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THE INTRAURBAN LOCATION RATIONALE(S) OF THE KNOWLEDGE-CREATING SERVICES: TWO ITALIAN CASE-STUDIES

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ABSTRACT

In recent decades, a lively debate has developed within economic geography about the changing contents and interpretations of the agglomeration economies. These changing contents refer to the ongoing transitions from the industrial to the knowledge-driven economy and from a deterministic to an evolutionary theoretical approach. While there is wide consensus about the leading position of the agglomeration economies with respect to the location economies in the new context, their nature is being still debated, especially between the *New Economic Geography* (NEG) and the *Evolutionary Economic Geography* (EEG). In fact, unlike NEG, the EEG underlines the role of non-pecuniary economies, owing to the rising importance of the relational/meso factors compared with the techno-economic ones. The present paper aims at contributing to the debate by (a) using an 'interpretive' approach to the knowledge-driven economy; (b) focusing on its most representative branch, namely the Knowledge-creating Services and (c) considering the intra-urban scale, which is a decisive scale as far as meso-economic factors are concerned. To corroborate the theoretical frame, a spatial-econometric analysis on two very different Italian Metropolitan Areas is performed. Our results, while confirming the importance of the agglomeration economies also in the knowledge economy, suggest that they depend on wider milieu conditions, thus eventually substantiating the EEG approach. On the normative side, the results allow targeted urban policies to be devised in relation with the knowledge-driven economy.

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1. Introduction

According to the economic geography literature, location factors predict only a minor part of the spatial distribution of activities (Ellison, Glaeser, 1999), so that it is reasonable arguing that it mostly depends on agglomeration factors. What remains quite debatable within the present-day pattern of development, characterized by the driving role of immaterial-and-relational factors, are the nature and the relative weight of the agglomeration economies, owing to the circumstance that they both vary throughout the product cycle (Duranton, Puga, 2001) as well as with changes in the techno-economic paradigm (Phelps, Ozawa, 2003; Neffke, 2008).

Not by accident, the debate was reopened by the *New Economic Geography* (NEG) (Krugman, 1991) at the beginning of the last Nineties, in conjunction with the ICT revolution and the related dramatic reduction in transmission and transportation costs. Espousing a general-equilibrium approach (Krugman, 1998) and referring to a dual economy, structured on an immobile, widespread and constant-returns sector (agriculture) and a mobile and increasing-returns sector (manufacturing), the NEG is characterized by (a) the internalization of the cumulative effects of the pecuniary externalities into the firm location rationale and (b) the indeterminacy that ensues in the manufacturing geography, following the reduction of transportation costs. More specifically, whilst high transportation costs induce manufacturing activities to evenly spread throughout space, their reduction can either trigger an even distribution or concentration, eventually resulting in concentration when transportation costs further lessen. These outcomes induce NEG to argue that location economies are effective only at the initial stage of industrialization, while agglomeration economies drive the following stages, thus ultimately shaping the real economic geography.

The question to be addressed is whether and to what extent this model remains valid also in the knowledge-driven economy, given that only part of its conditions complies with NEG's hypotheses. Precisely, the concordant conditions regard the facts that (a) knowledge-based activities benefit from increasing marginal returns (Lucas, 1988), at least within a given techno-economic-cultural paradigm and (b) the magnitude of and the trends in information exchange costs vary importantly depending on the codified or tacit character of the knowledge involved. Whereas costs referred to the codified knowledge have dramatically dropped thanks to ICTs' developments, those related to tacit knowledge have remained quite stable, owing essentially to the need for personal mobility and proximity[6]. On their turn, the divergent conditions refer to the circumstances that (c) unlike material production, learning is essentially a relational practice (Gibbons et al., 1994), so that information exchanges are an inherent character to the knowledge 'production' process and (d) related transaction costs are markedly high in the knowledge exchange/production, thus implying systematic recourse to extra-market devices, characterized by the importance of non-pecuniary externalities (Arrow, 1973). The notions of "distributed knowledge" (Tsoukas, 1996; Smith, 2000) and "distributed creativity" (Miettinen, 2006) mean precisely that indivisibilities and cumulative effects in this sector mainly lie within the meso- rather than within the micro- or the macro-economic dimension (Boschma, Frenken, 2006; Cooke, 2018).

Considering the concordant conditions and focusing on the economic activities which are especially devoted to the knowledge creation (the so-called 'Knowledge-Intensive Services' – KIS), our aim is to investigate their location pattern(s). According to NEG, codified knowledge-based KIS would locate randomly throughout a region or would tend to cluster when they are sensitive to reciprocal proximity[7] or to closeness to public services and infrastructures, especially when temporary proximity matters (Torre, 2008, 2011). Conversely, tacit knowledge-based KIS are expected to cluster at different degrees depending on the

[6] In the U.S., the *Internet Transit Price* dropped from 1,200 to 0.63 US$ per Mbps between 1998 and 2015, i.e. -56% compound rate per year, on average (Source: http://drpeering.net/white-papers/Internet-Transit-Pricing-Historical-And-Projected.php). On the contrary, between 1998 and 2014, the average freight revenue per Ton-mile rose about 1.8% and 0.8% per year, respectively in air and rail transports (U.S. Department of Labor, 2016), though on the background of a centuries-long decreasing trend (Glaeser, Kolhase, 2004).

[7] Asheim and Gertler (2006) actually note that also activities based on codified knowledge use tacit knowledge, especially in the cognitive explorative phases.

trade-off between internal agglomeration economies and proximity to their customers and suppliers (who may coincide). Since manufacturing represents a significant proportion of those customers/suppliers (Miles *et al.*, 1995), tacit knowledge-based KIS are supposed to cluster within or close to manufacturing areas. Conditions sub (c) and (d) would contribute to consolidate these trends over time, thanks to the cumulative effects of non-pecuniary externalities (Ottaviano, Puga, 1998), finally exacerbating divergences with latecomer regions (Compagnucci, Cusinato, 2014).

It follows that, also within the new techno-economic context, agglomeration economies would prevail on the location economies and, consequently, that the NEG model would fit again. These conclusions would remain definitively valid, were it not for the fact that a shift had also occurred in the disciplinary domain, challenging a NEG basic hypothesis. Following the "Schumpeterian Renaissance" (Freeman, 2007; McCraw, 2007) and the connected foundation of the *Evolutionary Economics* (Nelson, Winter, 1982), the major source of concern which is supposed to affect firms actually changed significantly, from the optimal exploitation of a given set of resources within a given system of market prices, to the need for innovating constantly to become and to remain price-setters, so that the overall perspective previously aimed at achieving a condition of general static equilibrium (spatial equilibrium included) has turned to ceaselessly upsetting such a tendency.

While adopting this perspective, the EEG (Boschma, Frenken, 2006) agrees with NEG in using a micro-economic approach, so that the real economic geography follows the course "of the entry, growth, decline and exit of firms, *and their location behaviour*" (Boschma, Frenken, 2011, p. 295; emphasis added). Unlike NEG, which focuses on the ex-ante optimal spatial configuration stemming from the composition of multiple optimal location micro-choices, EEG is however concerned (ex-post) with the evolutionary processes that cause the observable spatial distributions of economic activities, and that affect their future course through the working of path-dependent mechanisms (ibid.). Some regularities are, however, observable within these processes, thus making it possible to devise spatial policies. According to EEG, these regularities can be summarized as follows: (i) the 'material cause' of agglomeration economies, which lies at the basis of clusters formation, does not consist only in the pecuniary (though cumulative) advantages of proximity, as suggested by NEG, but also (and mainly) in firms' capacity to *generate* local spin-offs (which is the paramount innovation, according to Schumpeter); (ii) the presence and composition of related and/or unrelated variety characterizing a socio-economic milieu, be it a cluster, a district, a city, a region or else a nation, is the place-based factor mainly causing *generative* economies. It follows that, unlike NEG, location economies matter in the EEG approach, not only in the early phase of firms' location, but along their entire lifetime (as well as along the lifetime of the clusters they might belong to), provided that they refer to complex milieu conditions, rather than to separate locational micro-benefits.

The present paper aims at giving a contribution to this debate, while providing an empirical investigation on the geography of the knowledge-driven economy. More specifically, it aims at ascertaining if the NEG or the EEG approach better fits the knowledge-based pattern of development and, consequently, which is the relative importance of micro and meso agglomeration economies. Considering the work already made in this direction, the paper (a) substantially focuses on KIS location rationales at the intra-urban scale, a cutting-edge issue which has not been receiving sufficient attention in the literature; (b) on the methodological side, it refers to a specific KIS classification − the "Knowledge-creating Services" (KCS), as defined by Compagnucci, Cusinato (2014) – whose analytical soundness and heuristic power have been widely proved (Cusinato, Philippopoulos, 2015 in comparison with the excessively vague notion of KIS (Alvesson, 2001) and the excessively narrow, high-tech-oriented notion of KIBS (Miles *et al.*, 1995).

The paper is organized as follows. The next Section reassesses the issue of agglomeration economies according with an evolutionary/generative approach, by focusing on the intra-urban scale. An empirical spatial-econometric analysis, supported by GIS techniques, will be then carried out on the Italian Metropolitan Areas of Milan and Cagliari, to test the analytical consistency and the methodological viability of the framed approach in such very different socio-economic and urban contexts. The final section will draw conclusions on the analytical and normative domains.

2. Agglomeration economies in the knowledge-driven economy

Generative agglomeration economies[8] are not a new topic in the scientific debate, having been introduced by Jane Jacobs (1961, 1969), who considered them as the city key-characteristic[9]. Cities, in fact, in addition to representing the physical anchorage of a socio-spatial context, 'naturally' and continuously cause and renew agglomeration economies, thanks to their inherent conditions of heterogeneity and relational density (Cusinato, 2007, 2015). The debate thus developed by focusing on the dyads of related/unrelated variety (Glaeser *et al.*, 1992; Frenken *et al.*, 2007) and MAR/Jacobsian economies (cf. Caragliu *et al.*, 2016). The relative importance of each dyadic factor, however, remains a not well achieved question (ibid.), mainly because of the micro-and-positivist foundations of the evolutionary approach. In actual fact, this approach prevents EEG to investigate the synergies that arise within and between the two dyads, owing to the twofold reason that they cannot be ascribed to the individual behavior and are not empirically observable.

Lessons learned from Jacobs (1961, 1969), Redfield and Singer (1954) and, even earlier, Durkheim (1895) suggest us that the generative effects, albeit resulting from individual rationales and connected behaviors, ground on structural rather than functional conditions. It follows that, first, related and unrelated variety refer to and are shaped by complex milieu conditions, which lie beyond any possible individual direct intervention (Cooke, 2018) and, second, dealing with agglomeration economies within an evolutionary perspective requires *really*[10] adopting a meso-approach, eventually opening to a shift from EEG towards a *Relational Economic Geography* (Sunley, 2008). The notions of National System of Innovation (Lundvall, 1992), Learning Region (Morgan, 1997) and Triple Helix (Etzkowitz, Leydesdorff, 2000), along with other similar notions which endogenize the cumulative effects of learning synergies, actually show that EEG acknowledges the importance of the relational dimension, but they make so while maintaining a micro-economic approach, with the consequence that those cumulative effects are supposed to depend on the *deliberate* interaction between the actors involved (basically, enterprises, institutions and research centers), thus neglecting the role of any possible milieu/structural condition.

Questioning the epistemological foundations of the current evolutionary approach goes beyond the aim of this paper. However, having evoked them allows us to be aware about the deeper implications of an apparently 'normal'[11] investigation into the issue of agglomeration economies, and about the connected selection of suitable hypotheses and tests. Regarding the hypotheses, past investigations at the regional and the metropolitan scales have proved that urban factors crucially affect KIS/KCS location choices, along with their relationships with other activities. In detail, they showed that:

- urban location is typical to KIS/KCS, while location in major cities, where cumulative effects occur more likely and/or at a higher level, is typical of symbolic knowledge-based activities (Compagnucci, Cusinato, 2016a, b). Moreover, Andersson, Hellerstedt (2009) and Isaksen, Onsager (2010) showed that especially large end-markets, which characterize larger urban contexts, attract sophisticated KIS/KCS;
- conditions of internal proximity within the KIS/KCS sector importantly matter, in the form of Marshallian economies (Ihlanfeldt, Raper, 1990; Astrakianaki Aji, 1995; Gong, Wheeler, 2002; Andersson, Hellerstedt, 2009), albeit at a lower level for science-based activities (Ó hUallacháin, Reid, 1992; Ó hUallacháin, Leslie, 2007; Shearmur, 2012; Spencer, 2015; Compagnucci, Cusinato, 2016b), in line with the theoretical expectations (Asheim, Gertler, 2006; Asheim *et al.*, 2011). A strong interdependency internal to the "knowledge sector" was empirically proved by Wood (2006), who found that, in England, "almost two-thirds of KIBS purchases were on other KIBS on 2003" (p. 346);

[8] "Generative", in that they foster innovation, rather than merely yielding cost-cutting or revenue-increase.

[9] Redfield and Singer (1954) were, indeed, the forerunners in this direction. They introduced the notion of "heterogenetic city", without however explicitly connecting this term to firm's innovativeness, as Jacobs rather did.

[10] Which means, not only maintaining that the meso dimension matters, as EEG truly does, but also endorsing its disciplinary status.

[11] In the Kuhnian sense.

- on the contrary, proximity to manufacturing appears to be an ambiguous location factor (Andersson, Hellerstedt, 2009). According to Astrakianaki Aji (1995), it is relevant for some kinds of services, such as advertising (a typical symbolic-based activity), but it works at a lesser extent for other professional jobs. Compagnucci, Cusinato (2016b) showed that, first, a spatial correlation occurs between KCS and manufacturing at the regional level and, second, it is possible to shed more light on this topic by distinguishing between the knowledge bases involved. A strong spatial correlation exists, for instance, between High & High-Medium Tech industry and analytical knowledge-based KCS, on the one hand, and between Medium-Low & Low Tech industry and synthetic knowledge-based KCS, on the other.

The strong attractiveness cities exert on KIS/KCS, in general, and especially on their most sophisticated categories corroborates the idea that, in addition to Marshallian economies, urban locational factors play a crucial role at the regional level. This result contradicts the NEG model, where concentration is supposed to occur in any one region, while corroborating the EEG approach, which is more sensitive to place-based externalities. Thus, the question arises of whether this result remains valid also at the intra-urban scale, where the impact of local differences in the milieu condition might be less relevant than at the supra-urban scales owing to the shorter distances.

Whilst most of the current works on the intra-urban location rationales deal with manufacturing and its re-location, especially after the period of the industrial restructuring, the few works regarding KIS/KCS highlight the role of both agglomeration and location factors, by agreeing essentially on:

- KIS based on face-to-face contacts prefer central location, despite high rent levels (Ó hUallacháin, Reid, 1992; Fois, 2016);
- proximity to transport infrastructures, and notably hubs, also matters (Ihlanfeldt, Raper, 1990; Gong, Wheeler, 2002; Arauzo-Carod, Viladecans-Marsal, 2009).

On the contrary, these works differ regarding some methodological features about empirical investigations, such as, for instance, the choice of the spatial unit of analysis. Whilst most of them use discrete spatial units (districts, zip zones, concentric rings, hexagons), only a minority uses punctual locations through GIS techniques, even if they eventually assemble data at some discrete spatial level in order to perform an econometric analysis (Ó hUallacháin, Reid, 1992; Gong, Wheeler, 2002; Ó hUallacháin, Leslie, 2007; Garcia-López, Muñiz, 2011; Fois, 2016).

With these premises and arguing that at the intra-urban scale proximity to manufacturing does not matter importantly, the paper aims at testing the following null hypotheses:

a) KCS are not sensitive to urban economies, as a whole[12]*, at the intra-urban scale*

and, more specifically:

b) KCS are not sensitive to agglomeration economies at the intra-urban scale;

c) KCS are not sensitive to locational factors at the intra-urban scale.

3. Two Italian case-studies

The above hypotheses were tested on two Italian Local Labor Systems (LLS)[13], which differ in many respects: Milan and Cagliari[14]. Apart from the geographical location (Milan, as a city, is the Lombardy capital, placed in the Northern Italy, while Cagliari is the capital of the Sardinia island, in the *Mezzogiorno*), Milan, with its 3.7 million inhabitants and 1.7 million workers and the most advanced industrial and services activities, is the Italian economic capital. Its rich infrastructural system along with a long tradition of financial, trade, political and scientific relationships with northern European countries have made it one of

[12] The expression "as a whole" summarizes the milieu/system effect, which is reputed to be higher than the arithmetic sum of its components.

[13] LLSs are the Italian version of the Home-to-Work Areas or the Functional Urban Areas. See ISTAT (2014).

[14] From here on, when speaking about 'Milan' and 'Cagliari', we refer to their respective LLS, if not differently indicated.

the main European metropolitan areas. On the other hand, Cagliari counts 0.5 million inhabitants and less than 0.2 million workers. Its connections with the Continent are provide by maritime and air services (respectively about 13 hours and 1 hour to Rome), so that it is a full insular urban reality. The differences in the inhabitants' economic conditions are equally important: the added value per capita was € 34.2 and € 20.0 thousand euros respectively in the provinces of Milan and Cagliari, on 2007 (Source: http://sitis.istat.it), thus mirroring the secular dualism between the Northern and the Southern Italy. Finally, from the territorial viewpoint, Milan is part of a compact metropolitan system, which covers most of central and northern Lombardy, while Cagliari is a typical central place within a system of surrounding minor centers. The common character between these two urban realities, which is relevant for this paper aims, is that they are both specialized in KCS (considering the national average as benchmark) albeit at a very different level and in a different way. The Location Quotient (LQ)[15] of total KCS amounts respectively to 2.17 and 1.23, and the specialization mostly depends on the private – in Milan – and public – in Cagliari – component (Compagnucci, Cusinato, 2016b).

Testing the above framed hypotheses in such different contexts seems thus interesting to ascertain if this kind of services is affected by the same location and/or agglomeration economies under changing urban conditions. To this extent, the empirical analysis was split in four main steps: (1) providing a geo-referenced KCS database in both LLSs; (2) rendering the related KCS geography; (3) defining the intra-urban territorial unit of analysis on which (4) performing the spatial-econometric analysis.

3.1. Data base

Regarding the first step, the universe of enterprises belonging to the different KCS breakdowns[16] (at a five-digit ATECO 2007 detail[17]) and their respective postal addresses were provided by the Cagliari Chamber of Commerce (Register of Enterprises). Since the Register does not contain professional activities, these latter were drawn from the Yellow Pages internet site[18], thus representing only a sample of their respective universes. For this reason, and not being aware of the representativity of that sample, the following analyses were carried out separately for KCS enterprises and KCS professionals. In addition to the geo-referenced KCS, we also considered some other relevant points, namely highway tollgates and underground stations (only for Milan), as well as airports, railway stations for long-distance trains and the two main City Halls, which are all representative of intra-urban static location economies (for details, visit the interactive website: http://kcs.nsupdate.info/).

3.2. Spatial units

KCS and the other relevant points were geo-referenced onto the "OMI Zones", which served as the discrete spatial units of analysis at the intra-urban level. An OMI Zone is a continuous portion of the municipal area, where the local real estate market can be considered homogeneous (cf. *Osservatorio del Mercato Immobiliare* - Observatory on Real Estate Values, n.d.). The delineation of the OMI Zones results

[15] LQ_{ij} expresses here the ratio between the number of employees in sector *i* and residents in LLS *j*, and the correspondent ratio at the national level.

[16] The KCS classification is as follows: 1) *Core KCS*: Services whose core activity consists in the governance of creativity; 2) *Core-related KCS*: Services whose normal activity consists in knowledge application, which interact systematically with Core KCS; 3) *Activities Collateral to KCS*: Service or manufacturing activities which technically support the above categories (for more details, see Compagnucci, Cusinato, 2016b). To shed more light on the underpinning spatial rationales, we generally considered two further distinctions: a) *Core* and *Core-related KCS* were split into *Private* and *Public*, depending on whether they normally work according to market criteria or not; b) drawing from Asheim *et al.* (2011), *Core KCS* were further classified with reference to their knowledge base: *Analytical*, *Synthetic* and *Symbolic* (Table A in the Appendix). Owing to constraints in the statistical sources, the present work deals only with Private KCS.

[17] ATECO is the Italian version of NACE (*Nomenclature Statistique des Activités Economiques*).

[18] The professional activities considered are the following: architects, engineers, lawyers, notaries, specialized designers, geologists, translators, psychoanalysts and psychologists, reporters, firm consultants, auditors, professional membership organizations.

from joining one or more cadastral micro-zones. The typical urban OMI Zone is sized as a neighborhood, or a district. On the contrary, the typical rural OMI Zone is relatively wide, but this is not a problem for our investigation because the presence of KCS in these areas is a remote event. For each OMI Zone, the *Osservatorio* provides the urban rent and the sale values distinctly for apartments/houses, boxes and similar, shops, warehouses, workshops, offices, plants, according to the cadastral classification[19]. The OMI Zone form and size comply with the following criterion: the ratio between the minimum and maximum real estate values must be equal to 1.5 or less, relatively to both rent and sale. In this paper, the average rent values were considered with reference to "Offices", and were expressed in €/m^2/month[20]. The OMI Zones digital cartography was downloaded from the *Agenzia delle Entrate* – the Italian Revenue Authority[21]. It required a careful topological reconstruction, in order to remove possible incompatibilities with the GIS tools. In doing so, the geometries of the OMI Zones were reshaped using the official cartography of the municipal boundaries[22].

Table 1 shows the main features of the two LLSs in terms of KCS and OMI Zones. Cagliari counts respectively 164 OMI Zones and about 3,200 KCS enterprises, whereas Milan contains 521 OMI Zones and counts nearly 50,000 KCS. Total and urbanized areas of each OMI Zone were derived from the land use maps of Lombardy and Sardinia, according with the second level *Corine Land Cover* codes 1.1 and 1.2[23]. What clearly emerges is the overwhelming importance of the Milan KCS system with respect to Cagliari. Not only it counts almost fifteen times KCS enterprises, but more than twenty times as regards Core KCS enterprises, a condition that marks its quantitative and qualitative superiority in this sector. Also the urban features are very different, in that Milan, while having a smaller total area, has an urbanized area three times wider than Cagliari.

Table 1 – KCS enterprises, OMI Zones and connected areas of the Milan and Cagliari LLS

LLS	Core KCS	Core-related KCS	Activities Collateral to KCS	Total KCS enterprises	N° OMI zones	Area (Ha)		
						Total	of which, urbanized areas	Share of urbanized areas %
Cagliari	1,002	1,327	941	3,270	164	246,864	23,632	9.57
Milan	20,372	18,223	10,401	48,996	521	183,868	69,934	38.03
Milan/Cagliari	20.33	13.73	11.05	14.98	3.18	0.74	2.96	

3.3. The KCS geography

Charts 1 and 2 describe the KCS punctual location in the two LLS. The first characteristic to be noted is that KCS locate preferably in a central position, where the highest cloud density can be found. A second characteristic regards their spatial pattern, which appears to be hierarchically ordered according to the central place model. In fact, the most important KCS core is surrounded by lower-ordered KCS centers, almost regularly distributed over the space. This is true for both LLSs, although at a very different level, in that the maximum density at the OMI Zone level is 21.35 KCS/km^2 in Milan, whereas it reaches only 3.27 in Cagliari.

[19] See http://www.agenziaentrate.gov.it/wps/content/nsilib/nsi/documentazione/omi.

[20] On July 2017, the last release by the *Osservatorio* referered to the second half of 2016.

[21] http: //www.agenziaentrate.gov.it/wps/content/nsilib/nsi/documentazione/omi.

[22] Available at http://www.istat.it/it/archivio/24613.

[23] According to the *Corine Land Cover*, the "urbanized area" includes the Urban fabric, the Industrial and the Commercial areas (www.eea.europa.eu/pblications/CORO-landcover/download). In this work, we added the surface of the roads falling into it.

Chart 1– KCS enterprises cloud – Cagliari

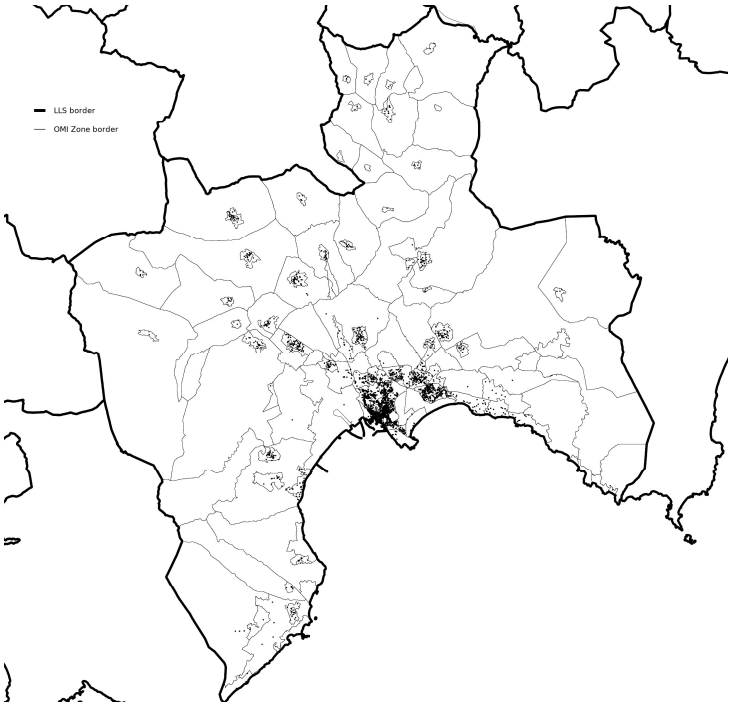
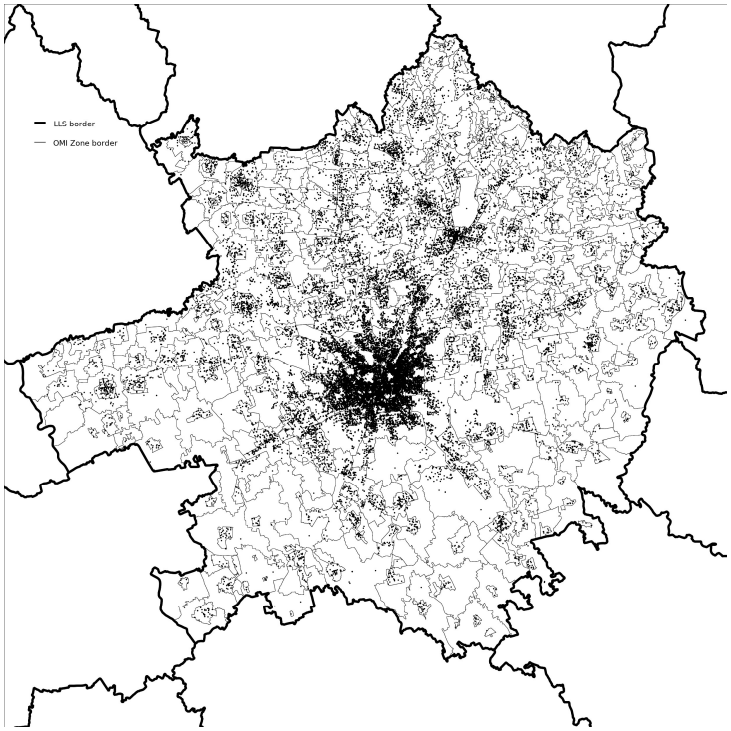


Chart 2 – KCS enterprises cloud − Milan



Urban and social implications of Milan's monocentric pattern

Chiara Mazzoleni

The manifold world of professions and of the activities related to the knowledge economy connotes the post-industrial transition of the contemporary city. It has structured the urban space and eased the formation

of “generative milieus” or “creative fields”, which operate at different spatial scales, but more intensively in the metropolitan core, as several recent studies show (Scott, 2006; Hutton, 2009; Cusinato, Philippopoulos-Mihalopoulos, 2015). At the same time, it competes with households for the appropriation of space, not only to take advantage from the available economic chances, but also from the use of public goods, the exploitation of urban economies and their location values. These phenomena, which go with the production of negative externalities and strong economic, social and urban inequalities, appear more striking in case of lack of adequate public policies or, more generally, of institutional weakness.

As noted by previous works (Mazzoleni, 2012, 2016), the Milan case distinguishes from other cases of European cities that have taken advantage from globalization and the knowledge economy precisely because of the inadequacy of the public policies, the unsuitability of the regulatory devices of that transition and its impacts on social cohesion and urban-life quality. Though the local political frame has changed with the 2011 administrative elections, the center-left administration struggled and is still struggling to devise a strategy for bestowing institutions with a clear driving role in the urban transformation processes, and firstly with a metropolitan master plan. A plan, this one, that can govern and mitigate, at the same time, the consequences of the strong neo-liberal pull of the center-right administrations that succeeded in leading the municipality during the most intensive and delicate phases of change of the economic base and the social structure of both the city and its metropolitan area.

The outcomes of the neo-liberal politics consisted, firstly, in the reinforcement of the monocentric model in the location dynamics of the activities related to the knowledge economy and in a rising social polarization, which have become evident in the last years, with the recovering of the real estate crisis. The most important outcomes are as follows:

- The consolidation of the metropolitan area as a spatial continuum in which urbanization, land use, spatial dynamics of all kinds of KCS and socio-spatial differentiation are markedly shaped by a core-periphery pattern.
- The renewal of the most strategical dismissed central areas, now endowed with directional functions in the financial and insurance sectors, along with residential functions for the highest housing segment. The Expo heavy legacy, with the issue for the re-use of the respective area (with the prospect of an “Innovation, Knowledge and Science Park”, including the Human Technopole and the Scientific Campus of the University of Milan), leaves indeed unresolved the destiny of both *Città Studi* (with its thirty-three big buildings and their 250,000 m^2 of walkable area, and the connected land properties) and the crucial semi-central zone with its multifaceted socio-economic fabric.
- The great expectations and the strong pressures exerted by *FS Sistemi Urbani*, a company controlled by *Ferrovie dello Stato*, having the mission of exploiting the wide areas of the ex-railway yards (125 Ha in Milan, more than the ex-Expo area). These yards, situated in strategic locations, at the join between the central and semi-central urban sectors, have been the subject of negotiations since the first 2000s, between the Municipality and the Region. The ensuing programs and the connected agreements envisaged the construction of one million m^3 of gross floor surface, but did not turned into variations in the city master plan because of the then following deep crisis of the real estate market and the developers’ increasing interest towards central areas. The story of these railways yards has remained the most cumbersome issue the past municipal boards left unresolved, mainly because they are considered as strategic areas for the colonization of important semi-central settings by big development companies.
- The presence of an important asset of dismissed, abandoned or unfinished areas and buildings (which were previously destined to manufacturing and trade, public equipment, residence, offices) within and around the city (beyond Milan, 38 municipalities in the first and second ring, with 740 registered unutilized buildings, out of which 262 in urban areas, 180 of private and 82 of public property). This asset appears as a cloud of more than 800 Ha of covered surface (Dal Borgo *et al.*, 2017). Within the urban area, the most important concentrations locate in the northern and, especially, the west-northern periphery – in the zone between *Viale Certosa* and *Viale Fermi* – and in the southern and especially the

east-southern periphery, between the ex-slaughter house and the new *Santa Giulia* settlement. These are places where the abandonments sum up with the most degraded settlements, along with social exclusion, or where they countervail the new residential quarters. Within the metropolitan area, the most dense settlements of abandoned buildings occur in the northern municipalities with respect to Milan, which had been the most involved urban realities by the industrial development (especially, Sesto San Giovanni, Baranzate, Cornaredo, Nerviano, Parabiago), and which mark the past existence of a local manufacturing district characterized by a strong identity (like along the Olona valley).

- The serious financial difficulties of the Regional Agency for the Public Housing (Aler), which administered about 72,000 apartments in Milan and the province, with about 300,000 tenants, before than the Milan Municipality conferred the administration of its real estate (28,791 apartments) to a controlled company (*Metropolitana Milanese spa*). The outcomes of a long season of Aler mismanagement (2004-2013), which was subservient to the politics and which made ruinous estate investments (through the controlled company Asset), were rendered by the final report of the Regional Committee of enquiry on Aler.
- Moreover, a relevant portion of the vacant Aler estate asset is in condition of high decay (9,700 units in Milan), as well as of vacant apartments that are abusively occupied (4,000 units). These situations cut importantly the availability of apartments for rent, in front of more than 23,000 applications for social housing. The most degraded conditions, where the fragmentation is the highest one within the social fabric (with cases of conflict between the quarter committee and the committee for the defense of the irregular occupants), concentrate in the popular quarters of Lorenteggio–Giambellino, San Siro, Fulvio Testi–Sarca. These quarters, which date up to the '40s-'60s period, appear as enclaves of marginality and social disadvantage in the semi-central area, near the internal ring belonging to the late 19th century avenue system designed by Beruto. Despite the growing rise in housing disadvantage, an extraordinary sales plan was set up by Ater, having an availability of 10,000 units by 2019.

In the lingering lack of appropriate urban policies, city vision and strategic governance of urban transformations by the public actors, these latter lie enslaved to the stronger private interests and driven by the opportunistic investors' behavior. Not only the strong pressure by the most profitable economic activities – such as Private Core KCS – in the metropolitan core has consolidated over time, but also the growing interest by the biggest real estate investors in the inner city has become manifested. All this causes an unsustainable rise in urban rents, creates barriers for further developments of these activities themselves, impoverishes the urban milieu and exacerbates the center-periphery gap.

What is rather emerging in the Milan center, through the acquisition of large urban areas on which to develop massive projects by big Italian and foreign developers, is the transformation (in the sense of a sharp scaling-up in the buying of buildings) of corporate structures and strategies by some private operators and foreign sovereign funds. This is functional for large real estate investments to be made, to integrate the core of large cities into the global network as an emerging frontier space. As Saskia Sassen (2015) recently pointed out, "this emergent frontier-space arises in a context of increasingly hardwired 'bordering' inside cities and across cities. Gated communities are but the most visible representation of these bordering conditions. The uses that global corporate capital makes of our cities are part of that hard bordering".

Another typical feature of the new urban question, in addition to the increase in inequality and social polarization, is the emergence of a process of de-urbanization and the systematic transformation of the proprietary acquisition model of urban space (i.e. large corporate models of private ownership), which have heavy implications for equity, democracy and rights.

With a considerably inadequate public administration, which has entrusted and continues to delegate the urban transformation strategies to the major private operators (early the Fiera, now the State railways), the urban condition of Milan is even worse than that depicted by Giulio Sapelli (2010). In his reflection, he denounced the substantial decay of the public realm, the huge social inequality which is evident in that the one percent of the population possesses forty percent of the urban wealth, which places Milan among the most unequal European cities.

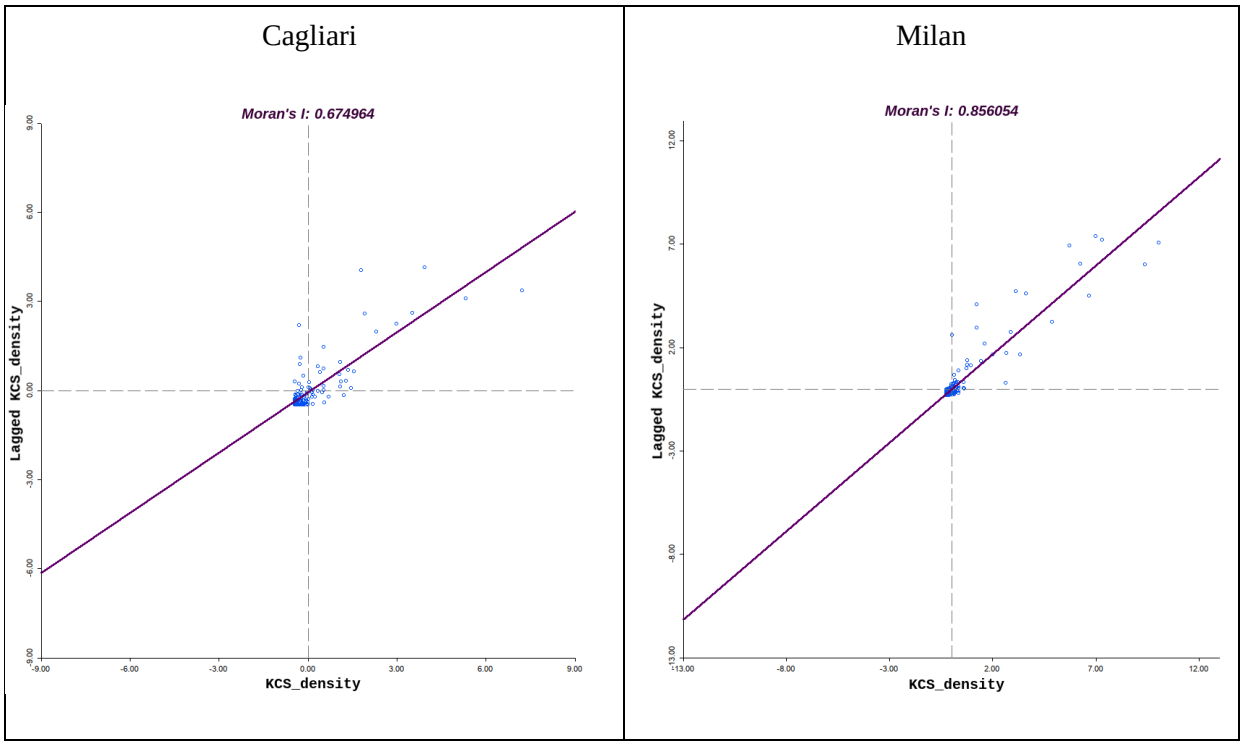
The recent transformations of central urban areas, and the ones that will became available in the medium-long run (i.e. the transformations of disused railway yards) have made it clear that there is a strong disconnection between the city high competitiveness and attractiveness, which have stimulated the colonization of urban space by highly profitable economic activities and large real estate operators, and its low social cohesion.

3.4. Spatial-econometric analysis

The spatial-econometric analysis was split in three sub-steps: (1) verifying the presence of spatial autocorrelation among the OMI Zones regarding the KCS density. If so, a linear regression model (such as the ordinary least squares method – OLS) cannot be performed, since the assumption of no autocorrelation is infringed, in that the errors are correlated with observations. Should the spatial autocorrelation be confirmed, (2) delineating the respective clusters; (3) performing a regression model that controls for spatial autocorrelation.

1. The existence of spatial autocorrelation was tested by means of the Global Moran Index (*Moran I*) (Moran, 1948; Anselin, 1995), calculated in GeoDa. Graph 1 portrays the results through the Moran scatterplot. The X axis reports the normalized values of the KCS density, while the Y axis the spatial lags of the same variable. The slope of the regression line provides an estimation of the *Moran I*. Following Anselin (1995), in case of no spatial correlation, points are sprawled over the four quadrants. In our case, on the contrary, they can be interpolated by a line running along the first and third quadrants, thus suggesting the existence of a positive spatial correlation between the variables.

Graph 1 – Moran I scatterplots



The *Moran I* values, which are equal to 0.67 and 0.86 respectively in Cagliari and Milan, suggest that the spatial autocorrelation, though affecting both cases, is more relevant in Milan. In both LLSs, most of points locate close to the axes origin. These points represent the OMI Zones having an average (standardized) KCS density surrounded by analogous characteristics. On the contrary, points located in the first quadrant represent the OMI Zones which belong more likely to a cluster, as they have high KCS density values surrounded by OMI Zones with similar high values (High-High modality). The main difference between the two urban areas is that, in Milan only the HH modality shapes the KCS

spatial pattern, while in Cagliari a few cases appear of High-Low and Low-High modalities, thus outlining a more checkered geography.

2. Given the presence of spatial autocorrelation, we performed the LISA analysis (Local Indicator of Spatial Autocorrelation; Anselin, 1995) to identify the KCS clusters according to their density. Charts 3 and 4 illustrate the results of this analysis, which can be discussed taking also into account the *Moran I* scatterplot.

Chart 3 – KCS LISA Clusters – Cagliari

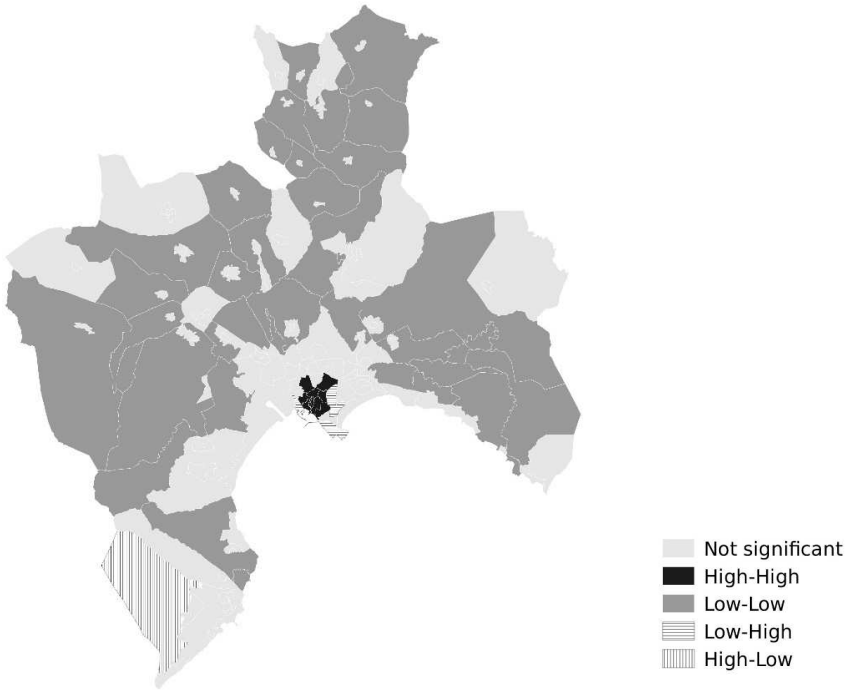


Chart 4 – KCS LISA Clusters – Milan

In both LLSs, High-High (H-H) clusters are located in the very urban center of their respective area, which denotes the presence of a monocentric hierarchical model of the knowledge economy geography. The main difference between the two cases is that in Milan there is a larger "non-significant/sprawled" area between H-H and L-L clusters than in Cagliari, where the L-L clusters are closer to the main center. Secondarily, unlike in Milan, some hybrid clusters (H-L and L-H) are observable in Cagliari, as announced by the *Moran I* scatterplot, which denotes a less strict hierarchical spatial organization and, ultimately, a less monocentric model than in Milan.

3. Given the presence of spatial autocorrelation and, consequently, the impossibility to perform a standard OLS regression, we used a maximum likelihood Spatial LAG model in GeoDa (Anselin *et al.*, 2006). First, we examined the correlation between KCS location and urban rent at the OMI Zone level. In doing so we assumed that urban rent is the price the economic agents (households and firms) are willing to pay in order to benefit from urban economies 'as a whole'[24] under space scarcity conditions. On the basis of these results, we successively investigated the relationships between intra-urban KCS density and specific agglomeration and location economies.

The variables used in the analysis are the following:

a) "KCS_{ij}_density" is the dependent variable. It expresses the KCS density per hectare, where *i* indicates the KCS breakdown and *j* the OMI Zone considered. The density is calculated by dividing the number of KCS units per the OMI urbanized area.

b) "$KCS_{\bar{i}j}$_density", is the KCS density per Ha in the OMI Zone *j* of the complementary KCS categories $\bar{i}$ with respect to the *i* category considered in "KCS_{ij} density";

c) "UR_J" is the variable that summarizes into a unique monetary value (urban rent) the level of urban economies 'as a whole,' in each OMI Zone, be they of a pecuniary or a non-pecuniary/relational kind. In this work, we considered the average rent values referred to "Offices", as supplied by the *Osservatorio del Mercato Immobiliare* at the *Agenzia delle Entrate.* On this point, it is worth noting that these values are provided only for the OMI Zones having a statistically significant number of observations on real estate transactions in recent times. This means that three different circumstances can occur: (i) OMI Zones where both KCS activities and Offices rent values are given, which represents the most desirable situation; (ii) OMI Zones with no KCS and no Offices rent values, which implies their exclusion from the following analysis and (iii) OMI Zones where some KCS are located, but with no Offices rent values, due to an insufficient number of recorded cases. In this event, we considered the Houses rent value, using the conversion parameters supplied by the *Agenzia delle Entrate* manual. Should also this value be lacking, we assumed the value of the nearest category in sequence (Box and similar, Shop, Warehouse, Workshop, etc.), always using the conversion guidelines. Finally, in the rare circumstance that urbanized areas do not have any real estate value, UR was assumed to be equal to the average Office rent values of the neighboring areas. When missing also these latter, it was derived from the average between the rent prices of the most similar real estate categories of the contiguous areas.

d) "$Dist_j$_infras" is the minimum spatial distance between the *j* OMI Zone barycenter and, separately, the highway tollgates, airports and railway stations for long-distance trains, being proxies of physical accessibility;

e) "$Dist_j$_hall" is the spatial distance between the *j* OMI Zone barycenter and the main City Hall within the LLS considered, as a proxy of centrality;

f) "$Dens_j$_metro" is the density of underground stations, calculated by dividing the number of underground stations in the *j* OMI Zone by the value in hectares of its urbanized areas, as a proxy of intra-urban accessibility;

[24] See footnote 12.

g) "$Dens_j$_pop" is the population density, calculated by dividing the number of inhabitants of the *j* OMI Zone by the value in hectares of its urbanized areas. The population derives from processing data from http://www.istat.it/it/archivio/104317, through GIS techniques.

The variable sub b) expresses the Marshallian economies internal to the KCS sector; the variables sub d), e) and f) measure the static urban location economies, while that sub g) represents a factor of competition between alternative uses of the urban soil. All the variables were standardized.

The LAG model takes the following form:

$$y = \rho W_y + x\beta + \varepsilon y$$

where

- y is the dependent variable, namely "KCS_{ij} density";
- the term ρW_y indicates the weight given to the spatial interaction between the observed variables in any spatial unit. These interactions were summarized into a contiguity matrix W_y, which can be identified according with different methods, depending on the geometrical feature of the spatial units of analysis and the nature of the observed variables (Anselin, Getis, 1992, Getis, Altstadt, 2004). Borrowing from the chess terminology, the "queen" criterion was used to generate the contiguity matrix W_y, meaning that two areas were considered contiguous when in direct contact through at least a vertex or a side;
- $x\beta$ represents the vector of the above listed independent variables, from b) to g);
- εy is the statistical error term.

3.5. Outcomes of the LAG model

Table 2 shows that there is a significant and positive correlation between "KCS_{ij}_density" and "UR_J" in both LLSs and for every KCS breakdown, even though the relationship is generally stronger in Milan. These results suggest that KCS are willing to pay for urban rent to benefit from higher levels of urban economies 'as a whole' or, in other words, that they have a high propensity to locate in central areas. The same considerations hold true for the professional activities, even if, in this case, a bias may arise from the fact that the examined sample could prefer central locations[25]. Linear coefficients do not confirm univocally that KCS based on face-to-face contacts prefer a central location. In fact, also Analytical Core KCS, which are based on codified knowledge, show higher propensity to a central location than most of other categories mainly based on tacit knowledge. This behavior could depend on their need for proximity to other research centers, and mainly universities, because of the recourse to face-to-face contacts in the cognitive explorative phases.

Table 2 − Spatial LAG regression between KCS density and urban rent

KCS breakdowns	*Cagliari*			*Milan*		
	Linear coeff.	*LAG coeff. (ρ)*	*p(α)*	*Linear coeff.*	*LAG coeff. (ρ)*	*p(α)*
Private Core, of which:	0.1042	0.7539	0.0005	0.0364	0,8781	0.0000
Analytical	0.1390	0.4416	0.0038	0.2179	0,7056	0.0000
Synthetic	0.1035	0.7454	0.0005	0.1149	0,8694	0.0000
Symbolic	0.1310	0.6931	0.0004	0.0580	0,8872	0,0112
Core-related	0.1329	0.6741	0.0001	0.0997	0,8854	0.0000
Collateral	0.1560	0.6566	0.0000	0.2054	0,7676	0.0000
Professionals	0.0755	0.5748	0.0040	0.3071	0,4160	0.0000

Tables 3 and 4 resume the results of the second step of the spatial-econometric analysis (for the detailed results, see Tables B1 and B2 in the Appendix), which aimed at ascertaining which kind(s) of externalities

[25] In fact, since the registration in the Yellow Pages results in a monetary cost, they more likely contain those activities which are more willing to pay in order to appear, which could relate to the willingness to pay for urban rent.

drive the KCS general propensity to locate in central areas, if Marshallian economies internal to the KCS sector itself and/ or specific intra-urban location economies. The following stylized facts emerge from the LAG model:

- internal agglomeration economies to the KCS enterprise sector (Marshallian economies) significantly affect KCS location in both case-studies. The sum of the linear coefficients resulting from the (normalized) regression of a certain KCS breakdown on the complementary KCS breakdowns generally exceeds .85, thus suggesting the presence of important agglomeration externalities. More specifically:
  - Core KCS are sensitive to proximity to lower-ranked KCS, especially to Core-related KCS, except for the Analytical KCS in Cagliari;
  - the co-location between Core KCS sub-categories (Analytical, Synthetic and Symbolic-based) are more varied and, generally, weaker;
- the intra-urban static location economies matter sporadically and not univocally. When positive, the total linear coefficient is lower than .065, meaning that, on average, the impact of these intra-urban static location economies is about thirteen times lower than the impact of Marshallian economies;
- in both LLSs, the most sophisticated KCS (Core KCS) compete with household locational choices, while those belonging to the less sophisticated KCS (Core-related KCS and Activities Collateral to KCS) are generally embedded into the residential areas. These results may be interpreted as the outcome of the gentrification process which is affecting the areas where the most sophisticated KCS are located (see the above contribution by Chiara Mazzoleni in this paper);
- the KCS professional activities (Table 4) follow the same spatial pattern, with the exception of their negative relationships with Core KCS in Cagliari. Here again, Core Professional KCS compete with residential land uses. Finally, no specific intra-urban static location factor appears to be significant in this sub-sector.

In conclusion, it is possible to affirm that:

1. the hypothesis that "*KCS are not sensitive to urban economies, as a whole, at the intra-urban scale*" is rejected because there is significant positive correlation between every "KCS_{ij}_density" and urban rent in both case-studies;
2. the hypothesis that "*KCS are not sensitive to agglomeration economies at the intra-urban scale*" is rejected. In fact, in both case-studies it appears that Marshallian economies internal to the KCS sector represent the main location factor for knowledge-intensive services;
3. the hypothesis that "*KCS are not sensitive to* (static) *locational factors at the intra-urban scale*" remains ambiguous, since it does not hold significantly true for some KCS categories (although differently in Cagliari and Milan), while it holds true for others categories (again differently in the two LLSs);
4. it finally emerges that the most sophisticated KCS and the Professional activities are competing with residential land uses in both case-studies.

Table 3a − KCS intra-urban agglomeration and location factors, and respective linear coefficients – Cagliari (N° of obs.: 153; p(α) ≤ .05)

KCS breakdowns	*Marshallian agglomeration factors*						*Static location factors*						*Population density*
	Analytical	*Synthetic*	*Symbolic*	*Core-related*	*Collateral*	*Total*	*Proximity to airport*	*Proximity to rail station*	*Proximity to tollbooth*	*Proximity to city hall*	*Subway stations density*	*Total*	
Private Core, of which:	ø	ø	ø	0.4236	0.4161	.8397			ø		ø		-0.0640
Analytical	ø	*1.3837*			*-0.3525**	*1.0312*			ø		ø		
Synthetic	*0.1745*	ø	*0.1764*	*0.3923*	*0.1467*	*.8899*			ø	*-0.0725**	ø	*-0.0725*	*-0.0346*
Symbolic		*0.2857*	ø		*0.6777*	*.9634*	*-0.1236*	*0.0480**	ø	*0.1090**	ø	*.0334*	*-0.0433**
Core-related		0.5777		ø	0.2753	.8530			ø		ø		0.0680
Collateral	-0.0615*	0.2460	0.5189	0.2384	ø	.9418			ø		ø		0.0947

ø: not considered factor *: .05 < p(α) ≤ .1

Table 3b − KCS intra-urban agglomeration and location factors, and respective linear coefficients – Milan. (N° of obs.: 521; p(α) ≤ .05)

KCS breakdowns	*Marshallian agglomeration factors*						*Static location factors*						*Population density*
	Analytical	*Synthetic*	*Symbolic*	*Core-related*	*Collateral*	*Total*	*Proximity to airport*	*Proximity to rail station*	*Proximity to tollbooth*	*Proximity to city hall*	*Subway stations density*	*Total*	
Private Core, of which:	ø	ø	ø	.7709	.1705	.9414		-.0057				-.0057	-.0178
Analytical	ø		*-0.1412*	*0.8854*	*0.1308*	*.8750*		*0.0111*				*0.0111*	*-0.0650*
Synthetic		ø	*0.1341*	*0.8893*		*1.0234*		*-0.0036**			*0.0281*	*.0245*	*-0.0240*
Symbolic	*-0.0908*	*0.7454*	ø	*-0.2597*	*0.3790*	*.7739*					*-0.0896*	*-0.0896*	
Core-related	0.1146	0.7828	-0.0519	ø	0.0568	.9023					-0.0417	-0.0417	
Collateral	0.1816		0.4928	0.2568	ø	.9312		0.0134	-0.0130*	0.0169*	0.0476	.0649	0.1810

Table 4 − Professionals intra-urban agglomeration and location factors, and respective linear coefficients (N° of obs: Milan: 521; Cagliari: 153)

LLS	*Marshallian agglomeration factors*				*Static location factors*						*Population density*
	Core KCS	*Core-related KCS*	*Collateral KCS*	*Total*	*Proximity to airport*	*Proximity to rail station*	*Proximity to tollbooth*	*Proximity to city hall*	*Subway stations density*	*Total*	
Cagliari	0.3960	0.2786		.6746			ø		ø		-0.0602
Milan	-0.6698	1.0712	0.1932	.5946							-0.0820

4. Conclusions

The "KCS intra-urban location rationale(s)" is a cutting-edge research program which has not received the attention it deserves because of both theoretical limits and the difficulty in gathering data. Although at a very preliminary stage, the above analysis showed that, at the intra-urban scale, KCS location is much more responsive to Marshallian economies than static location economies, both in Milan (a larger and central urban area) and Cagliari (a smaller and peripheral urban area). At first glance, this outcome corroborates the soundness of the NEG approach also to the knowledge economy. Two other regularities arose, however: first, the KCS general willingness to pay for urban rent, which mirrors their propensity to choose a central urban location (where 'central' refers to the density of net-positive externalities) and, second, the competition for the urban space between the most sophisticated KCS breakdowns and residential uses. Jointly considered, these two propensities suggest that Core KCS, as well as medium-upper dweller classes, look for high-quality and high-urbanized areas, which can be also explained with their willingness to gain a prestigious aura (Alvesson, 2001). These results turn in favor of the EEG approach, since the KCS sensitiveness to urban economies 'as a whole', also at the intra-urban scale, rather than to specific static urban economies, mirrors their sensitiveness to milieu/generative place-based effects (which ultimately are the most complex kind of location economies). This conclusively means that, while admitting that the NEG approach correctly interprets the dynamics of the regional economic geography within an industry-based system, it does not seem equally suitable when dealing with the knowledge-driven economy, because of the important role played by the meso dimension and the related place-based and non-pecuniary economies within it.

At least a question remains unresolved, however. Having ascertained the importance of both Marshallian economies and the urban economies 'as a whole' for the KCS sector, it is not yet clear whether these two kinds of externalities are independent or consequential to each other. Since urban economies 'as a whole' measure the milieu effect, it becomes actually possible to argue that they are *the* true location driver for the knowledge-intensive activities at the intra-urban scale, while the Marshallian economies would follow as a secondary effect. Further work is therefore needed on this issue.

Some policy suggestions targeted to the KCS intra-urban location follow. Acknowledging that the city is the suitable location for this kind of activities, policies would promote their intra-urban location while avoiding possible negative effects, mainly arising from the excessive competition with other land uses and urbanization diseconomies at large, like urban polarization. Policies would therefore aim at reconciling the KCS propensity for central location with the need of avoiding urban congestion and, consequently, the rise of an urban rent extra-premium. Since urban rent consists in a net revenue transfer from the soil user (KCS included) to the soil owner, which entails lower profitability for economic activities and/or their customers, as well as increasing social inequalities, the main goal for urban policies thus becomes that of 'widening' the 'supply of central places'. This implies a shift from the monocentric urban pattern, which is typical of the KCS spontaneous location rationale, towards a polycentric urban pattern. Such a pattern would have to be composed of different intra-urban central places belonging to the same rank, in order to be equally attractive for specialized classes of sophisticated KCS. In the specific case of Milan, such a strategy would consist in moving from the current monocentric hierarchical metropolitan system towards a networked metropolitan system, where various upper-ranked and specialized centralities interact, as it is observable in the Munich and the Paris Metropolitan Regions (see, respectively, Mazzoleni, Pechman, 2015; Compagnucci, 2015). A further suggestion is avoiding specialized zooning within these centralities, while creating mixed and high-quality urban milieus, in line with the suggestions coming from the studies on the creative class (Florida, 2002).

Finally, though the relationships with the infrastructural networks and, in general, static location factors proved to be ambiguous or weak, it seems hard to affirm that in-and-out urban accessibility does not matter also at the intra-urban scale. Better investigating this topic and devising more targeted policies represent a further issue for future research, while maintaining that both require a meso/milieu approach to be effective.

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Appendix

Table A – Private KCS Classification

Ateco 2007	5-digit description	Knowledge base	Ateco 2007	5-digit description	Knowledge base
Core KCS					
58110	Book publishing	Symbolic	71121	Engineering activities	Synthetic
58130	Publishing of newspapers	Symbolic	71122	Integrated engineering services	Synthetic
58140	Publishing of journals and periodicals	Symbolic	71124	Aerial photography and mapping activities	Synthetic
58210	Publishing of computer games	Synthetic	72110	Research and experimental development on biotechnology	Analytical
58290	Other software publishing	Synthetic	72190	Other research and experimental development on natural sciences and engineering	Analytical
59110	Motion picture, video and television programme production activities	Symbolic	72200	Research and experimental development on social sciences and humanities	Analytical
59120	Motion picture, video and television programme post-production activities	Symbolic	73110	Advertising agencies	Symbolic
59201	Sound recording publishing	Symbolic	73200	Market research and public opinion polling	Synthetic
59202	Music publishing activities	Symbolic	74101	Specialised design activities	Symbolic
59203	Recording studios	Symbolic	74102	Graphic designers activities	Symbolic
60100	Radio broadcasting	Symbolic	74109	Other design activities	Symbolic
60200	Computer programming activities	Symbolic	74201	Photographic activities	Symbolic
62010	Production of software not associated with publishing	Synthetic	74901	Agricultural consultancy	Synthetic
62020	Computer consultancy activities	Synthetic	74902	Security consultancy	Synthetic
62030	Computer facilities management activities	Synthetic	85520	Cultural education	Symbolic
63112	Database activities	Synthetic	85600	Educational support activities	Synthetic
63113	Hosting and related activities	Synthetic	90010	Performing arts	Symbolic
63120	Web portals	Synthetic	90030	Artistic creation	Symbolic
63910	News agency activities	Symbolic	94110	Activities of business and employers membership organisations	Synthetic
64200	Activities of holding companies	Synthetic	94121	Activities of professional membership organisations	Synthetic
66110	Administration of financial markets	Synthetic	94122	Activities of federations	Synthetic
69101	Legal activities	Synthetic	94200	Activities of trade unions	Synthetic
69102	Notarial activities	Synthetic	94920	Activities of political organisations	Synthetic
69202	Auditing activities	Synthetic	94991	Activities of organisations related to citizens' rights protection	Synthetic
69203	Labour consultancy activities	Synthetic	94992	Activities of organisations pursuing cultural and recreational purposes	Symbolic
70100	Activities of head offices	Synthetic	94994	Activities of organisations pursuing international cooperation and solidarity	Synthetic

70210	Public relations and communication activities	Synthetic	94995	Activities of organisations pursuing philanthropy	Symbolic
70220	Business and other management consultancy activities	Synthetic	94996	Activities of organisations pursuing promotion and defense of the animals and of the environment	Symbolic
71110	Architectural activities	Symbolic	94999	Activities of other organisations n.e.c.	Synthetic

Core-related KCS

52292	Transport services	77400	Leasing of intellectual property and similar products, except copyrighted works
59130	Motion picture, video and television programme distribution activities	78100	Activities of employment placement agencies
61901	Internet access providers	78200	Temporary employment agency activities
62090	Other information technology and computer service activities	78300	Other human resources provision
63111	Data processing	79902	Activities of tourist guides
63990	Other information service activities n.e.c.	82110	Combined office administrative service activities
69201	Accounting and bookkeeping activities; tax consultancy	82300	Organisation of conventions and trade shows
71123	Surveyor activities	82912	Commercial information agencies
71201	Technical testing and analysis	85592	Training courses
71202	Quality checking and labelling	85593	Language schools
73120	Media representation	85599	Other education n.e.c.
74103	Technical designers activities	90020	Support activities to performing arts
74300	Translation and interpretation activities	90040	Operation of arts facilities
74909	Other professional, scientific and technical activities n.e.c.		

Activities Collateral to KCS

46510	Wholesale of computers, computer peripheral equipment and software	58120	Publishing of directories and mailing lists
46432	Wholesale of recorded media, sound and video	58190	Other publishing activities
46433	Wholesale of optical, photographic and cinematographic products	74202	Photographic laboratory, developing and printing
46492	Wholesale of books, newspapers and journals	82190	Photocopying, document preparation and other specialised office support activities
47410	Retail sale of computers, peripheral units and software in specialised stores	82200	Activities of call centres
47610	Retail sale of books in specialised stores	82992	Distribution's agencies of books, newspapers, journals and periodicals
47621	Retail sale of newspapers and stationery in specialised stores	82999	Other business support service activities n.e.c.
47630	Retail sale of music and video recordings in specialised stores	93299	Other amusement and recreation activities
95110	Repair of computers and peripheral equipment		

Table B1 – LAG Model results – Cagliari

Parameters	*Analytical Core KCS*		*Synthetic Core KCS*		*Symbolic Core KCS*		*Total Core KSC*		*Core-related KCS*		*Activities Collateral to KCS*		*Professional activities*	
R-squared	0.6175		0.9213		0.8969		0.9190		0.8879		0.9220		0.7825	
Log likelihood	154.212		316.812		269.917		305.586		280.7		292.562		291.21	
	Coeff.	*P(α)*	*Coeff.*	*P(α)*	*Coeff.*	*P(α)*	*Coeff.*	*P(α)*	*Coeff.*	*P(α)*	*Coeff.*	*P(α)*	*Coeff.*	*P(α)*
Constant	0.0177	0.4158	-0.0191**	0.0176	0.0023	0.8367	-0.0196**	0.0231	0.0087	0.4233	0.0057	0.5800	-0.0088	0.3094
Analytical Core KCS	ø	ø	0.1745**	0.0000	-0.0004	0.9924	ø	ø	-0.0337	0.3557	-0.0615*	0.0682	ø	ø
Synthetic Core KCS	1.3837**	0.0000	ø	ø	0.2857**	0.0045	ø	ø	0.5777**	0.0000	0.2460**	0.0047	ø	ø
Symbolic Core KCS	0.0290	0.8538	0.1764**	0.0019	ø	ø	ø	ø	0.0152	0.8354	0.5189**	0.0000	ø	ø
Total Core KSC	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	0.3960**	0.0000
Core-related KCS	-0.1436	0.3950	0.3923**	0.0000	0.0261	0.7542	0.4236**	0.0000	ø	ø	0.2384**	0.0007	0.2786**	0.0001
Collateral Services to KCS	-0.3525*	0.050	0.1467**	0.0260	0.5189**	0.0000	0.4161**	0.0000	0.2753**	0.0007	ø	ø	0.0888	0.1916
Distance to the main City Hall	-0.0336	0.7652	0.0725*	0.0892	-0.1090*	0.0699	0.0420	0.3593	-0.0219	0.6908	0.0103	0.8443	0.0230	0.6334
Min. distance to highway tollgates	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø
Min. distance to airports	0.0066	0.9552	-0.0532	0.2279	0.1236**	0.0433	-0.0164	0.7274	0.0034	0.9514	-0.0254	0.6292	-0.0038	0.9401
Min. distance to railway stations	0.0405	0.4263	0.0229	0.2306	-0.0480*	0.0713	0.0194	0.3387	-0.0120	0.6257	0.0153	0.5041	-0.0009	0.9684
Density of underground stations	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø
Population density	-0.0056	0.9080	-0.0346**	0.0471	-0.0433*	0.0644	-0.0640**	0.0004	0.0680**	0.0016	0.0947**	0.0000	-0.0602**	0.0035

ø: not considered factor **: $p(\alpha) \leq .05$ *: $.05 < p(\alpha) \leq .1$

Table B2 – LAG Model results – Milan

Parameters	*Analytical Core KCS*		*Synthetic Core KCS*		*Symbolic Core KCS*		*Total Core KSC*		*Core-related KCS*		*Activities Collateral to KCS*		*Professional activities*	
R-squared	0.9113		0.9894		0.9643		0.9878		0.9902		0.9446		0.5882	
Log likelihood	1187.9		1669.42		1253.33		1614.83		1702.45		1150.08		913.729	
	Coeff.	*P(α)*	*Coeff.*	*P(α)*	*Coeff.*	*P(α)*	*Coeff.*	*P(α)*	*Coeff.*	*P(α)*	*Coeff.*	*P(α)*	*Coeff.*	*P(α)*
Constant	0.0035	0.4360	-0.0016	0.3698	-0.0092**	0.020	-0.0042**	0.0299	-0.0016	0.3389	0.0174**	0.0006	-0.0091	0.2228
Analytical Core KCS	ø	ø	0.0150	0.3842	-0.0908**	0.0154			0.1146**	0.0000	0.1816**	0.0001	ø	ø
Synthetic Core KCS	0.0912	0.4051	ø	ø	0.7454**	0.0000	ø	ø	0.7828**	0.0000	0.0620	0.6030	ø	ø
Symbolic Core KCS	-0.1412**	0.0012	0.1341**	0.0000	ø	ø	ø	ø	-0.0519**	0.0025	0.4928**	0.0000	ø	ø
Total Core KSC	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	ø	-0.6698**	0.0000
Core-related KCS	0.8854**	0.0000	0.8893**	0.0000	-0.2597**	0.0085	0.7709**	0.0000	ø	ø	0.2568**	0.0357	1.0712**	0.0000
Collateral Services to KCS	0.1308**	0.0013	-0.0012	0.9432	0.3790**	0.0000	0.1705**	0.0000	0.0568**	0.0002	ø	ø	0.1932**	0.0033
Distance to the main City Hall	0.0032	0.7148	-0.0001	0.9746	0.0076	0.3312	0.0019	0.6385	0.0035	0.2876	-0.0169*	0.0830	0.0127	0.4042
Min. distance to highway tollgates	-0.0016	0.8176	-0.0030	0.2654	-0.0060	0.3106	-0.0048	0.1112	0.0009	0.7201	0.0130*	0.0786	-0.0040	0.7276
Min. distance to airports	-0.0008	0.9369	0.0017	0.6438	-0.0024	0.7649	0.0002	0.9571	-0.0017	0.6227	0.0001	0.9888	-0.0024	0.8745
Min. distance to railway stations	-0.0111**	0.0460	0.0036*	0.0984	0.0068	0.1618	0.0057**	0.0191	-0.0004	0.8418	-0.0134**	0.0273	0.0073	0.4350
Density of underground stations	0.0178	0.3821	0.0281*	0.0984	-0.0896**	0.0000	-0.0027	0.7722	-0.0417**	0.0000	0.0475**	0.0307	0.0483	0.1398
Population density	-0.0650**	0.0004	-0.0240**	0.0010	0.0158	0.3252	-0.0178**	0.0256	0.0112	0.1036	0.1810**	0.0000	-0.0820**	0.0076

ø: not considered factor **: $p(\alpha) \leq .05$ *: $.05 < p(\alpha) \leq .1$