1	1	1	1	0	1	1	1	9
Castel di Sangro	3	1	1	1	1	1	1	0	1	1	1	9
Atri	3	1	1	1	1	1	1	0	1	1	1	9
Penne	3	1	1	1	1	1	1	0	1	1	1	9
Atessa	3	1	1	1	1	1	1	0	1	1	1	9
Giulianova	2	1	1	1	0	1	1	0	1	1	1	8
Popoli	2	1	1	1	0	1	1	0	1	1	1	8
Pescina	4	1	1	1	0	1	1	0	1	1	1	8
Tagliacozzo	4	1	1	1	0	1	1	0	1	1	1	8
Casoli	4	1	1	1	0	1	1	0	1	1	1	8
San Demetrio ne' V.	4	1	0	1	0	1	1	0	1	1	1	7
Catignano	4	1	0	1	0	1	1	0	1	1	1	7
San Valentino in A.	4	1	0	1	0	1	1	0	1	1	1	7
Guardiagrele	4	1	1	1	0	1	1	0	0	1	1	7
Villa Santa Maria	4	1	0	1	0	1	1	0	1	1	1	7
Celano	4	1	1	1	0	1	1	0	0	0	1	6
Celenza sul Trigno	4	1	0	0	0	1	1	0	1	1	1	6
Carsoli	4	1	0	1	0	1	1	0	0	0	1	5
Torre de' Passeri	4	1	0	1	0	1	1	0	0	0	1	5
Montereale	4	1	0	1	0	0	1	0	0	0	1	4
Pescasseroli	4	1	0	1	0	1	0	0	0	0	1	4
Trasacco	4	1	0	0	0	1	1	0	0	0	1	4
Isola del Gran Sasso	4	1	0	1	0	1	0	0	0	0	1	4
Sant'Egidio alla Vibrata	4	1	0	1	0	1	0	0	0	0	1	4
Martinsicuro	4	1	0	1	0	1	0	0	0	0	1	4
Manoppello	4	1	0	0	0	1	1	0	0	0	1	4
Gissi	4	1	0	0	0	1	1	0	0	0	1	4
Palena	4	1	0	1	0	1	0	0	0	0	1	4
Castiglione Messer M.	4	1	0	0	0	1	1	0	0	0	1	4
Balsorano	4	1	0	0	0	1	0	0	0	0	1	3
Castelvecchio Subequo	4	1	0	0	0	0	1	0	0	0	1	3
Rocca di Mezzo	4	1	1	0	0	0	0	0	0	0	1	3
Scanno	4	1	0	0	0	1	0	0	0	0	1	3
Crognaleto	4	1	0	0	0	1	0	0	0	0	1	3
Miglianico	4	1	0	0	0	1	0	0	0	0	1	3
Navelli	4	1	0	0	0	0	0	0	0	0	1	2
Castiglione Messer R.	4	1	0	0	0	1	0	0	0	0	0	2
Valle Castellana	4	1	0	0	0	0	0	0	0	0	1	2
Palmoli	4	1	0	0	0	1	0	0	0	0	0	2
Calascio	4	0	0	0	0	0	0	0	0	0	1	1
Francavilla a Mare	–	1	1	1	0	1	1	0	0	1	1	7
Nereto	–	1	1	1	0	1	1	0	0	1	1	7
Pratola peligna	–	1	0	1	0	1	1	0	0	1	1	6
Orsogna	–	1	0	1	0	1	1	0	0	1	1	6
Torricella Peligna	–	1	0	1	0	1	1	0	0	1	1	6
Città sant'Angelo	–	1	1	1	0	1	1	0	0	0	1	6
Montorio	–	1	0	1	0	1	1	0	0	1	1	6
Notaresco	–	1	0	1	0	1	1	0	0	1	1	6
Roseto	–	1	1	1	1	1	0	0	0	0	1	6
Barisciano	–	1	0	1	0	1	1	0	0	0	1	5
Magliano de'Marsi	–	1	0	1	0	1	1	0	0	0	1	5
Capestrano	–	1	0	1	0	1	1	0	0	0	1	5

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Table A2 (*continued*)

Municipality	Pole Rank	Pharmacy	Hospital	1st level secondary school	2nd level secondary school	Teather/ cinema	Magistrate's court	District court	Local tax offices	Stamp duties and registration taxes	Police	Total number of services
Casalbordino	–	1	0	1	0	1	1	0	0	0	1	5
Pianella	–	1	0	1	0	1	1	0	0	0	1	5
Bisenti	–	1	0	0	0	1	1	0	0	1	1	5
Campli	–	1	0	1	0	0	1	0	0	1	1	5
Civitella del Tronto	–	1	0	1	0	1	1	0	0	0	1	5
Caramanico	–	1	1	0	0	0	1	0	0	0	1	4
Alanno	–	1	0	1	0	1	0	0	0	0	1	4
Montesilvano	–	1	0	1	0	1	0	0	0	0	1	4
Tocco da Casauria	–	1	1	0	0	1	0	0	0	0	1	4
Mosciano	–	1	0	1	0	1	0	0	0	0	1	4
Sant'Omero	–	1	1	0	0	1	0	0	0	0	0	3
San Pio delle Camere	–	0	0	1	0	0	0	0	0	0	0	1

Source: our elaboration on Official Dictionary of Municipalities and inhabited centres (Istat, 1957)

Table A3
Municipalities by pole of destination for the provision of selected services. 1951

Municipality	Pharmacy	Hospital	Magistrate's court	District court	Local tax offices	Stamp duties and registration taxes
Avezzano						
L'Aquila						
Teramo						
Pescara						
Chieti						
Lanciano						
Vasto						
Sulmona						
Ortona						
Castel di Sangro				Sulmona		
Atri				Teramo		
Penne				Pescara		
Atessa				Lanciano		
Giulianova				Teramo		
Popoli				Pescara		
Pescina				Avezzano		
Tagliacozzo				Avezzano		
Casoli				Lanciano		
San Demetrio ne' V.		Aquila		Aquila		
Catignano		Pescara		Pescara		
San Valentino in A.		Pescara		Pescara		
Guardiagrele					Chieti	
Villa Santa Maria		Atessa				
Celano				Avezzano	Avezzano	Avezzano
Celenza sul Trigno		Agnone		Vasto		
Carsoli		Tivoli		Avezzano	Tagliacozzo	Tagliacozzo
Torre de' Passeri		Tocco da Casauria		Pescara	Popoli	Popoli
Montereale		Aquila		Aquila	Aquila	Aquila
Pescasseroli		Pescina	Gioa dei Marsi	Avezzano	Pescina	Pescina
Trasacco		Avezzano		Avezzano	Avezzano	Avezzano
Isola del Gran Sasso		Teramo	Tossicia	Teramo	Teramo	Montorio
Sant'Egidio alla Vibrata		Sant'Omero	Nereto	Teramo	Giulianova	Nereto
Martinsicuro		San Benedetto	Nereto	Teramo	Giulianova	Nereto
Manoppello		Pescara		Pescara	San Valentino	San Valentino
Gissi		Vasto		Vasto	Atessa	Atessa
Palena		Atessa	Lama dei Peligni	Chieti	Casoli	Casoli
Castiglione Messer M.		Atessa		Vasto	Celenza sul Trigno	Celenza sul Trigno
Balsorano		Sora	Civitella Roveto	Avezzano	Avezzano	Avezzano
Castelvecchio Subequo		Sulmona		Sulmona	Sulmona	Sulmona
Rocca di Mezzo			Aquila	Aquila	Aquila	Aquila
Scanno		Sulmona	Sulmona	Sulmona	Sulmona	Sulmona
Crognaleto		Teramo	Montorio	Teramo	Teramo	Montorio
Miglianico		Chieti	Francavilla a Mare		Chieti	Francavilla a Mare
Navelli		Aquila	Capestrano	Aquila	San Demetrio	San Demetrio
Castiglione Messer R.		Penne	Bisenti	Teramo	Teramo	Bisenti
Valle Castellana		Ascoli/Teramo	Civitella	Teramo	Teramo	Teramo

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Table A3 (*continued*)

Municipality	Pharmacy	Hospital	Magistrate's court	District court	Local tax offices	Stamp duties and registration taxes
Palmoli		Vasto	Celenza sul Trigno	Vasto	Celenza sul Trigno	Celenza sul Trigno
Calascio	Castel del Monte	Aquila	Barisciano	Aquila	San Demetrio	San Demetrio
Francavilla a Mare				Chieti	Chieti	
Nereto				Teramo	Giulianova	
Pratola peligna		Sulmona		Sulmona	Sulmona	
Orsogna		Guardiagruele			Lanciano	
Torricella Peligna		Lanciano		Lanciano	Casoli	
Città sant'Angelo				Pescara	Pescara	Pescara
Montorio		Teramo		Teramo	Teramo	
Notaresco		Teramo		Teramo	Atri	
Roseto			Notaresco	Teramo	Atri	Notaresco
Barisciano		Aquila		Aquila	San Demetrio	San Demetrio
Magliano de'Marsi		Avezzano		Avezzano	Avezzano	Avezzano
Capestrano		Aquila		Aquila	San Demetrio	San Demetrio
Casalbordino		Vasto		Vasto	Vasto	Vasto
Pianella		Pescara		Pescara	Pescara	Pescara
Bisenti		Teramo		Teramo	Teramo	
Campli		Teramo		Teramo	Teramo	
Civitella del Tronto		Teramo		Teramo	Teramo	Teramo
Caramanico				Pescara	San Valentino	San Valentino
Alanno		Pescara	Catignano	Pescara	Catignano	Catignano
Montesilvano		Pescara	Pescara	Pescara	Pescara	Pescara
Tocco da Casauria			Torre de'Passeri	Pescara	Popoli	Popoli
Mosciano		Giulianova	Giulianova	Teramo	Giulianova	Giulianova
Sant'Omero			Nereto	Teramo	Giulianova	Nereto
San Pio delle Camere	Barisciano	Aquila	Barisciano	Aquila	San Demetrio	San Demetrio

*Flows of commuters to the pole in ordinal scale (1 = the highest commuting flow).
Source: our elaboration on Official Dictionary of Municipalities and inhabited centres (Istat, 1957)

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