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SPACE AND POVERTY LINKAGES: THREE EMPIRICAL ESSAYS

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Introduction.

I. Motivation.

The nature and intensity of the relation between *space*, both physical and socio-economic, and *individuals* is crucial to understand many multidimensional phenomena (such as economic development, poverty, vulnerability, social exclusion, crime) and, also, some environmental and strictly urban issues (such as pollution, mobility, risk management, cities degradation). As pointed out by the second European Quality of Life Survey (EQLS), carried by the European Foundation for the Improvement of Living and Working Conditions (Eurofound) in 2010,

> « a person's quality of life is not only shaped by individual choices and behavior: the surrounding environment and the public services on offer have a big influence on how people perceive the society they live in and on their evaluation of their own quality of life. » (p. 10).

Poverty may refer to a number of *cumulative* deprivations, such as limited access to employment opportunities and income, inadequate and insecure housing and services, violent and unhealthy environments, little or no social protection mechanisms, limited access to adequate health and education opportunities. Policy responses and inclusive program options at the city level should hopefully include, therefore, a number of different structured interventions with respect,

for instance, to labor markets, employment, urban services, public finance, urban governance, capacity building.

The necessity of paying special attention to these issues is remarked at various levels. At the supra-national level, wellbeing and poverty historically coexist in close proximity in the urban space, with a systematic growing trend of urban poverty and disparities of income, especially in phases of rapid change and economic development:

> «when cities already have high levels of inequality, spatial and social disparities are likely to become more, and not less, pronounced with economic growth. High levels of urban inequality present a double jeopardy. They have a dampening effect on economic growth and contribute to a less favorable environment for investment. But just as importantly, urban inequality has a direct impact on all aspects of human development, including health, nutrition, gender equality and education» (UN-HABITAT, 2008)

At the regional level, the European Union shares, among its strategic objectives, the promotion of social cohesion through a local regeneration based on targeted interventions, encouraging research on polarization of inequality, inter-regional disparities, spatial concentration of poverty and "place-based" processes of social protection and social intervention :

> « The concentration of deprivation in urban neighborhoods remains an issue in many European cities. […] This is combined with the concentration of unemployment in particular city districts. In these high unemployment districts, other aspects of deprivation are typically concentrated. This includes low quality housing

> and inadequate public transport and other services such as education as well as low income levels and high crime rates» (Growing Regions, growing Europe – Fourth Report on economic and social cohesion, 2007)

Especially in the last decade, city became the center of a global flow of people, capital, infrastructure, culture and urban policies have found themselves facing new challenges, ranging from transformation of the economic structure of cities (the scaling of production and the divestment of the manufacturing system), the involvement of new operators and the finding of new financial resources, the revival of cities themselves and their attractiveness (functions, business, investment). Inequalities have taken various forms, ranging from different levels of human capabilities and opportunities, participation in political life, consumption, and income, to disparities in living standards and access to resources, basic services and utilities. Although the traditional causes of inequality – such as spatial segregation, unequal access to education and control of resources and labor markets – have persisted, new causes of inequality have emerged, such as those in access to communication technologies and skills, among others. The city level seems therefore to be between the most suitable to explore the linkage between space and poverty, because of its alternative status of "laboratory", as well of "sink", of wellbeing: those processes generating opportunities and wealth tend to systematically coexist with some negative ones associated to the waste of environmental quality and social cohesion.

A detailed study of these issues was the subject, on one hand, of the research project "Cities, wellbeing and poverty: multidimensional poverty profiles for integrated public actions", coordinated by Enrica Chiappero, director at the Human Development, Capability and Poverty - International Research Center of the Institute for Advanced

Study (IUSS) of Pavia and financed by Fondazione Lombardia per l'Ambiente, to which I have participated as junior researcher together with many other juniors and senior scholars from Università Bicocca, Politecnico di Milano and Università di Pavia between 2008 and 2010. On the other hand, some of the considerations emerged have been more extensively treated in "Gli spazi della povertà" (forthcoming, edited by Enrica Chiappero-Martinetti, Stefano Moroni and Giampaolo Nuvolati), which has collected the point of view of urbanists, sociologists and economists on the linkage between space and poverty and illustrated some national and international experiences accordingly. These two works have considered both the *theoretical* level, with the intention to identify the conceptual boundaries of the linkage space- individuals and to provide a unifying theoretical framework for the study of any possible interrelations between them, and the *empirical* level, in order to identify and produce a set of suitable indicators to represent the considered poverty dimensions and to provide their spatial representation. Thirdly, some useful recommendations for the design of public policies have also been suggested, addressed both to places (*pro–place* policies) and/or individuals (*pro-people* policies), with special attention to those socio-economic interventions for the most vulnerable groups and conditions.

This thesis follows these works, exploding the *empirical* level of the linkage between space and poverty in the city of Milan, although under 2 different and exogenous territorial partitions: on one hand, the former 20 areas of decentralization and, on the other hand, the so called 180 "aree funzionali", the very last allowing deeper and more precise considerations.

II. Lessons from the *area effects* debate in U.S.

The linkage between poverty and space has been widely explored across the years and within a variety of disciplines (sociology, geography, economics, urban planning, political science), portraying, as stated by Chiodelli:

> « a very wide spectrum, ranging from a sort of environmental determinism of the Chicago school (Park et. al., 1925; Wirth, 1938), to a sort of "inconsequentismo" (of a part of the Marxist geography of the eighties, but also of a proportion of post-modern contemporary sociology), in which space loses weight and the causal relationship almost disappears. Today, in general terms, it seems that the second pole has gained more force and appeal within the academic world." (Chiodelli, 2011)

Avoiding any environmental determinism, I support the hypothesis of a *direct* and *contextual* linkage between space and poverty. Given the almost endless literature, I limit my attention mainly to that urban-sociological, "geographically" circumscribing the context of reference to the United States which is, in terms of description of the phenomenon, the most articulated and well-structured over time. I find particularly interesting the debate on the *area effects*, which postulates some existing linkages between poverty and space although without specifying which is dependent upon the other (Atkinson and Krintea, 2001). Being considered as the net contribution to the change of life-chances, given a certain place of residence, the area effects can be both positive and negative and are intended to identify how the district of residence (as a whole) affects in relation to urban poverty[1].

[1] They are therefore taken into account many more strictly social variables (eg, patterns of socialization and family). See, for example, Ellen and Turner (1997).

Although the first empirical research in U.S. was merely descriptive[2], starting from the middle of the second decade of the 20th century the issue gained a scientific relevance, thanks to Chicago school[3] and, later in 1965, to the Moynihan Report. A multitude of studies flourished even if, beginning with a general convergence on the description of the phenomenon, many different interpretations emerged, mainly attributable to two opposing lines of research, i.e. the liberal and the conservative approach, which, in the decades, dominated the scientific debate on the subject[4]. The extensive analytical production that has concerned, until present, the concentration of poverty in U.S. provided some interesting insights about the influence of the space variable in relation to urban poverty, summarily suggesting a dichotomy based on two macro-areas. On one hand, some *personal* characteristics, related to individuals, may be influenced by space and therefore favor the emergence of the phenomenon of pauperization; on the other hand, some properly "spatial" factors, including some environmental conditions, may determine poverty, both directly and indirectly. The debate over the importance of such individual factors, on one hand, and on some more

[2] See in this regard Riss, 1890 and Addams, 1902.

[3] Studies by Park, Burgess, McKenzie and colleagues turned out to be profitable, both for a rich and varied theoretical work (that provided a benchmark for subsequent developments of urban sociology and disciplines dealing with the city) and for a series of insights on the introduction of spatial categories in the conceptual vocabulary of social sciences.

[4] "Liberals have traditionally emphasized how the plight of disadvantaged groups can be broader related to the problems of society, including problems of discrimination and social class subordination. They have also emphasized the need for progressive social change, particularly through governmental programs, to open the opportunity structure. Conservatives, in contrast, have traditionally stressed the importance of different group values and competitive resources in accounting for the experiences of the disadvantaged; if reference is made to the larger society, it is in terms of the assumed adverse effect of various government programs on individual or group behavior and initiative" (Wilson, 1987: 5). According to the reconstruction provided by Wilson, the liberal view prevailed in the sixties, but began to weaken in the next decade, and thus give place to the dominance of the conservative vision in the eighties.

structural phenomena, on the other hand, rotated around the concept of the "culture of poverty"[5] and, later, of the so-called *underclass*, the very last still implying a strong focus on individual behavior and on the intergenerational transmission of poverty, although in a more structured scientific framework[6]. However, beyond distinctions between *culture of poverty* and *underclass*, it is interesting to note how the last emerged with greatest evidence in specific spatial contexts, circumscribed and precisely identified[7].

According to Dreier, the emphasis on such spatial factors (remarked for instance in Wilson, 1987) encouraged subsequent studies on the area effects of poverty concentration and, following the capability approach of A. Sen (which Dreier et al. explicitly assume), if poverty is not simply a matter of income but it means impossibility of living a decent life and of achieving expectations, space as "a place of life" takes its full importance, being the variable able to ensure opportunities and influence the functionings of the residents (Dreier et al., 2004). Not only the behaviors (as pointed out by the culture of poverty and by the underclass), but rather the life chances (in terms of health, educational and career opportunities, personal safety), seem therefore marked by the spatial concentration of poverty (Squires e Kubrin, 2005: 52-55).

[5] The theory of the *culture of poverty* is defined in its main features in the late sixties, mainly through the work of Oscar Lewis.

[6] Around the term "underclass" has been spent a significant academic debate. For a discussion of the *liberal* approach to the underclass, see Wilson (1987: 6-13). For a brief overview of some research on the underclass see Jargowsky and Yang (2006: 55-56).

[7] These territories were generally defined "underclass areas", showing a divergence from the national average in at least one of the four socio-economic indicators which have been identified as central to the definition of the American mainstream (percent of adult males outside the labor market; rate of the early school leavers; number of households with children headed by single women; number of households dependent on public assistance) (Jargowsky and Yang, 2006: 57).

III. State of the art in Italy.

In Italy the attention devoted to the relationship between spatial and social factors with respect to urban poverty is much less significant, as well as fragmentary (Apple, 2006: 217 and Parker, 2004: 130). Among the notable exceptions, it is important to highlight, firstly, the research condensed around *Sociologia Urbana e Rurale*, directed by Paolo Guidicini[8].

Secondly, some other important contributions fall within the discipline of *regional economics*, mostly collected by the Italian Association for Regional Science (AISRe) and the European Regional Science Association (ERSA). The question of *how* to perceive the space in relation to individuals became in the last decades a central issue, although a clear unifying framework for such analysis is still lacking. The role of the spatial dimension is considered, for instance, as determinant in the process of prices creation[9] or in that of income distribution under conditions of unequal regional allocation of resources, eg in different Local Labour Systems (SLL)[10]. Most of this

[8] See, among others, Guidicini et al. (ed.), 1991, 1993, 1996, 1997, 2000. Specifically, for a brief review of studies on poverty in Italy see Martinelli, 1991, Pieretti, Bosi, 1991.

[9] One of the most recent and interesting literature, although mainly referred to U.S., considers the *hedonic* approach, which has become an established methodology in environmental economics and to which regional economists look with great interest. The rationale behind this approach is that, ceteris paribus, houses in areas with cleaner air will have this benefit capitalized into their value, which should be reflected in a higher sales price (Anselin and Lozano-Gracia 2007) and thus no longer accessible, even if desired, for a low-income household. Originating with the classic studies of Ridker and Henning (1967) and Harrison and Rubinfeld (1978), it has generated a voluminous literature dealing with theoretical, methodological and empirical aspects. Extensive reviews are provided in Smith and Huang (1993, 1995), Boyle and Kiel (2001), and Chay and Greenstone (2005), among others. Part of these references are further specified in the first and in the second essay of this thesis.

[10] A SLL represents a particular local context, consisting of two or more municipalities in which the population resides and works. The boundaries of these areas are subject to variations depending on the attractiveness and it can happen that SLL disappears when the municipalities are becoming part of another, or other,

studies have considered the *spatial econometrics* as a very useful and complementary tool to explore the *contagion* effects among areas or neighbors, these last being responsible of phenomena of growing polarization of inequalities, as well as (missing) convergence. The empirical evidence and most of the analysis of territorial cohesion are oriented to discuss, in fact, how space matters in the dynamics of convergence among European regions, as well as Italian (Arbia, Basile and Salvatore, 2002). Many studies explore the role of the agglomerative factors for the increasing economic convergence, postulating that spillovers diffusion process is easier in agglomerated areas (Guastella and Timpano, 2009)[11].

Thirdly, the linkage between spatial variables and individuals has been very recently considered also within the debate on *quality of life*, issued by the ISQOLS (The International Society for Quality -of-Life Studies). However, alongside the development of these international networks, it should be noted as in our country such theoretical research has struggled to take shape. Some studies and research on the livability of cities, provinces and regions have been carried out by local governments (IReR 1985, 1992, 2003, 2000 and 2010), focusing on the living conditions and lifestyles of citizens (Istat 2008, 2009). Since, as stated, most of this research is characterized by a substantial fragmentation, lack of comparability, an almost non-existent accumulation of results and a theoretical and methodological ground which is often superficial, a conference (sponsored by ISTAT) has been launched in Florence in September 2010, with the aim of

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SLL. The availability of data at the SLL, therefore, allows to "describe the complex configuration of the Italian economic system, characterized by geographical identity with very different structural connotations and also with development paths that are not comparable" (Davì and Barbaccia, 2008).

[11] Please refer to the second essay of this thesis for further references on the contribution of spatial econometrics to different disciplines, included economics and social sciences.

collecting studies on quality of life in Italy and comparing experiences under a unique framework of reference. Although very ambitious, the conference has benefited from insights and contributions of many researchers, public and private institutions, including some interested on the linkage between poverty and space in the Italian metropolitan cities.

IV. Empirical studies on Milan.

A growing number of surveys and research, mostly sociological, is available to gain some insights on the linkage between space and individuals in Milan. Between the most consolidated research are the annual reports on "poverties" by Caritas Ambrosiana, a sort of "state of the art of Milan" (*Rapporto sulla città*, in its Italian acronym) by Ambrosianeum and the annual surveys on the quality of living provided by the permanent observatory of Associazione MeglioMilano. On the other hand, some contributions have been also provided for planning purposes, as a result of a fruitful cooperation between the Municipality of Milan, Università Bicocca, Politecnico di Milano and some other independent planners. Between these contributions, I hereby point out two main research works.

On one hand, Francesca Zajczyk has investigated how the poverty is distributed within the former twenty areas of decentralization in Milan and whether there are areas of greater poverty intensity and concentration[12]. She explores the relationship between space and individuals wondering whether there are differences between areas in terms of available resources and conditions of hardship or vulnerability.

[12] Zajczyk F (2005), *Segregazione spaziale e condizione abitativa*, in La povertà come condizione e come percezione (ed. Benassi, D).

On the other hand, Lidia Diappi investigated the interaction between three different systems in Milan: the social system (social interaction, quality of housing, job opportunities, culture, leisure, personal care, consumption), the economic system (economic wellbeing, concentration and dynamic businesses, real estate market, accessibility to transportation, processing and investment opportunities) and the physical environment system (air quality, water, soil , green, capacity for regeneration, environment)[13]. The interactions among these systems are complex and unpredictable and present the opportunity for new methodologies of scientific investigation (Diappi et. al, 1998).

Both the contributions recommend to adopt an integrated multidimensional approach for the analysis of wellbeing, poverty and the relationships between individuals and space, harmonizing the information available within a framework and defining a unifying set of variables and indices of simple interpretation and monitoring. In particular, a clear distinction has been made between a sort of *physical* endowment and a *socio-economic* context. Similarly, in this work I have privileged a unifying framework introduced by Giampaolo Nuvolati (although purely theoretical), inspired by the *capability* approach of A. Sen and extensively illustrated in Chiappero-Martinetti, Moroni and Nuvolati (2011). This scheme suggests to shape the capability set as a combination of three interdependent and composite measures of wellbeing, related to the *physical, economic* and *social* endowment of each area, in order to catch the most suitable poverty (or wellbeing) profile. As we will see further in the first essay of this thesis, these dimensions are also indicative of many facets of the relationship between space and poverty in urban affluent societies and of consolidated traditions of study and research (respectively the

[13] Diappi, L. et al. (1998) *Urban sustainability : complex interactions and the measurement of risk*.

already mentioned literature on quality of life developed by ISQOLS, the theory of social morphology of Durkheim and the Chicago school, the discipline of environmental psychology).

V. Original contribution and methodology.

In opposition to the numerous contributions on the linkage between space and poverty, it was lacking, in our view, a unifying analytical framework of reference for the systematic exploration of these issues. In the research project "Cities, wellbeing and poverty: multidimensional poverty profiles for integrated public actions" and partially also in the book “Gli spazi della povertà” (forthcoming), we have attempted to provide a full theoretical proposal which does not confuse the different levels of analysis required and, at the same time, is able to catch both the complexity of such linkage and the different ways in which space can influence - or not - the individuals. This thesis follows the conceptual framework adopted in the research project and provides three empirical essays as original contributions. The linkage between space and poverty has been mainly exploded referring to poverty *concentration* and to the effects of poverty and wellbeing *contagion* among neighbors. Is poverty concentrated or distributed in Milan? Is it possible to draw a sort of spatial regime, in order to reach a clear territorial partition of wellbeing / poverty within a city? It is argued that the concentration of poor people in an area is, in itself, a variable that affects the reproduction of poverty, triggering a vicious cycle of multiplication of discomfort, among other things, contributing to the perpetuation of poverty within the household and neighborhood of residence.

In the first essay I briefly introduce the accepted theoretical hypothesis on the linkage between space and poverty, which we have more extensively illustrated in Chiappero-Martinetti, Moroni and Nuvolati

(2011). I have built a system of indicators which is coherent with the three dimensions of urban poverty selected (i.e. physical, economic and social) and tested its empirical validity in Milan. The main intent was to illustrate local disparities in terms of combinations of these three dimensions (i.e. multidimensional profiles of poverty) for each of the former 20 areas of decentralization. The three composite indices shouldn't hopefully be considered as purely measures, but as a suitable conceptual framework for planning at the local (even neighbor) level and, on the other hand, as effective advocacy tools, underscoring the importance of multidimensional approach and making it a priority concern in local development agenda.

Furthermore, between those dimensions themselves, some spillover or contagion effects occur. As already stated, as the most recent literature on urban studies and spatial econometrics has shown, the income dimension (usually considered in terms of average per capita income) seems to be positively and significantly auto-correlated within a region and even within neighbors in a metropolitan area, according to distinct regimes of concentration - claiming the principle of spatial heterogeneity[14]. In the spatial econometric models, in particular, interactions between the observation units (for instance between neighbors) are modeled in terms of a certain distance between them (time distances, distance from a certain critical threshold, contiguity..), allowing more accurate analysis, even for those non-stationary regimes. The second essay, therefore, refines the first analysis based on the former 20 areas of decentralization and considers a greater level of territorial partition (i.e. 180 areas or, in Italian, "aree funzionali") and

[14] Haining 1990; Bailey and Gatrell 1995; Anselin 1998a,b; LeGallo and Ertur 2003. Spatial autocorrelation, however, has been observed with respect to many other variables which typically characterizes the urban context, such as crime, pollution, inequality, hedonic prices of houses (Anselin 1988, 2001a,b; Case, Rosen, & Hines, 1993; Holtz-Eakin, 1994; Bockstael, 1996; Simmons et al., 1973; Walker, Moran, & Anselin, 2000, Baller & Richardson, 2002).

many years (2000-2006), although focuses only on the economic dimension. After having briefly explored the current research on poverty concentration in urban areas and pointed out the limits of some conventional measurement techniques, the attention has shifted to the potentials of the Exploratory Spatial Data Analysis (ESDA) approach on such topics, including the spatial autocorrelation tests (global Moran's I) and the tests for local clustering and instability (LISA). I have therefore elaborated the spatial statistics introduced, with reference to the average per capita income in each of the 180 functional areas of Milan between 2000 and 2006. As far as many similar neighbors (both rich and poor) are concentrated (rather than dispersed), a certain relationship between (income) poverty and space has been supposed to be confirmed.

Finally, in the third and last essay, I have definitively exploded the analysis, testing the robustness of the conceptual framework introduced in the first contribution if referred to the same territorial partition of the second one (i.e. 180 areas, or neighbors). At this level of disaggregation, unfortunately, only a few between the original data were available, especially referring to the *social* dimension. The main intent of this very last essay was to draw some considerations about the relation between poverty and space starting from a purely data-driven approach, which has to be read as complementary to the one, theory-driven, of the first essay. On one hand, I have adopted a model assuming that the different dimensions of poverty are unobservable (latent) variables collected at least through a set of *functionings*-based measures and explained by some exogenous variables and conversion factors. Despite wellbeing is mostly unobservable (as a multidimensional concept based at least on a physical, economic and social dimension), some observable measures may be in fact considered as satisfactory proxies. It is the case of the availability of basic services, infrastructure, formal and informal care networks for most vulnerable groups, a relatively low environmental

criticality (in terms of acoustic pollution or excessive exposure to traffic), an acceptable level of inequality, etc. On the other hand, the same latent constructs (i.e. physical, economic and social) may be converted freely and differently according, for instance, to households characteristics (in terms of number of equivalent components, household status and preferences, etc.), or influenced by some exogenous policy actions. After having briefly described the data available for the 180 neighbors of Milan, I have performed a preliminary factor analysis to explore the relationships among each variables and the latent factors, given the distribution of the former between the 180 areas. I have then run a confirmatory factor analysis (otherwise called a measurement model) to test the validity of such hypothesized latent construct, which did not result, as expected, unidimensional. The measurement model could be also considered as the first part of a full latent variable model, being hopefully subject of further research since it requires much more information on the side of the exogenous factors. The essay has also provided, at this point, a cluster analysis, based on the identified latent sub-constructs, and a sort of "poor neighbors typology". I have finally suggested some policy recommendations based on a joint use of *people-based* and *place-based* interventions and recommended, following a tentative intuition of Chiodelli (2009), a possible correspondence between *poverty types* and *policy types*. It is argued, in fact, that considering the linkage between poverty and spatial characteristics is relevant at least to develop policies which are more responsive to contextual features and more directed to the various components of the phenomenon.

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1. Foundations and robustness of a multidimensional poverty taxonomy of the 20 areas of decentralization of Milan

1.1. Introduction

This first essay has the aim of benchmarking infrastructural and socioeconomic characteristics of the former 20 areas of administrative decentralization[15] of Milan (Italy), following the purely theoretical framework illustrated in Chiappero-Martinetti, Moroni and Nuvolati (2011)[16] based on three different concepts of urban environment, i.e. "physical", "economic" and "social". As we will see below, these dimensions are also indicative of many facets of the linkage between *space* and *poverty* in urban affluent societies and of consolidated traditions of study and research. The focus on these issues (rather than on the traditional concepts of human development or economic development, typically explored in developing countries) is due to the greater importance it assumes in developed contexts, such as that which we refer. These dimensions partially refer to the concept of

[15] I have privileged the former territorial partition into 20 areas of decentralization to the current one into 9 since, as also pointed out by Zajczyk, it allows to analyze not too large population quotas (on average 65 000 persons) and to better observe the differences between central areas, semi-central and peripheral. The current zones, in fact, contain a higher number of inhabitants (about 144 000 on average) and often include even many inhomogeneous social areas (Zajczyk, pag. 57).

[16] Nuvolati (2011). Spazio e povertà: una tipologia per l'analisi delle città, in Gli spazi della povertà (forthcoming).

"social development", recently explored in the social sciences[17]. In addition to the evaluation of multidimensional phenomena such as poverty and social exclusion, the concept of social development also considers the factors of *social cohesion*, in line with the strategic objectives of social policies in Europe and Italy.

The essay considers two levels. On one hand, the conceptual framework is provided, postulating the hypothesized linkage between poverty and space in the light of the capability approach of A. Sen, briefly mentioning its theoretical assumptions (§ 1.2) and illustrating some significant research done on these topics in Milan (§ 1.3). In particular, the framework suggests to shape the capability set as a local combination of three interdependent and composite measures of wellbeing related to the physical, economic and social endowments of each area (§ 1.4), in order to catch the most suitable *poverty profile* for each of the former 20 areas of decentralization of Milan (§ 1.5). On the other hand, such hypothesis is tested empirically, through a set of measurable indicators, an internal consistency check (§ 1.6) and a robustness analysis (§ 1.7).

1.2. Theoretical assumptions

1.2.1. Space and poverty in the capability approach

The capability approach of A. Sen is useful to explore the interrelations between individuals (or families) and space. In the evaluation of the *capabilities*, through the appropriate levels of achievement attained in the various dimensions of wellbeing (otherwise called *functionings*), great importance has to be devoted to the analysis of the context in which the individuals themselves are

[17] Abburrà, Borrione, Cogno and Migliore (2005), Balestrino A., Sciclone N. (2000), Bernetti, J., Casini, L. (1995).

located. As remarked by Chiodelli (2009, 2011), a good synonym of "context" may be that of "grouping" : it would be a terrible mistake to assume that individual initiative does not play any role in determining the ability of a person to get out of poverty but, on the other hand, we would make the same terrible mistake if we attribute such responsibility just to this individual, as if it depends on some intrinsic quality of the person. When one takes into account situations of despair, or deprivation that lasted probably for generations, where all those around are in a state of severe deprivation, it should be wondering how much initiative can a person have in a similar context[18]. The differences in the social, economic and/or cultural context seem to play a crucial role for the determination of poverty, both at the individual and household level.

1.2.2. Control of the abilities and cumulative effects

As suggested by Dispari (2009), poverty is closely related to the *degree of control* of the individuals towards different resources of the urban context, *i.e.* the ability to access to housing, infrastructure, services. The access to public transport, for instance, is an important indicator of how the individual is able to move enough to take advantage of the urban labor market and find employment, as well as use of health services and attainment to schools. Of course such control over the resources has itself a multidimensional component to be taken into account, since a dimension of poverty is often the cause, or at least contributes, to the intensification of *more* dimensions of

[18] "[…] sarebbe un terribile errore ritenere che l'agire e l'iniziativa individuale non giochino alcun ruolo nel determinare la possibilità per una persona di uscire dalla povertà […], ma d'altra parte commetteremmo un terribile errore se imputassimo solo all'individuo questa responsabilità, come se ciò dipendesse da qualche intrinseca qualità della persona. Quando si prendono in considerazione situazioni di disperazione, di deprivazione che si protrae probabilmente da generazioni, dove tutti coloro che ti stanno intorno sono in uno stato di grave deprivazione, bisognerebbe chiedersi quanta iniziativa può avere una persona in un simile contesto " (Sen, 1993: 314, Italian version).

poverty. On the other hand, the combination of two or more different dimensions of poverty (for instance income poverty and lack of aggregation opportunities) could determine a surplus of disadvantage which is not properly the sum of the previous two. As pointed out by Zajczyk (2005), the ability, availability and easy movement of individuals within the territory provides a significant expansion of contact opportunities, information, professional and cultural growth and use of services. A useful example is provided by the access to cultural events. There are a variety of reasons why disadvantaged groups tend to access less than other members of society. The key factor is the associated costs of participation, such as entrance fees. Secondly, information about cultural activities is unevenly spread across society and some groups are not reached by mainstream media and advertisements. A third reason is accessibility, something very relevant for people with disabilities, but also for those who live in peripheral areas, poorly connected by public transport and without a car. Another factor is the type of cultural activities on offer: the activities may appeal only a part of the citizenship, and may have been designed without consulting more disadvantaged groups. For example, a recent study in the UK has found that, in larger cities, cultural events tend to be attended more by external visitors than locals from a disadvantaged background[19].

As a result I have considered, for each of the former twenty areas of decentralization, some indicators of three different concepts of "urban environment", accordingly to a multidimensional concept of space: (i) a physical dimension, in terms of housing characteristics, environmental criticality, infrastructures and public services; (ii) some income-based variables, in terms of income inequality and persistence

[19] Museums, Libraries and Archives Council (2009) The Role of Museums, Libraries, Archives and Local Area Agreements, Final Report, April 2009.

of poor families and (iii) a social dimension, in terms of public offer of care services and assistance, aggregation through sports and cultural initiatives and security. On the other hand, I have selected many indicators of "control", in terms of number of certain services or aggregation, leisure and assistance facilities available over the territory, implicitly assuming that a certain number of such facilities (with respect to the surface of the area or the population density) is a good proxy of potential usability in a metropolitan context such as the one of Milan. This tripartite division (physical, economic and social) seems to be in line also with the recent report by Eurocities on *Social Exclusion and Inequalities in European Cities*, which enhances itself the importance of considering a multidimensional approach to the issues of poverty and exclusion :

> "The main challenge of deprived neighborhoods is that they are faced with a concentration and combination of economic, social and environmental problems, cumulating in the local population experiencing an additional level of exclusion. A further problem affecting disadvantaged areas is the quality of the built environment and public infrastructure, with the quality of housing conditions, public spaces, public services and schools often being below the national or city average. This is further aggravated by a lack of basic facilities as services and retailers relocate due to the low purchasing power of the area. People living in deprived areas tend to suffer from multiple disadvantages ranging from a lack of opportunities (stemming from poor-quality schools and few local businesses), to low aspiration levels (due to a lack of positive role models), to reduced mobility and low levels of political participation. […] A negative image is

often associated with these areas, often through media reports focusing on criminality and social problems. As a consequence, local inhabitants are often stigmatized to the point that it is more difficult for them to find a job" (Eurocities 2010, p. 20)

1.3. Space and poverty in Milan: an archipelago model

With respect to the linkage between space and poverty in Milan, the existing literature (mostly sociological) allows us to draw some considerations in terms of facts, concepts and suggested indicators.

1.3.1. Facts

In terms of facts, poverty in Milan seems to reflect a settlement logic based on a sort of "archipelago" model rather than to a more traditional "core-periphery" model: this model includes, in fact, some *micro-concentration* patterns of discomfort which justify the formation of different *social* peripheries, not necessarily geographically far away from the city, but rather inadequate in terms of ensuring access to infrastructure and services for aggregating and leisure, or environmental quality. No real "ghettos" seem to characterize the metropolitan city, since in many districts there have been significant concentrations of poor and, likewise, of non-poor. If we consider one of the most important dimensions of urban quality of life, i.e. housing[20], it is not difficult to find how its relation with the

[20] The literature reveals a strong correlation between housing poverty and urban poverty, both one-dimensional (thus related to the measurement of one aspect of the overall phenomenon) and multidimensional, for the determination of the composite measure (Townsend 1979, Gailly e Hausman 1984, Mack e Lansley 1985, Desai e Shah 1988, Muffels 1993).

space is strictly bijective, and hardly spurious. On one hand, the spatial trends (either individual choices of location, urban and social transformations, functional specialization of certain areas, pollution) seem to determine some of the actual clusters of economic poverty and foster the existing inequalities. On the other hand, the concentration of economic poverty in a neighborhood can affect the choice of settlement of an individual or a household, apparently because the different areas of the city *communicate*, both among themselves and within them, according to some other spatial factors[21]. The final outcome of a such bijective mapping between space and individuals is a rather heterogeneous *social mix*, both at the level of areas of decentralization and neighbors. The combination of spatial factors with the concentration of poverty seems to have outlined some significant trends including, for example, "trapping the elderly poor in the city, accepting fewer and fewer immigrants in the center, moving towards the hinterland many of the young new low-income families" (Mingione 2005).

1.3.2. Concepts

Before starting a data selection process, it is important to clarify the concept of *urban space*, adapting the previously mentioned theoretical assumptions to the context of Milan. As also stated in the introduction, following Chiappero-Martinetti (2011), space may primarily contribute to the process of wellbeing like many other public and private resources and, in some cases, as positive or negative multiplier. Secondly, it may be considered as direct determinant of wellbeing as well as indirect, in terms of a system (physical, economic, social) facilitating employment opportunities, relationships,

[21] As already pointed out in the introduction of this thesis, one of the most recent and interesting literature refers to the hedonic approach, which has become an established methodology in environmental economics.

accumulation of knowledge. Thirdly, space may constrain individual action (at least in a physical, social and economic form), preventing or adversely affecting the achievement of goals[22]. In Milan, these three conceptualizations of space (i.e. facilitator, determinant, constraint) are found almost in a similar proportion in the considered neighbors. In Città Studi, for instance, the widespread availability of universities (indicative of a degree of prosperity in terms of learning opportunities and aggregation capacity, for instance) is opposed to a network of public services which is strictly dependent on the university, resulting completely inadequate for local livability (Zajczyk 2005, p. 64). Similarly (and paradoxically), the area of Bovisa-Dergano is completely devoid of roads and pedestrian infrastructure in face, instead, of a system of public transport infrastructure highly efficient (Bovone e Ruggerone 2009). In other words, public transport seems to be more efficient than that private. Geographically widespread districts seem to preclude to many population groups (elderly, mothers, people who do not drive the car) access to public services within the whole area, as too far to reach by walk (urban blocks are almost ten times larger than in the city center). In some cases, the physical space in terms of opportunities, constraints and framework for action is no longer the same within the administrative boundaries: wherever possible, it seems therefore preferable to identify flexible policy levels for the most detailed level of disaggregation, such as neighbors. The case of San Siro, provided by Zajczyk, is very clear. This district is now the picture of spatial and social contradictions of Milan, since it is actually composed of two closing areas, divided by a road with a tram: "on one side the area of San Siro, which is among the richest in the city and, on the other, the "quadrilatero" of San Siro, which is now surely one of the most problematic areas in which it is evident even a perception of

[22] Chiappero-Martinetti (2011), in Gli spazi della povertà (forthcoming).

abandonment of physical place and where even those who have been allocated in public housing will not go "(p. 75).

1.3.3. Indicators and related policy recommendations

From the point of the formulation of possible indicators of the livability and quality of urban neighborhoods, the literature agrees in considering, on one hand, factors related to a strictly physical concern and, on the other hand, to socio-demographic variables and spillover effects. It is therefore convenient to choose some indicators able to catch simultaneously these three conceptualization of space, as was the case of two recent experiences related to the context of Milan and of a third one referred to Rotterdam city.

The first one, by Diappi, deals with the construction of a map of environmental sustainability in the metropolitan area of Milan, in terms of conditions of risk and opportunity. As illustrated in the introduction of the thesis, this work investigated the interaction between the social system, the economic system and the physical environment system of Milan, with two main intents. Firstly, the authors suggested a view of the city as a system of interconnected places with different functions and complementary features, in order to look for the identity of neighborhoods. Secondly, they aimed to evaluate the "quality of life", despite the difficulty of defining both the urban quality and parameters of such a quality. According to Indovina, urban quality relates to the essence and specificity of the single city and its structure is based on three groups of variables: physical environmental components, its operationalization modalities and the behavior of the inhabitants (Indovina, 1992). Such a belief is also at the basis of the annual report by Sole 24 Ore, benchmarking the 103 Italian provinces through a series of statistical data compiled in 36 charts and collected through main domains (standard of living,

business and professional services, environment and health, public policy, population, leisure)[23].

The second research, held by Zajczyk, investigated how the poverty is distributed within the former twenty areas of decentralization in Milan and whether there were areas of greater poverty intensity and concentration. As pointed out in the introduction of the thesis, she explored the relationship between space and individuals wondering whether there are differences between areas in terms of available resources and conditions of hardship or vulnerability. The goal was to define the areas within which deprivation generated intolerable situations at the individual or household level, involving the progressive deterioration of bio-psychological and cultural women and men of various ages, the loss of their social ties, degradation of their homes , their neighborhoods, towns and cities, the crisis of their habitat (Zajczyk 2005).

The third experience relates to the municipality of Rotterdam, which in 2008 launched the "Sociale Index", in order to monitor key aspects of the effectiveness of their urban regeneration policies (Colantonio 2009, 2011). Rotterdam is actually still promoting the integrated regeneration of its Southern neighborhoods, addressing social, physical, economic and cultural concerns simultaneously. In particular, the "Sociale Index" is a composite index analyzing Rotterdam's administrative neighborhoods, collecting and aggregating data concerning four main dimensions of areas and residents, including (i) personal abilities (language skills, health, income, education), (ii) living environment (level of discrimination, housing, public facilities, safety, etc.), (iii) participation (going to work/school,

[23] The full scoreboard, statistics, indices and all methodological details are available on the website http://www.ilsole24ore.com/includes2007/speciali/qualita-della-vita/scheda_finale.shtml.

social contact, social and cultural activities, etc.), and (iv) 'bonding' (mobility, 'feeling connected', etc.) (Colantonio 2009)[24].

[24] For a more detailed review of this experience please refer to Colantonio (2011). The issue of urban poverty has been frequently conceived within wider debates on *quality of life* in the urban districts and on the most suitable related indicators. Many indices are therefore available and may represent a possible reference for the definition of more sophisticated ones, even if a basic distinction between unidimensional or multidimensional should be done. For instance, the European Quality of Life Survey (EQLS), carried out in 2007 by the European Foundation for the Improvement of Living and Working Conditions (Eurofound) offered a multidimensional picture of the diverse social realities in the 27 EU Member States, providing for each of them a Public Services Index, a Neighborhood Services Index, a Health Service Index, an index measuring trust in institutions and one measuring tensions in society. Based on the analysis of these indexes, the report goes on to identify the extent to which the quality of society and public services differ between European countries. The measurement dimensions and indicators identified for each of these life domains are systematically related to various aspects of the individual quality of life as well as dimensions of social cohesion and sustainability as two major components of well-being at the societal level. Similarly, other experiences at the national level relate to the Quality of Life Project established in 1999 to provide social, economic and environmental indicators of quality of life in New Zealand's six largest cities, to the Calvert-Henderson Quality of Life Indicators (2000) and to the quality of life index in Los Angeles (updated annually by the United Way of Greater Los Angeles). The unidimensional construct was, on the other hand, the basis of three more comparative studies, which are performed annually. Firstly, the Basic Capabilities Index (BCI) – previously "Quality of Life Index"- by Social Watch, which is a simple average of three indicators: percentage of children who reach the 5th year of primary education, mortality among children under five, and percentage of child deliveries attended by skilled health personnel : http://www.socialwatch.org/node/11386 (last access: June 2010). The BCI assigns a score to each country and assesses its evolution over time for those countries for which reliable data are available. By not using income as an indicator, the BCI is consistent with a definition of poverty based on capabilities and (the denial of) human rights, thus free from the inaccuracies affecting income-based estimates. The BCI has been calculated for 176 countries, which were then grouped into categories. Secondly, the Global Quality of Living Report Global by Mercer Human Resource Consulting provides an annual City-to-City Index Comparison that summarizes the difference in the quality-of-living between any two cities: http://www.mercer.com/referencecontent.htm?idContent=1380465 (last access: June 2010). The total index is based on the following categories: consumer goods, economic environment, housing, medical and health considerations, natural environment, political and social environment, public services and transport, recreation, schools and education, socio-cultural environment. Thirdly, the Economist Intelligence Unit (EIU) provides an index based on a methodology linking the results of subjective life-satisfaction surveys to the objective determinants of quality of life across countries: http://www.economist.com/media/pdf/QUALITY_OF_LIFE.pdf (last access: June 2010). The starting point is survey results to derive the weights of the different determinants of quality of life. In particular, nine determinants were gathered: material wellbeing; health (life expectancy at birth, years); political stability and security; family life, community life, climate and geography, job security, political freedom; gender equality. Each dimension is weighted and scores are based on a

Nevertheless, the "Sociale Index" is based on a "South Pact"[25] conceived as a combination of people-based and place-based interventions to regenerate specific groups or sectors of residents living in Southern neighborhoods. In particular, local government is responsible for the *people* based actions, while sub-municipalities are responsible for those referred explicitly to *areas*.

In conclusion, it seems plausible to consider the relationship between space and poverty under at least three main approaches, considering how such relationship is mostly considered in literature as (i) bijective, (ii) hardly spurious and (iii) directly or indirectly subject to *cumulative* or contagion effects, which can greatly vary both *between* and *within* the neighborhoods. Secondly it seems plausible to choose indicators, and suggest some policies accordingly, at the most available level of detail, taking into account place-based and people-based components able to address different dimensions and domains of the phenomenon.

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scale from 0 to 10, countries being ranked from highest quality of life (highest score) to lowest, for a total of 111 countries ranked.

[25] The "South Pact" (Pact op Zuid) is the latest regeneration programme embarked upon Rotterdam municipal authorities to comprehensively regenerate the city's southern neighborhoods in an integrated fashion. As pointed out by Colantonio, at the beginning twentieth century, subsequent urban expansions of the area were characterized by an increasing specialization of the district in activities linked to the port functions. As a result, the district slowly became both physically and functionally poorly connected to Rotterdam's city centre. The trajectory of development in the Southern areas were also severely impacted by the widespread diffusion of air travel and the containerization revolution of the 1960s, which led to a substantial decline in passenger traffic between waterfronts and ports across the world and the closure of several piers and terminal liners in Rotterdam. In the Kop Van Zuid area, these innovations rendered most of the existing dock and warehousing facilities nearly useless, and shifted economic development away from the traditional port location (URBED and van Hoek, 2007).

1.4. Conceptual framework

As anticipated in the introductory part and according to the mentioned literature on Milan in this essay, individual (and household) wellbeing is explored through its potential interrelations with three different concepts of "space". i.e. physical, economic and social. These dimensions are crucial for the generation of wellbeing and should be considered in their complex interrelationships able to shape the capability set as both opportunities and constraints. From § 1.3, we know that the *control* over the assets and the ability to use such controlled goods to achieve basic functionings is crucial to discourage poverty and facilitate wellbeing. Secondly, the context of life, in terms of public and market resources, tangible and intangible, is still valuable to achieve important functionings. In terms of recommendations, it seems therefore appropriate to pay attention to the barriers (as well as facilitation factors) posed by the external environment, fostering (or discouraging) discrimination among individuals with regard to personal (presence of disability, vulnerable groups such as elders, minors) and environmental characteristics (pollution or, generally, the environmental criticality). As suggested by Dispari, it is necessary to pay attention to both resources and constraints offered and not only to the (de- contextualized) needs of individuals. On the other hand, it is important to focus on the role of the environment and of spatial relationships on the behavior of individuals.

From the mentioned studies on Milan it seems clear how the city centre is still considered the benchmark, even if the most functional mix is localized in the semi-central areas, characterized by high functional infrastructure and services, reduced drop businesses and a good cultural and professional level. Peripheries, on the other hand, seem to be characterized by a fairly widespread network of social

services, with good transportation facilities, but still dominated by moral degradation (poor urban values, micro-crime, social exclusion). The most suitable research methodology, therefore, should be able to investigate the urban space in its multiple meanings and, ultimately, should discourage the partition of neighbors into "universally rich" or "universally poor", but rather describe constraints and opportunities in relation to individuals and households.

1.4.1. Methodology

The analytical framework originally introduced by Nuvolati for the analysis of a city seems to be suitable for such purposes. It could be found as quite similar to the approach of the "city poverty profile" (Baker, Schuler, 2004), since it is based on a conceptualization of urban poverty focused on the role of the environment and on spatial relationships on individuals. Nevertheless, it encourages the definition of "poverty profiles" as combination of *three* different dimensions of the urban space (and, therefore, of three different dimensions of poverty). The first dimension is indicative of the purely *physical* linkage between poverty and space and has been built on the basis of the existing literature on *quality of life*, collected by the International Society for Quality of Life Studies (ISQOLS). Poverty is conceived as a condition of *infrastructure or services lack* in a given area and therefore the researcher may be interested, for instance, in the housing conditions, in the level of environmental criticality, in the provision of basic public services (such as education, health, culture and leisure, retailers).

The second dimension (economic) assumes that "space affects poverty in terms of social, economic and cultural environment in which the trajectories of marginality are defined" (Nuvolati 2011). This tradition of studies have taken the first moves by the theory of

social morphology of Durkheim and then from the Chicago school[26] and its studies of human ecology, which tended to evaluate biotic and cultural adaptation of the population found in the various districts, to estimate the processes of invasion, conflict and succession by different social groups. In this framework, poverty basically means the *concentration of situations of socio-economic hardship*. According to this perspective, the researcher could instead ask what are, over a certain threshold, the presence of poor population or the level of economic inequalities in the study area rather than in other parts of the city, and why this happens (because of the dearth of services, of the history of the neighborhood, of the lack of capital in the neighborhood?)[27].

Finally, the third and last dimension, ("social", or "socio-symbolic"), has been inspired from the discipline of environmental psychology[28]. Poverty is here conceived in terms of *loss of meaning of the places* and thus the researcher may ask what is, compared to a date reference threshold, the level of attachment and identity of population in the areas of interest or the pace of transformation of the same places, rather than others.

[26] Lynch (2006), Migliorini and Venini (2002), Moroni S. (2001), Rauty (1995), Saunders (1981).

[27] As pointed out by Nuvolati, in these two attempts of defining space (i.e. physical and economic), there seem to be crossed two analytical levels: in the first, attention shifts to the physicality of social phenomena, in order to find general rules; the second focuses, however, to the spatial specificity, even in historical terms, always as an explanation of social phenomena (Nuvolati 2011). Such theoretical framework suggests that poverty (and wellbeing) may assume different connotations for instance in northern peripheries, rather than in the southern, in Milan, because the two have specific morphological profiles and have been largely characterized by different events, eventually behind the same strictly economic and geographical conditions.

[28] Bianchi E. and Perussia F. (1982), Bonnes M., Bonaiuto M. and Lee T. (2004), Migliorini L. and Venini L. (2002).

In short, the first dimension (physical) adapts the space to a *functional organization* and to the provision of basic services and infrastructure. Poverty, therefore, means lack of private and public spaces, poor quality building maintenance, poor accessibility of services, spatio-temporal isolation of the neighborhood with respect to the city, poor environmental quality. The second dimension (economic) portrays the physical space as a *container of hardship and social marginalization* and therefore poverty is characterized by common social pathologies (drug addiction, crime, prostitution, diffusion of poors and inequalities). Finally, the third dimension (social) refers to physical space as the *basis for the symbolic representation and spontaneous aggregation and care* between people[29]. In this case, poverty means lack of benchmarks, anonymous spaces, frequent turnover of business, lack of aggregation and care services at the neighbor level. Based on the different existing allocation in these three dimensions, eight profiles of areas have been portrayed. The desired hypothesis to verify is whether, and to what extent, these profiles are able to capture the complexity of conditions that exist in reality, generated between physical, economic and social conditions. It must be noted, however, that these characterizations are defined *à priori*, with the intent to verify their empirical robustness.

1.4.2. Data selection

The choice of indicators has been guided by the previously mentioned conceptual framework and according to criteria of relevance, accuracy, timeliness, accessibility and coherence. In general, the strengths and weaknesses of composite indicators largely

[29] For a comprehensive overview on the meaning of the social (symbolic) dimension in Milan and on motivations leading to focus on some indicators rather than others, please refer to Mauri (2011), Spazio e simboli, in Gli spazi della povertà (forthcoming).

derive from the quality of the underlying variables. The range of sub-domains, or pillars (housing and environment, inequality, assistance, etc.) within each multidimensional sub-construct (physical, economic and social) is covered in a balanced way, as we will see further in the correlation analysis. Secondly, almost all data have been collected from "official sources" (e.g. national statistical offices or other public and private local bodies working under national statistical regulations or codes of conduct) with respect to the same reference year, that is 2006. Different sources have been taken into account (not necessarily the most accessible) and therefore many quality dimensions. Thirdly, coherence over time and across the areas is guaranteed, since data are based on common (previously defined) concepts, definitions, classifications and methodology. Data selection process has been discussed and completed by referring to the existing mentioned literature. However, the proposed scheme is based on a partially subjective reading (especially in terms of data selection, normalization and weighting).

1.4.3. Multivariate analysis

Even though the aim of this essay is not to rank the 20 neighbors of Milan, but rather to combine three different composite indicators, it seems convenient to pay attention to the interrelations between the elementary indicators and to the underlying nature of the data. This preliminary step is helpful in assessing the suitability of the data set and to provide an understanding of the implications of the methodological choices, e.g. weighting and aggregation, during the construction phase of the composite indicators. However, most of the multivariate analysis techniques seem to be not reliable if the sample is small compared to the number of indicators (as the present case is), since "results will not have known statistical properties" (OECD 2008,

p. 26)[30]. I have therefore considered the overall correlation nested structure within each composite indicator of wellbeing (physical, economic and social) and assigned a weight on the basis of such results. Secondly, because of the correlation structure (available in the appendix of this essay) and according to experts recommendations provided in the following paragraphs, some of the most commonly used tools of multivariate analysis are not useful, since they risk to be misleading for the interpretation of the results. It seems however appropriate to check for a robustness analysis of the composite indices, particularly adopting different sources of uncertainty in the input factors, such as : (a) standardization of the row indicators, instead of the min- max normalization; (b) a weighting scheme based of the equal importance of the individual indicators, rather than the equal one of the sub-domains; (c) a geometric (rather than linear) aggregation rule, in order to do not account for full compensability; (d) exclusion of one of the pillars (or sub-domains) at the time, from the total computation of the composite. As anticipated in the introductory part of this essay, this will be the subject of § 1.7.

[30] The question of how many cases (or countries, neighbors, areas) are necessary to perform Principal Component Analysis or Factor Analysis has no scientific answer and methodologists'opinions differ. Alternative arbitrary rules of thumb in descending order of popularity include the following: rule of 10 (there should be at least 10 cases for each variable); 3:1 ratio (the cases-to-variables ratio should be no lower than 3); 5:1 ratio, recommended by Bryant & Yarnold, 1995; Nunnaly, 1978, Gorsuch, 1983 (the cases-to-variables ratio should be no lower than 5); rule of 100 (the number of cases should be the larger of "5 × number of variables" and 100); rule of 150, recommended by Hutcheson & Sofroniou, 1999 (at least 150 - 300 cases, closer to 150 when there are a few highly correlated variables); rule of 200, recommended by Gorsuch, 1983 (there should be at least 200 cases, regardless of the cases-to-variables ratio); significance rule by Lawley & Maxwell, 1971 (there should be 51 more cases than the number of variables, to support chi-square testing). It is important to note that these rules are not mutually exclusive. Bryant & Yarnold (1995), for instance, endorse both the cases-to variables ratios and the Rule of 200.

1.4.4. The physical dimension (PW)

The composite indicator of the physical wellbeing (2006 PW) is composed by 2 indices and 10 variables grouped into two domains or sub-dimensions (housing and environment, infrastructure and services). The composite index is the weighted sum of these sub-components, normalized according to the land size of each area (in square meters) and finally standardized taking into account the minimum and the maximum values assumed by the indicators. As widely performed in literature, standardization allows to compare data coming from multiple sources and expressed in different units. Raw data have been taken from the SIT (the official geographic information system of the municipality of Milan), from the General Census of Population 2001 (especially as regards historical buildings including museums, schools, hospitals), from local real estate agencies (such as Gabetti), from public health agencies and foundations. Fondazione Lombardia per l'Ambiente has kindly provided part of the information concerning the Housing and Environment sub-pillar. More information (e.g. the number of cinemas) were obtained by consulting specialized websites. In the next paragraphs the main considerations of relevance are explained[31].

1.4.4.1. Housing and environment

Housing, in Milan as in many other cities, is crucial for several reasons. Today, perhaps more than before, the housing market exerts a

[31] All the correlation scores (on the basis of which the individual indicators have been chosen and aggregated) are provided in the appendix. The most common rule of thumb suggested by *Handbook on Costructing Composite Indicators* (OECD, 2008) recommends a correlation value between 0.4 and 0.8. If the correlation between two indicators is over 0.9, it is recommended to sum the two or even to split equally the weight, according to the nested structure of the sub-domain. On the other hand, whereas two indicators show a very low correlation this is indicative of their independence, thus are considering two different aspects of relevance with respect to the same composite phenomenon (physical wellbeing, for instance).

considerable pressure on middle-class families as a result of rising rents and the increase value of houses, extending the risk of poverty to middle or low income families, not previously involved in the problem (young couples, temporary workers, non-resident students, families and single parents, elderly). Housing poverty ranges from poor quality housing (structural deficits, lack of services), to the deprivation of personal accommodation (such as living in temporary accommodation, illegal rentals), to the discomfort arising from the relationship between the house and its inhabitants (overcrowding, forced cohabitation, domestic violence), to homelessness, the most extreme form of housing exclusion. Inadequate housing is sometimes concentrated in specific neighborhoods. As reported by Eurocities, in Budapest's Magdolna district (HU), 21% of houses do not have basic amenities and 40% are overcrowded[32]. The data from Ghent also suggest that in some neighborhoods, the rate of uninhabitable housing is very high[33] (Social Exclusion and Inequalities in European Cities, p. 18). In this work, housing has been discussed mainly through the main issue of *quality*. On one hand, housing costs (such as average rent/ month and price/ square meter for sale) are a good proxy of the livability of the area, supposing that market properly reflects a significant number of information such as the overall neighbor quality, the closeness to primary services and infrastructure for mobility, the eventual tendencies of requalification or area conversion, etc. An area registering a high price for rent and/ or for sale is therefore supposed to be relatively rich with respect to the others and therefore positively

[32] Regeneration Programme in Budapest – Józsefváros, Magdolna Quarter Programme 2007 available at: www.rev8.hu/csatolmanyok/eng_dokok/eng_dokok_2.pdf (last access : June 2010).

[33] Local Social Policy in Ghent, (2008) Strategic long-range plan 2008-2013, summary in English, available at: www.lokaalsociaalbeleidgent.be/documenten/publicaties%20LSB-Gent/LSB-plan%20Gent.pdf (last access : June 2010).

contributes to the overall physical wellbeing in the area (positive polarity). According to Ufficio Studio Gabetti, in 2006 residential values in Milan have increased by 1,7%. The map looked pretty heterogeneous, with many neighborhoods experiencing significant revaluations, in some cases exceeding the nominal share of 5%. On the other hand, a relatively high crowding index is a good proxy of the (scarce) livability, since it measures the available space per individual in a sort of "representative house" (negative polarity). In the Italian context, where it is clear the trend towards reducing the number of household members, housing overcrowding seems to correlate with higher intensity of poverty[34], since in metropolitan cities, such as Milan, crowding is often associated with situations of cohabitation.

Environmental vulnerability is one of the most critical factors in terms of effective assessment, as hardly fits the strict administrative boundaries (especially at the neighbor level) and, above all, takes into account different pressures and contagion. In other words, it does not seem very likely (nor useful) to imagine that area *x* is polluted more (or less) than the neighboring area *y* and that factors such as pollution from traffic or noise does not have a chance to spread beyond the administrative boundaries. In this work, I computed a score of environmental criticality for each of the former 20 areas of decentralization of Milan, on the basis of a research report recently published by Fondazione Lombardia per l'Ambiente and Municipality of Milan, dealing with a target-oriented assessment of air quality and the exposure to risk of the population of Milan. The report collects in a map the total emission pressures[35] for each grid cell[36] and, secondly,

[34] The correlation exhibited between the crowding index and the index of poverty diffusion is in fact particularly high and precisely registers a value of 0.9115.

[35] Emissions from traffic, from point sources, both civil and industrial.

[36] Each square cell has a side corresponding to 250 meters.

it draws a map of vulnerabilities in the territory[37] intersecting them with the pressures surveyed, in order to obtain a map of the critical points that takes into account the potential physical danger and sensitivity of receptors. I have then assigned a score of environmental criticality to each of 20 areas, based on the weighting of the various cells that compose them. This score was finally combined with an index measuring the availability of public green spaces over the whole land size. Obviously, if a high score in terms of environmental criticality index is synonym of poor quality of life (negative polarity), on the contrary the presence of green spaces may be indicative of a greater well-being in terms of quality of life, leisure opportunities and relationships (positive polarity). According to the correlation structure, the two indicators seem to be weakly related, meaning they explore two different dimensions within the same "environment" sub-pillar. On the other hand, the whole consistency within the larger pillar "housing and environment" holds, as provided in the appendix. Therefore, within the overall composite 2006 PW, I have assigned to each of the five individual indicators (three related to housing and two to environment) the same weight, that is 1/10.

1.4.4.2. Infrastructure and services

There are many types of infrastructure and services available at the neighbor area that could be taken into account. The choice fell on seven variables that cover important aspects for the quality of life and positively impact the livability (positive polarity). The composite index takes into account, firstly, the presence of educational infrastructure, health, cultural and commercial services. In the latter, the number of medium-large retails and the number of banks have been included as factors which positively affects the quality of life (positive polarity), since on one hand they offer a greatest (and in

[37] Schools, hospitals or areas with particular population density.

most cases cheaper) offer of goods and, on the other hand, satisfy ordinary credit needs, such as investments, loans, etc. They have been considered as proxies of the *physical* dimension, rather than social, since they do not properly foster the facilitation of social cohesion, opportunities for socializing, consolidation of relations of solidarity, like for instance the stores at the pure neighbor level do. Since the number of medium-large retails and the number of banks exhibit a very high correlation (0.9712), they have been recorded as a unique measure, in order to avoid the risk of a double counting. Secondly, it is considered the dimension of mobility and transport facilities, through the presence at the local level of tram stops, subways or railways and the availability of car and interchange parking. The importance of the last group relies on the capability of "being mobile", as a precondition for full participation in society, as places such as schools, offices, shops, sports and leisure facilities are often dispersed across cities. Local public transport fulfils a crucial role in providing affordable and sustainable mobility. However, these can be "costly", for instance if not systematically available in the entire urban area. A number of factors in urban mobility can lead to worsening social exclusion: some residential areas are not well serviced by public transport; for safety reasons, some groups, such as women and the elderly, may feel concerned over using quite far away public transport at certain times, such as late at night; suburbanization and disperse patterns of development (such as out-of-town shopping centers and office buildings) require adequate public transport systems. Without these, the risk is to exclude those without a private car from fully benefitting, while increasing car-dependency which can lead to unsustainable traffic congestion and pollution (Eurocities 2009). Since all the indicators exhibit a significant correlation, I have assigned, within the overall composite 2006 PW, to each of the seven individual

indicators (four related to services and three to infrastructure) the same weight, that is 1/14.

1.4.5. The economic dimension (EW)

The composite indicator of the economic wellbeing (2006 EW index) has been estimated using as proxies, respectively, a measure of inequality in the income distribution (Gini coefficient) and the index of economic poverty diffusion. Both measures have been built taking into account the average per capita income, weighted by the equivalent number of households components. The original information on income has been extracted from AmeRIcA (Anagrafe milanese e Redditi Individuali con Archivi)[38] dataset, which is property of the Municipality of Milan. Since we have implicitly assumed that a high per capita income is associated to a state of economic wellbeing, both the information on inequality and poverty included in the composite measure are characterized by a negative polarity. Secondly, the two indices have been standardized (although already ordered by construction from 0 to 1), in order to properly combine two measures with a quite different variance.

1.4.5.1. Economic inequality

Gini coefficient varies, by construction, between 0 and 1, where 0 corresponds to a state of perfect equality and 1 corresponds to the opposite situation of maximum inequality, or total concentration of income. Since I did not have access to data on individuals, I have used the average value of the corresponding percentile of income. The Gini index has been calculated as an approximation of the inequality

[38] In addition to providing very detailed information on the characteristics of taxpayers registries, the database provides information on income declared for tax purposes in the statements of income and net of tax. As such, it is naturally influenced by the characteristics of tax law and the presence of tax evasion. It is, however, the only available source allowing so detailed information on the distribution of incomes.

among the 100 classes of income, explicitly excluding the *within* component. It was assumed that all individuals within a given centile have the same total income, equal to the average income of the same percentile.

1.4.5.2. Poverty diffusion

The index of poverty diffusion measures the ratio between the number of poor identified according to a poverty threshold (conventionally fixed in 60% of the median income distribution in Milan), and the total number of individual residents. The index ranges from 0 to 1 and its interpretation is straightforward, being nothing more than the percentage of poor.

1.4.6. The social dimension (SW)

The composite indicator of the social wellbeing (2006 SW index) consists of a weighted sum of four sub-domains (or pillars), respectively related to safety, assistance, aggregation and leisure. This dimension is supposed to be crucial in the process of creation of a community identity, since it facilitates, even indirectly, social cohesion among residents. Participation in cultural initiatives, association and solidarity may help, in fact, to equip people with "soft skills", such as team work, communication, responsibility-taking and problem solving, therefore increasing their employability. For these reasons, the sub-domains (or pillars) were normalized by the number of residents or particular groups, depending on the public service provided (such as households, elderly people, children). Correlation matrix, on the basis of which the elementary indicators have been selected and aggregated, is provided in the appendix.

1.4.6.1. Safety

In this domain they have been taken into account the local structures of police in each area, compared to the resident population. There were included in the count municipal police, carabinieri and state police with the exception, however, of the national civil defense, military and financial police. The basic idea is that these structures represent an important element of security and control of the area, with a social function also. The polarity is, straightforward, positive.

1.4.6.2. Assistance

The "assistance" pillar collects information from six positively polarized indicators, weighted by the population of reference. In particular, four variables have been normalized by total population: pharmacies; doormen, social guardians and "portierati"; care centers for disabled people[39] ; mental health centers. Center for children, minors and family services were related to families, while those centers for elderly assistance (even daily services, multitasking laboratories, public accommodations managed by the local municipality or affiliated) were only related to elders (over 65 years of age). These structures, in most cases, provide accommodation for not self-sufficient people, who cannot rely on their own family or other social safety nets or solidarity initiatives. Nevertheless, offering daytime activities involving, as operators, a large number of volunteers, they respond efficiently to the needs of a population which is not affected by the most serious social pathologies but could be considered, however, at *risk* of poverty (people living alone, families just below the poverty line). The presence in a given area of a large number of care facilities dedicated to certain groups more than others

[39] Including those offering daily services, directly and indirectly managed by the municipality of Milan, providing training services to autonomy.

may therefore indicate a significant percentage of situations of distress. Also, these centers have to be considered strategic in reducing the risk of vulnerability at the local level, since a growing number of families seems to be affected by relatively minor (but persistent) reduction of wellbeing. According to the correlation structure, the elementary indicators seem to be weakly correlated, partly because of different normalization rules (for instance some areas register a very high number of elders, with respect to the overall population), allowing to include in the composite index of the "assistance pillar" different information. I have therefore assigned to each of them (within the overall composite 2006 SW) the same weight, that is 1/24.

1.4.6.3. Aggregation

The aggregation pillar (or sub-domain) considers those facilities promoting exchanges between people, in terms of reports, ideas and projects. Among the possible indicators that may positively fall within this definition there were considered the following categories: stores at the strictly neighbor level, extrapolating the most common types but also more significant in symbolic terms[40]; religious centers; youth centers (CAG) and Aggregation Multi-Function Centers (CAM); associations; sports facilities (such as playgrounds, bowling greens, volleyball, basketball multipurpose fields). All have been normalized by the number of residents in each area. According to the correlation structure, some elementary indicators seem to be significantly correlated (without exceeding the critical value of 0.90), while others exhibit a weaker correlation. It is therefore possible to conclude, similarly to the previous sub-pillar, that the composite index of the

[40] There were included, in particular, the following categories: newsstands, bookstores, bars, tobacco shops, delicatessens, grocers, butchers, fishmongers, supermarkets, grocery stores, bakeries, street vendors selling fruit, vegetables and meat, sellers of no fresh food, sellers of beverages.

"aggregation" domain collects different types of information. I have therefore assigned to each of them the same weight, that is 1/20.

1.4.6.4. Leisure

This index is a sum of the number of cultural centers and of the number of libraries in each area (including district libraries with and without the loan point, and the media libraries), normalized by population. Cultural events, as well as leisure and sporting activities, are a vital aspect of urban life. Participation in these activities offers city residents opportunities to be included in society, with positive effects on wellbeing and self-development. Systematic exclusion from cultural activities can reinforce feelings of social exclusion, marginalization and distance from mainstream society.

1.5. Composition of multidimensional poverty profiles

The need to create composite indicators arises in many situations: when the survey covers individuals or households, institutions, departments and territorial units, regions, countries, in order to explore objective or subjective characteristics. In general, the synthesis has the advantage of avoiding reporting and interpretation of a large number of elementary indicators to carry out simpler and faster analysis, especially in comparative terms (Maggino 2004). A composite indicator undoubtedly facilitate communication with general public and promote accountability but, on the contrary, may lead to inappropriate policies if dimensions of performance that are difficult to measure are ignored and if the construction process is not transparent (OECD 2008, p. 14). In this work, the three composites (2006PW, 2006EW and 2006SW) have been computed for each of the

former areas of decentralization of Milan and combined in order to identify the corresponding poverty profile. I have firstly adapted the purely theoretical taxonomy introduced by Nuvolati (2011) to the context of Milan, on the basis of the combination of three composite measures.

Table 1 – Combination of dimensions

	1	2	3	4
2006 PW index	Positive	Positive	Positive	Positive
2006 EW index	Positive	Positive	Negative	Negative
2006 SW index	Positive	Negative	Negative	Positive
	5	6	7	8
2006 PW index	Negative	Negative	Negative	Negative
2006 EW index	Negative	Negative	Positive	Positive
2006 SW index	Positive	Negative	Negative	Positive

Source : elaboration of the author (adapted from Nuvolati, 2011).

Table 2 – Poverty profiles

1	Well equipped area, both in terms of infrastructure and basic services, facilities for aggregation and assistance to groups at risk of marginalization. Low environmental criticality, good quality of housing and reduced poverty / inequality.
2	Well equipped area in terms of infrastructure and basic services, but lacking in terms of services for the aggregation and assistance to groups at risk of marginalization. Low environmental criticality, good quality of housing and reduced poverty / inequality.
3	Well equipped area in terms of infrastructure and basic services, but lacking in terms of services for the aggregation and assistance to groups at risk of marginalization. Low environmental criticality, good quality of housing and high poverty / inequality.
4	Well equipped area, both in terms of infrastructure and basic services, facilities for aggregation and assistance to groups at risk of marginalization. Low environmental criticality, good quality of housing and high poverty / inequality.
5	Well equipped area in terms of services for the aggregation and assistance to groups at risk of marginalization, but lacking in terms of infrastructure and basic services. High environmental criticality, poor quality of housing and high poverty / inequality.
6	Not well equipped area, both in terms of infrastructure and basic services, facilities for aggregation and assistance to groups at risk of marginalization. High environmental criticality, poor quality of housing and high poverty / inequality.
7	Not well equipped area, both in terms of infrastructure and basic services, facilities for aggregation and assistance to groups at risk of marginalization. High environmental criticality, poor quality of housing, low poverty / inequality.
8	Well equipped area in terms of services for the aggregation and assistance to groups at risk of marginalization, but lacking in terms of infrastructure and basic services. High environmental criticality, poor quality of housing and low poverty / inequality.

Source : elaboration of the author (adapted from Nuvolati, 2011).

One of the most important outcome of a such (revisited) typology relies on the research aim and therefore on the nature of the score board. Rather than a pure ranking (where the poorest neighbors usually gain the very last positions), this work emphasizes the combination between individual and spatial determinants of poverty, and check for any similarities between neighbors, in order to enhance points of weakness and strength and encourage "area-based" policy interventions, both in their "place" and "people" components. It is important to note that compensability occurred only within the same dimension of poverty (for instance with respect to the individual indicators related to housing, environment, services and commercial facilities), rather than be fully adopted in a sort of unidimensional "poverty score" and subsequent poverty ranking.

As mentioned, the construction of the three composite indicators of wellbeing has been based on the correlation structure behind the elementary indicators and on the criteria of relevance expressed in the previous paragraphs. Normalization procedure has been differentiated, since the elementary indicators of the 2006 PW index have been normalized by the land size (expressed in square meters), while those of the 2006 SW index by the overall population (or segments of population). The 2006 EW index, based on the per capita average income, has to be considered as already normalized. Secondly, I have considered an equal weight for each of the pillars, or sub-domains (e.g. housing and environment; infrastructure and services) and, consequently, a different weight to elementary indicators (e.g. crowding index, the housing purchase price per square meter, educational facilities, etc.)[41]. In order to sum and facilitate comparisons between areas, the values have been then standardized

[41] For a consultation of the weighting schemes adopted please refer to the appendix.

with reference to minimum and maximum values reached by the corresponding indicator (min-max criteria).

Each composite indicator (and also the individual indicators and the pillars) ranges therefore from zero to one, with zero associated with the condition of worst well being, or most severe poverty. To still facilitate comparisons, the indicators entering in the composition of the corresponding index with a negative polarity (e.g. crowding index, the index of environmental criticality, the Gini index, the index of poverty diffusion) were replaced by their complementary value.

1.6. Results

Tables A.1.8, A.1.9 and A.1.10 in the appendix illustrate the results per each of the three dimensions considered. The cells colored in grey show systematically the presence of values lower than the corresponding threshold level (conventionally fixed in the median of the distribution) and therefore considered as proxy of the "absence" of the corresponding asset or endowment.

The city center represents the highest reference point in terms of wellbeing, even with some notable exceptions. Certainly it is in terms of infrastructure, basic services and housing, but not in environmental quality terms. The diffusion of poverty is minimal but, not surprisingly, inequality is greatest[42]. The situation is different in relation to the social dimension: the city center is still the benchmark with respect to security, leisure and certain components of aggregation. It is no longer, however, with respect to the "assistance"

[42] In the city center, Gini coefficient is equal to 0.604, while the lowest values (around 0.41) are scored in the peripheries. Forlanini-Taliedo, on the other hand, registers the lowest Gini (0.411), but the highest index of poverty diffusion (0,206). All values are provided in the appendix.

sub-domain, probably because of the minimal presence of social distress.

Standardized values of the three composite indices of wellbeing (physical, economic and social) are finally provided in Table A.1.11, together with the corresponding poverty profiles.

In general, the empirical analysis revealed a very weak presence of both profiles 1 and 6 (respectively characterized by the presence or absence of the *all* dimensions considered), with respect to a more strong spatial concentration of some "mixed" profiles (i.e. characterized by at least one positive or negative dimension). It is, in particular, the cases of those areas characterized by the profile type 3 (with positive physical dimension and negative economic and social dimensions) and the profile type 8 (with negative physical dimension and positive economic and positive social dimensions). The remaining areas correspond to profiles 2, 4 and 7, while areas characterized by profile 5 have not been found at all.

1.6.1. Profile 1: not poor

The areas included in the profile 1 are Centro Storico (the city center) and Niguarda- Ca' Granda- Bicocca, registering a positive value of all the three dimensions of wellbeing. However, the two areas are not properly comparable in terms of the economic composite indicator of wellbeing: if the city center registers a standardized value which coincides with the median (0.446), Niguarda-Bicocca scores one of the highest (0.944). The difference is related to the most severe level of inequality in Centro Storico with respect to the whole city, which is not fully balanced with a relatively low index of poverty diffusion. On the other hand, Niguarda- Bicocca registers one of the lowest level of inequality and an index of poverty diffusion which is slightly above the median. These areas are expected to be well

equipped, both in terms of basic services and facilities for aggregation and assistance to groups at risk of marginalization. Focusing on the elementary indices, it is easy to understand how the composite indicator of physical wellbeing is positively influenced by a strong presence of health services, cultural and sporting facilities, tram stops and the greatest availability of public green spaces with respect to the corresponding land size. The value of the composite indicator well above the median is dependent, on the other hand, also on some other indicators which are just below the median values, without being "critical": in the area of Niguarda- Ca' Granda- Bicocca, for instance, the average price per square meter for sale and the average rent per month is slightly below the median and also the exposure to pollution seems to be above the median, even if not critical. This latter indicator affects even more negatively also the composite indicator of the physical wellbeing registered in the city center. The composite indicator of the social wellbeing is maximized in the city center, even with some relevant exceptions, which may be due to a demographic trend or a relative absence of a certain typology of social disadvantage. For instance, the city center scores a number of centers for minors and families, for disabled, for mental care (CPS) and a number of multi-purpose sporting fields which are below the median with respect to the whole city. On the other hand, the overall maximum value of the composite indicator of the social wellbeing, both the city center and Niguarda- Bicocca, is positively affected by a mix of some determinants such as the presence of police stations, centers for assistance to many groups at risk of marginalization (elderly, disabled, minors), associations, multi-purpose centers for aggregation and sports, libraries and cultural centers.

1.6.2. Profile 2: poor in the social dimension

Areas included in the profile 2 are expected to be characterized by a good equipment in terms of infrastructure and basic services, but lacking in terms of services for the aggregation and assistance to groups at risk of marginalization. Combination between the availability of basic services, housing quality and environmental safety (in terms of public green available and general index of criticality) is over the median value and combination between the economic inequality level (in terms of income disparities) and poverty diffusion is not critical. In Milan, this is the case of Lorenteggio-Inganni. The composite indicator of the physical wellbeing is mainly positively influenced by a relatively good quality of housing (measured by a low crowding index and an average price for sale slightly above the median), by the availability of education, health, cultural and commercial facilities, parkings and public green spaces, such as parks. On the other hand, the exposure to pollution seems to be critical with respect to other areas of Milan. The composite indicator of the economic wellbeing is positively affected by a relative low index of poverty diffusion and a Gini slightly below the median value. The composite indicator of the social wellbeing finally registers many critical values below the corresponding median, since the area seems to be not well equipped in terms of police stations, assistance to most vulnerable groups (elders, minors, families, disabled), religious centers, associations.

1.6.3. Profile 3: poor in the economic and social dimensions

Areas included in the profile 3 are expected to be characterized by a good equipment in terms of infrastructure and basic services, but lacking in terms of services for the aggregation and assistance to groups at risk of marginalization. Combination between the

availability of basic services, housing quality and environmental safety (in terms of public green available and general index of criticality) is over the median value, while combination between the economic inequality level (in terms of income disparities) and poverty diffusion is relatively critical. It is the case of almost all the areas around the city center, such as Venezia- Buenos Ayres, Vittoria- Romana- Molise, Ticinese- Genova, Magenta-Sempione, Città Studi- Argonne and, in the extreme north-west periphery, San Siro- Q8- Gallaratese. It would be clearly misleading to consider all areas equally, as can be seen from the individual indicators. With reference to the composite indicator 2006PW, for example, the six areas appear broadly divided into two main blocks, both characterized by a positive value (i.e. above the median). On one hand, those areas close to the city center, such as Venezia- Buenos Ayres, Vittoria- Romana- Molise, Ticinese- Genova, Magenta-Sempione are characterized by a composite indicator *clearly* above the median. The components that most affect the outcome are related to a high index of housing quality and availability of commercial facilities, services and infrastructure. However, these areas seem to be particularly exposed to pollution and suffer from a very low availability of public green with respect to the corresponding land size. On the other hand, San Siro- Q8- Gallaratese, show values of housing quality which are lower than average (in particular, the rent is below the median, compared with an average price for sale slightly lower than that recorded in the city center) and a lack of availability of services, shopping facilities and transport infrastructure. Conversely, San Siro registers a higher environmental quality, both in terms of availability of green areas and reduced exposure to pollution. With reference to the composite indicator 2006EW, all the areas seem to be negatively influenced by income inequality, measured by a Gini coefficient above the median (compared to a modest share of poverty) The only exception is San

Siro-Gallaratese, which combines a relative high level of economic disparities with a high index of poverty diffusion. This result seems to confirm also the previous and already mentioned research by Zajczyk, particularly claiming that this area is substantially divided into non-poors and extremely poors (p. 75). Finally, with reference to the composite indicator 2006SW, we are in the presence of strong heterogeneity between the areas considered. All, except Vittoria-Romana- Molise and Ticinese- Genova, are characterized, in relation to population, by a low number of police stations, "portierati" and health porters, centers for children and vulnerable, religious centers, multi-purpose and youth centers. Conversely, the only area located in the suburbs (San Siro), shows a greater availability of centers for elderly (offering daily and residential services), multi-purpose sporting fields, cultural centers and libraries at the district level. In general, compared with the whole city (particularly with those areas scoring a social composite indicator below the median, such as profiles 2, 6 and 7), areas characterized by profile 3 seem to share a critical value of the "assistance" and "aggregation" sub-domains.

1.6.4. Profile 4: poor in the economic dimension

Areas included in the profile 4 are expected to be characterized by a good equipment, both in terms of basic services and facilities for aggregation and assistance to groups at risk of marginalization. On the other hand, in these areas it is also registered an overall value of the economic dimension relatively below the median (i.e. negative), as a result of high economic inequality (in terms of income disparities) and/or critical poverty diffusion. It is the case of one of the closest areas to the city center, Greco- Zara. The composite indicator of the physical wellbeing seems to be positively affected by an overall good housing quality, the availability of different services and

infrastructure, while environmental quality seems to be poor in terms of scarce availability of public green spaces and, even more, of an increasing exposure to pollution. With reference to the composite indicator of the economic wellbeing, the area is negatively influenced by a high level of income disparities and by a relative low level of poverty diffusion. Finally, the composite indicator of the social indicator is very slightly above the median, thus revealing a quite scarce presence and availability of many services of care and aggregation, even if sufficient with respect to the population density. On the other hand, the area is well equipped with pharmacies, shops at the neighbor level, multi-purpose sporting and youth centers, associations, libraries and cultural facilities.

1.6.5. Profile 6: poor in all dimensions

The areas included in the profile 6 are located in the north part of Milan, both in first (Bovisa- Dergano) and second (Monza-Padova) peripheries. These areas register values of all the three composite indicators (physical, economic and social) below the median and, according to the previously mentioned typology, are expected to be not well equipped, both in terms of basic services and facilities for aggregation and assistance to groups at risk of marginalization. On the other hand, these areas are expected to be characterized by a very high level of income disparities and/ or poverty diffusion. The composite indicator of the physical wellbeing seems to be negatively characterized by a scarce quality of housing, partly due to two of the most critical values of the crowding index and to a relatively low price per square meter for houses sale. Both these results may be explained by the high demand of housing in the area, particularly due to university students. Anyway, the composite seems to be negatively influenced also by a very scarce availability of health services, sports and cultural facilities, parking and public green spaces. The economic

wellbeing, on the other hand, is mostly influenced by a very high concentration of poors in the area, while inequality falls slightly below the median value. Finally, the composite indicator of the social wellbeing in Bovisa- Dergano is heavily determined by the lowest availability of services for elders, associations and multi-purpose fields for youth aggregation, with respect to the whole city. Similarly, Monza- Padova lacks many services for assistance to most vulnerable groups (even informal), for aggregation and leisure.

1.6.6. Profile 7: poor in the physical and social dimensions

Areas included in the profile 7 are expected to be characterized by a scarce equipment, both in terms of services for the aggregation, assistance to groups at risk of marginalization and basic services. On the other hand, the level of income disparities and/or poverty diffusion seems to be not particularly critical. This is the case of Corvetto- Rogoredo- Vigentina even if, looking at the individual indicators, this area is rather comparable to those of the profile 6. According to the composite indicator of the physical wellbeing, the area registers in fact very low levels of almost all the indices considered, with the exception of that measuring the exposure to pollution, which is the lowest in the whole Milan. The composite indicator of the economic wellbeing is slightly above the median value (registering a score of 0.447 over a median value of 0.445), because of the combination of a value of income inequality substantially around the mean (0.805, with respect to the threshold of 0.809) with a poverty diffusion index not particularly low, even if below the median, with respect to other areas. Finally, the composite indicator of the social wellbeing seems to be negatively influenced by a scarce availability of police stations, pharmacies, cultural services and libraries, centers for minors and vulnerable families, stores at the local level and associations.

1.6.7. Profile 8: poor in the physical dimension

Areas included in the profile 8 are expected to be characterized by a good equipment in terms of services for the aggregation and assistance to groups at risk of marginalization, but lacking in terms of infrastructure and basic services. Combination between services of care, centers for assistance to more vulnerable groups, aggregation and safety facilities is over the median value, while basic services and transport facilities seem to be lacking. In these areas it is also registered an overall value of the economic dimension relatively above the median (i.e. positive), thus combination between the economic inequality level (in terms of income disparities) and poverty diffusion is not critical as in the case of the previously mentioned profile 3. It is the case of almost all the extreme peripheries around the city center, such as Affori- Bruzzano- Comasina, Feltre-Ortica, Forlanini-Taliedo, Chiesa Rossa- Gratosoglio, Barona- Ronchetto, Baggio- Forze Armate and Vialba- Certosa-Quarto Oggiaro. With reference to the physical dimension, the seven areas seem to be all negatively characterized by a poor quality of housing (high crowding index, relatively low price for sale and rent, probably because of the geographic distance from the city center), by a consistent lack of basic services, with respect to other areas in Milan (especially schools, health centers, transport infrastructure, parking) and by a very scarce presence of commercial structures, such as banks and large retails. On the other hand, environmental criticality is not as high as in other areas in the city center, because of a greater availability of public green spaces and, even more, of a reduced exposure to pollution. With reference to the economic dimension, all seven areas seem to be negatively influenced by the factor of poverty diffusion, which is clearly above the median (compared to a modest income inequality), with the only exception of Feltre- Carnia- Ortica. Finally, with

reference to the social dimension (positive), the components that most affect the outcome are related to the availability of police stations, of "portierati" and informal care networks at the neighbor level, of centers for disabled, of religious centers and of multi-purpose sporting centers. Of course the allocation of such services is heterogeneous since, for instance, Chiesa Rossa- Gratosoglio records a particular high presence of aggregation services (even if lacks some stores and shops), while Barona- Ronchetto Naviglio registers (perhaps because of a different demand) the most diversified supply of services of assistance to the most vulnerable groups (such as disabled, elderly, minors and families) and Affori-Bruzzano and Vialba- Quarto Oggiaro are characterized by a strong presence of cultural centers and libraries at the neighbor level. The latter is also the benchmark for the availability of informal care networks, in terms of presence of "portierati", guardians and social keepers.

1.7. Robustness analysis

1.7.1. Internal consistency checks

Before implementing the robustness analysis, it is recommended to check for the internal consistency of the three conceptual sub-frameworks (each one corresponding to the composite indicators 2006PW, 2006EW and 2006SW). Experts suggest to check for (i) a correlation between 0.4 and 0.8 between the pillars (or sub-dimensions) and the overall composites; (ii) positive correlations between the pillars. In our case, with the exception of the economic indicator which has been built only from two individual indicators, these conditions hold.

Table 3 Correlation matrix between 2006PW and the pillars

	Housing and Environment	**Infrastructure and Services**
Housing and Environment	1.000	
Infrastructure and Services	0.599	1.000
2006PW	0.807	0.956

Notes: all coefficients are statistically significant at p< 0.05 (n=20)
Source: elaboration of the author.

Table 4 Correlation matrix between 2006SW and the pillars

	Safety	**Assistance**	**Aggregation**	**Leisure**
Safety	1.000			
Assistance	0.633	1.000		
Aggregation	0.619	0.572	1.000	
Leisure	0.526	0.269*	0.619	1.000
2006SW	0.888	0.728	0.839	0.767

*Notes (*):*coefficient not statistically significant at p< 0.05 (n=20)
Source: elaboration of the author.

On the other hand, correlation coefficients should report the expected sign, both with respect to the corresponding pillar and the composite indicator itself. This is also confirmed, as provided in the appendix (tables A.1.12 and A.1.13).

1.7.2. Modeling uncertainties

Several assumptions *à priori* have to be made when constructing composite indicators, e.g. on the selection of indicators, data normalization, weights and aggregation methods. The robustness of the composite indicators and the underlying policy messages may thus be contested. As recommended by the *Handbook on Constructing Composite Indicators* by OECD (2008), a combination of uncertainty and sensitivity analysis can help gauge the robustness of the composite indicators and improve transparency:

"the results of the robustness analysis are generally reported as country [areas] rankings with their related uncertainty bounds, which are due to the uncertainties at play. This makes it possible to communicate to the user the plausible range of the composite indicator values for each country [area]. The sensitivity analysis results are generally shown in terms of the sensitivity measure for each input source of uncertainty. These sensitivity measures represent how much the uncertainty in the composite indicator for a country would be reduced if that particular input source of uncertainty were removed." (p. 34-35)

Ideally, all potential sources of uncertainty should be addressed: selection of individual indicators, data quality, normalization, weighting, aggregation method, etc. In this work, since there is no imputation due to missing values, I have focused on four main uncertainties/ assumptions: inclusion/ exclusion of one pillar per each of the composites at the time, different normalization methods, different weighting schemes and different aggregation schemes. With respect to this very last point, as suggested by most of the recent works on multidimensional quality of life, an alternative scenario using an arithmetic average to combine indicators within a sub-

domain (so as to reduce measurement error and capture inconsistencies) and using a geometric average to combine the sub-domains (so as to "urge" an area to improve itself in those pillars where it is relatively weak) is explored.

Following OECD (2008), let CI be the composite indicator of a given dimension of wellbeing (physical, economic, social) for each area of decentralization c, with c= 1, .., 20 and :

$$CI_c = f_{rs} (I_{1,c}, I_{2,c},.. I_{Q,c}, w_{s,1}, w_{s,2}, .. w_{s,Q}), \quad (1)$$

according to the weighting model f_{rs} , r = 1,2,3 , s = 1,2 , where the index r refers to the aggregation system (LIN, GME, NCMC[43]) and index s refers to the weighting scheme (EQDOM, EQELEM[44]). The index is based on Q normalized individual indicators $I_{1,c}$, $I_{2,c}$,.. $I_{Q,c}$ for that area and scheme-dependent weights $w_{s,1}$, $w_{s,2}$, .. $w_{s,Q}$ for the

[43] By far the most widespread aggregation is the linear summation of weighted and normalized individual indicators (LIN), which has been adopted also in this work. Although widely used, an undesirable feature of additive aggregations is the implied full compensability, such that poor performance in some indicators can be compensated for by sufficiently high values in other indicators. For example, if in the present research the hypothetical composite of the social wellbeing were formed by safety, aggregation, assistance and leisure, two countries, one with values 21, 1, 1,1 and the other with 6,6,6,6, would have equal composites if the aggregation were additive and equal weights were applied. Obviously the two countries would represent very different social conditions which would not be reflected in the composite. If multi-criteria analysis (NCMC) entails full non-compensability, the use of a geometric aggregation (also called deprivational index, GME) is an in-between solution. Since "a country would have a greater incentive to address those sectors/activities/alternatives with low scores if the aggregation were geometric rather than linear, as this would give it a better chance of improving its position in the ranking" (p. 104, OECD 2008), an interesting case to be performed in the sensitivity and uncertainty analysis would be the adoption of a LIN rule for the aggregation within the sub-domains (or pillars) and a GME rule for the aggregation between the pillars, up to the computation of the final composite.

[44] As previously mentioned in §1.4, in this work each sub-domain (or pillar) is expected to equally contribute to the composition of the corresponding composite indicator, thus individual indicators contribute differently (EQDOM weighting scheme). One more possible weighting scheme suggested by experts recommends an equal contribution of each individual indicator to the composition of the corresponding composite indicator, thus sub-domains (or pillars) contribute differently (EQELEM weighting scheme). For a summary of both schemes please refer to the appendix.

individual indicators. The most frequently used normalization methods for the individual indicators are based on the Min-Max (2) z-score or standardized (3), or on the raw indicator (4) :

$$I_{q,c} \begin{cases} = \dfrac{x_{q,c} - \min(x_q)}{range(x_q)} & (2) \\ = \dfrac{x_{q,c} - \text{mean}(x_q)}{std(x_q)} & (3) \\ = x_{q,c} & (4) \end{cases}$$

where $I_{q,c}$ is the normalized and $x_{q,c}$ is the raw value of the individual indicator x_q for area c. As pointed out also by OECD, note that the Min-Max method (2) can be used in conjunction with all the weighting schemes and for all aggregation systems (LIN, GME, NCMC).

The rank assigned by the composite indicator to a given area, i.e. *Rank* (CI_c) is an output of the uncertainty/sensitivity analysis. The average shift in area rankings is also explored. This latter captures the relative shift in the position of the entire system of the 20 areas. It can be calculated as the average of the absolute differences in areas' ranks with respect to a reference ranking over the M areas of decentralization:

$$\overline{R_S} = \frac{1}{M} \sum_{c=1}^{M} \left| Rank_{ref}(CI_c) - Rank\ (CI_c) \right| \qquad (5)$$

Since the three composites 2006 PW, 2006EW and 2006SW have been introduced in this work as original contribution, the reference rankings are simply the ones obtained throughout the procedure mentioned in §2.6. The investigation of Rank (CI_c), $\overline{R_S}$ (and therefore the shifting of each area into a new poverty profile) is the scope of the following robustness analysis.

1.7.3. Robustness analysis of the 2006 PW

The uncertainty analysis results of the 2006 PW index ranking are provided in Table A.1.14. For each area, the reference rank (ref) is available, together with other possible scenarios of uncertainties due to normalization procedures, weighting, aggregation (geometric between the pillars, linear between the individual indicators) and exclusion to one pillar at the time. The main source of the variation is the combined effect of normalization (using z-scores, instead of min-max) and aggregation level. In particular, the ranks differ significantly if the second pillar (referred to infrastructure and services) were removed. This may be due either to a greater number of individual indicators within this pillar (than the housing and environment one), and/ or to a relative better performance of each neighbor with respect to variables related to primary services, infrastructures, mobility options, etc, as also found in the correlation structure within the framework.

Those areas characterized by wellbeing profiles with relatively high scores of 2006PW (profiles 1, 2, 3, 4) register a relatively low volatility (on average 5,7 positions and very rarely with a variation also in the profile), with the exception of Venezia- Buenos Ayres, Lorenteggio- Inganni, Niguarda-Ca' Granda Bicocca and Città Studi. For these areas, the normalization procedure may affect the final result as particular relevant uncertainty factor but not up to a different profile configuration. Nevertheless, as expected, the exclusion of one pillar at the time (housing/environment or infrastructure/ services) greatly varies the results.

Those areas characterized by wellbeing profiles with relatively low scores of 2006PW (profiles 6, 7, 8, marked in grey in Table A.1.15 in the appendix) register a higher volatility with respect to the previous

group (on average around 8 positions and sometimes a variation also in the profile). Also in this group of areas, however, the normalization procedure affects the final result as particular relevant uncertainty factor but not up to a different profile configuration (with the only exception of Feltre-Carnia-Ortica and Forlanini-Taliedo). Nevertheless, as expected, the exclusion of one pillar at the time (particularly the infrastructure/ services one) greatly varies the results.

Among the first ranked areas, the most pronounced improvements in the performance are observed for Ticinese- Genova and Città Studi-Argonne, which all gain 2 positions under a different scenario. In the first case, the improvement would has been due to a different normalization procedure (z-score rather than min-max), while in the second area the improvement is due to the subtraction of the housing/ environment pillar from the composite, since it registers particularly low values with respect to the availability of green spaces and the exposure to pollution.

Among areas ranked between 6 and 10, the most pronounced improvements in the performance are observed for Niguarda- Ca' Granda-Bicocca and San Siro-Gallaratese, which gain up to 5 positions under a different scenario. In both cases, the improvement would has been due to the subtraction of the infrastructure/ services pillar from the composite. Niguarda- Ca' Granda-Bicocca registers particularly critical values with respect to the availability of public infrastructure, parkings, schools (with the exception of the university) and commercial facilities, while San Siro-Gallaratese is characterized by a poor availability of almost all types of public services, with respect to its population and to the whole city (schools, hospitals, clinics, cultural centers, cinemas, commercial facilities, infrastructure in terms of metro and railway stops).

Among areas ranked between 11 and 15, the most pronounced improvements in the performance are observed for Chiesa-Rossa-Gratosoglio and Barona-Ronchetto-Naviglio, which gain up to 8 positions under a different scenario. In both cases, the improvement would has been due to the subtraction of the infrastructure/ services pillar from the composite. Both areas register particularly critical values with respect to the availability of almost all types of public services (schools, hospitals, clinics, cultural centers, cinemas, commercial facilities, infrastructure in terms of metro and railway stops), which negatively influence the composite indicator.

Finally, among the poorest areas in terms of 2006PW, the most pronounced improvements in the performance are observed for Forlanini- Taliedo and Feltre-Carnia- Ortica, which gain up to 11 positions under a different scenario. In both cases, the improvement would has been due to a different normalization procedure (z-score rather than min-max). However, it is important to note that standardization by z-score greatly affects only these two areas, since the major source of uncertainty is the inclusion/ exclusion of the infrastructure/ services pillar in the computation of PW indicator, thus indirectly confirming its importance in the evaluation. In order to provide an estimate of the magnitude of movement in ranks under the different simulation models, we define "volatility" as the difference between a country's best and worst rank (OECD, 2008). Table A.1.15 provides the results.

1.7.4. Robustness analysis of the 2006 EW

The uncertainty analysis results of the 2006 EW index ranking are provided in Table A.1.16. For each area, the reference rank (ref) is available, together with all other possible scenarios of uncertainties due to normalization procedures, aggregation (geometric, rather than

linear) and exclusion to one pillar at the time. Of course, because of the very reduced number of individual indicators (2) with respect to the previous 2006PW index (12), the robustness exercise may not be considered as informative. However, with respect to the computation of the 2006EW index, the main source of the variation occurs at the aggregation level. In particular, the ranks differ significantly if the second pillar (referred to income inequality) was removed.

Using a z-score normalization (rather than a min-max rule), the average shift is around 2 positions, while the score increases up to 4 positions implementing a not full compensability, such as a geometric aggregation (rather than linear). Volatility seems to be slightly higher in those areas characterized by wellbeing profiles with relatively low scores of 2006EW (profiles 3, 4, 6, marked in grey in Table A.1.17. in the appendix), even if most of the shifts are due, as already mentioned, to the exclusion of (out of two) pillar composing the final score of 2006EW. It is important to note that either Centro Storico and Forlanini-Taliedo (combining respectively the higher inequality with the lowest poverty diffusion and the lowest inequality with the higher poverty diffusion) score the median value and, at the same time, the highest volatility due to the exclusion of one pillar at the time.

Among the first nine areas, any particular improvement occur, with the exception of Affori-Bruzzano-Comasina, which gains 2 positions under a different scenario. In particular, the improvement would has been due to the subtraction of the poverty pillar from the composite, since it registers a particularly high poverty diffusion rate (around 19%), with respect to the whole city.

Among the last nine areas (and therefore excluding from this analysis the two areas registering a median value of the EW index), the most pronounced improvements in the performance are observed

for Venezia-Buenos Ayres, Vittoria-Romana-Molise, Ticinese-Genova and Magenta-Sempione, which gain up to 13 positions under a different scenario. In all cases, the improvement would has been due to the subtraction of the income inequality pillar from the composite. These areas, in fact, register particularly high level of inequality (between 0.53 and 0.58). Results are provided in Table A.1.17.

1.7.5. Robustness analysis of the 2006 SW

The uncertainty analysis results of the 2006 SW index ranking are available in Table A.1.18. For each area, the reference rank (ref) is provided, together with all other possible scenarios of uncertainties due to normalization procedures, weighting, aggregation (geometric between the pillars, linear between the individual indicators) and exclusion to one pillar at the time. The main source of the variation is the last one: in particular, subtracting the leisure pillar from the computation of the SW index, ranks differ greatly.

Those areas characterized by wellbeing profiles with relatively high scores of 2006SW (profiles 1, 4, 8) register a slightly lower volatility with respect to those areas characterized by wellbeing profiles with relatively low scores of 2006 SW (profiles 2, 3, 6, 7, marked in grey in Table A.1.19 in the appendix). On average, the first group shifts 5 positions (and very rarely with a variation also in the profile), while the second up to 6,8.

Among the first ranked areas, the most pronounced improvements in the performance are observed for Vialba- Certosa- Quarto Oggiaro and Niguarda- Ca' Granda- Bicocca, which gain 2 positions under a different scenario. In particular, the improvement would has been due to a different aggregation procedure (geometric aggregation between the pillars and linear aggregation within the individual indicators). As already mentioned in the theoretical part of this essay, an undesirable

feature of additive aggregations is the implied full compensability, such that poor performance in some indicators can be compensated for by sufficiently high values in other indicators. On the other hand, a country (or a neighbor) would have a greater incentive to address those sectors/activities/alternatives with low scores if the aggregation were geometric rather than linear, as "this would give it a better chance of improving its position in the ranking" (OECD 2008, p.104).

Among areas ranked between 6 and 10, the most pronounced improvement in the performance is observed for Greco-Zara, which gain up to 5 positions under a different scenario. Also in this case, a combination of linear aggregation within individual indicator and a geometric aggregation between the pillars, would have improved the ranks and without changing the correspondent wellbeing profile (as was also the case of Vialba- Certosa- Quarto Oggiaro and Niguarda-Ca' Granda- Bicocca).

Among areas ranked between 11 and 15, the most pronounced improvements in the performance are observed for Ticinese-Genova and Magenta-Sempione, which gain up to 5 positions under a different scenario. In the first case, the improvement would has been due to the subtraction of the assistance pillar from the composite. Maybe because of a particular demographic structure, this area registers a very poor availability of any centers for care and assistance to most vulnerable groups, especially disabled. Magenta-Sempione, on the other hand, dues its improvement to the subtraction of the aggregation pillar from the composite. This area is characterized by a very few neighbor shops, cultural facilities, multipurpose fields for sports and, above all, scores an almost absence of any CAG and CAM for youth aggregation, with respect to the rest of the city.

Finally, among the poorest areas in terms of 2006SW, the most pronounced improvements in the performance are observed for San Siro- Gallaratese and Lorenteggio-Inganni, which gain up to 9 positions under a different scenario in the sensitivity analysis. In both cases, the improvement would has been due to the subtraction of the safety pillar from the composite. With respect to the whole city and to the number of inhabitants, these areas register a very weak presence of police stations. In order to provide an estimate of the magnitude of movement in ranks under the different simulation models, we define "volatility" as the difference between a country's best and worst rank (OECD, 2008). However, it is important to note that most of the volatility scores are due to the extraction of one pillar at the time, thus indirectly confirming the independence of each sub-domain for the evaluation of poverty at the local level. Results are provided in Table A.1.19.

1.8. Concluding remarks

This first essay has hopefully tested empirically the appropriateness of a multidimensional conceptual framework to explore the dynamic interrelations between poverty of areas and poverty of individuals within the former 20 areas of decentralization of Milan. Based over previous experiences held in the same metropolitan area (although according to partially different territorial partitions) by groups of sociologists and urban planners and also over some national and international experiences in quality of life indices, I suggest to adopt an integrated multidimensional approach for the analysis of urban poverty and of the relationships between individuals and space, harmonizing the information available and defining a unifying set of variables and indices of simple interpretation and monitoring. The

dataset simultaneously explores three different concepts of "space" (and therefore of poverty) : the first referred to the *physical* availability of infrastructure, services, good quality of housing and environment (2006 PW index); the second related to the *economic* dimension, with particular attention devoted to income inequalities and poverty rates, rather than simply to the average per capita income (2006 EW index); the last referred to the network of those facilities fostering the identity, enhancing social cohesion and aggregation between people (2006 SW index). The second composite (2006 EW) and the latter (2006 SW), not surprisingly, do not systematically collect very high scores in the most favorable areas in terms of purely average per capita incomes (such as the closest to the city center). On one hand, although relatively rich, these areas are characterized by a strong inequality and a growing poverty diffusion and, on the other hand (maybe because of their demographic composition or because of a relative low demand) by a very scarce availability of informal care networks such as portierati, centers for assistance to most vulnerable groups (disabled, elders, minors alone), multipurpose fields for youth aggregation and associations. However, these facilities may help to reduce vulnerability conceived as the *risk* to become poor and thus should be considered at least as the most traditional variables (i.e. those collected in the 2006PW index).

For each composite, the threshold level has been conventionally fixed in the median of the distribution, considering those areas below the median as "poor", with respect to the ones above. Each elementary indicator (with the exception of Gini, poverty diffusion, environmental criticality and the crowding indices) has been weighted by the corresponding population (2006SW index) or by the land size (2006PW), in order to do not create any measurement bias and to allow the comparison of results. To each area of decentralization has

been therefore associated one, over the eight hypothesized, profiles of poverty, according to the combination of the composites 2006 PW, 2006 EW and 2006 SW. In order to test the conceptual framework, a robustness analysis has been performed, in terms of evaluation of uncertainty factors introduced at the time and of variation of the poverty profiles. In general, the taxonomy based on these latter seemed to be quite stable and robust even in light of a different normalization procedure, a different weighting, a different aggregation rule, the subtraction of one pillar from the composite. Secondly, this taxonomy seems to depict quite clearly some typical patterns of deprivation for each profile (which have been extensively reported in §1.6 and confirmed definitively in the robustness analysis in § 1.7) and, not surprisingly, the most represented types are also geographically clustered according to a sort of circular shape around the city center.

In terms of policies, the hardly spurious relationship between areas and individuals suggests to consider, on one side, some policies addressed to poorer areas (pro-place) and, on the other side, some interventions aimed to support vulnerable individuals (pro-people). Such policies could be defined and adopted on a trial basis and should also be accompanied by careful monitoring of the set of indicators used to capture different dimensions of wellbeing (such as the ones suggested here), integrating those objective information with also subjective evaluations.

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Appendix - Poverty indicators: from theory to practice.

Table A.1.1. Weighting scheme (EQDOM) for 2006 PW index

2006 PW index												
Total weight	1											
Total weight (%)	100											
Pillars (subdomains)	**Housing and Environment**					**Infrastructure and Services**						
Pillars weight	**1/2**					**1/2**						
Pillars weight (%)	**50**					**50**						
Individual indicators	Crowding index	sale price/ square meter	average rental fee/month (bilocal)	Environmental criticality index	Public green available	educational facilities	health facilities	sporting and cultural facilities	commercial facilities	tram line stops	metro and rail stops	private parking and interchange
Individual indicators weight	**1/10**	**1/10**	**1/10**	**1/10**	**1/10**	**1/14**	**1/14**	**1/14**	**1/14**	**1/14**	**1/14**	**1/14**
Individual indicators weight (%)	10	10	10	10	10	7,142	7,142	7,142	7,142	7,142	7,142	7,142
Polarity	-	+	+	-	+	+	+	+	+	+	+	+

Source: elaboration of the author.

Table A.1.2. Weighting scheme (EQELEM) for 2006 PW index

2006 PW index												
Total weight	1											
Total weight (%)	100											
Pillars (subdomains)	**Housing and Environment**					**Infrastructure and Services**						
Pillars weight	**5/12**					**7/12**						
Pillars weight (%)	**41,666**					**58,333**						
Individual indicators	Crowding index	sale price/ square meter	average rental fee/month (bilocal)	Environmental criticality index	Public green available	educational facilities	health facilities	sporting and cultural facilities	commercial facilities	tram line stops	metro and rail stops	private parking and interchange
Individual indicators weight	**1/12**	**1/12**	**1/12**	**1/12**	**1/12**	**1/12**	**1/12**	**1/12**	**1/12**	**1/12**	**1/12**	**1/12**
Individual indicators weight (%)	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333
Polarity	-	+	+	-	+	+	+	+	+	+	+	+

Source: elaboration of the author.

Table A.1.3. Weighting scheme (EQDOM, EQELEM) for 2006 EW index

2006 EW index		
Total weight	1	
Total weight (%)	100	
Pillars (subdomains)	**Poverty**	**Inequality**
Pillars weight	**1/2**	**1/2**
Pillars weight (%)	**50**	**50**
Individual indicators	Index of poverty diffusion	Gini index
Individual indicators Weight	**1/2**	**1/2**
Individual indicators weight (%)	50	50
Polarity	-	-

Source: elaboration of the author.

Table A.1.4. Weighting scheme (EQDOM) for 2006 SW index

2006 SW index													
Total weight	1												
Total weight (%)	100												
Pillars (subdomains)	**Safety**	**Assistance**						**Aggregation**					**Leisure**
Pillars weight	**1/4**	**1/4**						**1/4**					**1/4**
Pillars weight (%)	**25**	**25**						**25**					**25**
Individual indicators	Local police stations	Pharmacies	porters, health caretakers and "portierati"	Minors, families (centers)	Disabled (centers)	Mental health (centers)	Elders (centers)	Neighborhood stores	Religious centers	CAG, CAM	Associations	Special sports fields	Cultural centers, neighborhood libraries
Individual indicators weight	**1/4**	**1/24**	**1/24**	**1/24**	**1/24**	**1/24**	**1/24**	**1/20**	**1/20**	**1/20**	**1/20**	**1/20**	**1/4**
Individual indicators weight (%)	25	4,166	4,166	4,166	4,166	4,166	4,166	5	5	5	5	5	25
Polarity	+	+	+	+	+	+	+	+	+	+	+	+	+

Source: elaboration of the author.

Table A.1.5 Weighting scheme (EQELEM) for 2006 SW index

2006 SW index													
Total weight	1												
Total weight (%)	100												
Pillars (subdomains)	**Safety**	**Assistance**						**Aggregation**					**Leisure**
Pillars weight	**1/13**	**6/13**						**5/13**					**1/13**
Pillars weight (%)	7,692	46,153						36,461					7,692
Individual indicators	Local police stations	Pharmacies	porters, health caretakers and portierati	Minors, families (centers)	Disabled (centers)	Mental health (centers)	Elders (centers)	Neighborhood stores	Religious centers	CAG, CAM	Associations	Special sports fields	Cultural centers, neighborhood libraries
Individual indicators weight	**1/13**	**1/13**	**1/13**	**1/13**	**1/13**	**1/13**	**1/13**	**1/13**	**1/13**	**1/13**	**1/13**	**1/13**	**1/13**
Individual indicators weight (%)	7,692	7,692	7,692	7,692	7,692	7,692	7,692	7,692	7,692	7,692	7,692	7,692	7,692
Polarity	+	+	+	+	+	+	+	+	+	+	+	+	+

Source: elaboration of the author.

Table A.1.6 – Correlation structure within the 2006 PW index components

	crowding	pm2	rent	green	ECI	education	health	culture	commerce	tram	metro	parkings
crowding	1.0000											
pm2	-0.8735	1.0000										
rent	-0.6281	0.7854	1.0000									
green	0.1206	-0.1265	-0.0620	1.0000								
ECI	0.4590	-0.2748	-0.0869	0.0792	1.0000							
education	-0.7599	0.6916	0.5496	-0.1262	-0.6411	1.0000						
health	-0.8907	0.7966	0.6884	-0.0922	-0.4988	0.8956	1.0000					
culture	-0.8243	0.8843	0.8079	0.0091	-0.4014	0.7737	0.8701	1.0000				
commerce	-0.8672	0.8904	0.7790	-0.1462	-0.5065	0.8367	0.9021	0.9669	1.0000			
tram	-0.7733	0.7211	0.4773	-0.0138	-0.5674	0.7913	0.7649	0.6796	0.7822	1.0000		
metro	-0.7188	0.7316	0.5256	-0.2596	-0.6791	0.7113	0.7059	0.7718	0.8597	0.7080	1.0000	
parkings	-0.8520	0.7279	0.4504	-0.2392	-0.7195	0.8663	0.8315	0.7271	0.8390	0.8958	0.8321	1.0000

Source : elaboration of the author.

Table A.1.7 – Correlation structure within the 2006 SW index components

	police	pharmacies	infcare	households	disabled	mental	elders	shops	religion	CAGCAM	associations	multipurp	libraries
police	1.0000												
pharmacies	0.5201	1.0000											
informalcare	0.3856	-0.0020	1.0000										
houscare	0.1542	-0.0296	0.1963	1.0000									
disabledcare	0.2881	-0.3688	0.2578	0.1531	1.0000								
mentalcare	0.1552	0.0876	-0.0526	0.3918	0.5565	1.0000							
elderscare	0.6752	0.2896	0.3774	-0.1248	0.5463	0.4136	1.0000						
shops	0.3148	0.7922	-0.1387	0.1758	-0.5490	-0.0998	-0.1400	1.0000					
religion	0.7529	0.6062	0.4263	0.2123	0.0722	0.1704	0.5909	0.3903	1.0000				
cag__cam	0.3321	-0.0299	0.2942	0.3645	0.4007	0.2856	0.3809	-0.0892	0.4419	1.0000			
associations	0.5621	0.7799	0.1319	-0.2141	-0.2416	-0.2454	0.3919	0.6056	0.6466	-0.0310	1.0000		
multipurpose	0.0306	-0.2135	0.3671	0.2100	0.4792	0.3239	0.3835	-0.3435	0.1191	0.6094	-0.2073	1.0000	
libraries	0.5259	0.7935	0.3115	-0.1166	-0.2552	-0.1275	0.4196	0.5382	0.7597	-0.0126	0.9013	-0.1280	1.0000

Source : elaboration of the author.

Table A.1.8 Individual indices (normalized) within 2006 PW index

		Housing and Environment					Infrastructure and Services						
	normalization by surface (m^2)	Crowding index	sale price/ square meter	average rental fee/month (bilocal)	Environmental criticality index	Public green available	educational facilities	health facilities	sporting and cultural facilities	commercial facilities	tram line stops	metro and rail stops	private parking and interchange
Centro Storico	8142817	1	1	1	0,709	0,093	1	1	1	1	1	1	1
Greco- Zara	5803813	0,471	0,235	0,118	0	0,019	0,391	0,341	0,146	0,238	0,559	0,754	0,486
Venezia- B. Ayres	2432598	0,735	0,328	0,260	0	0	0,819	0,606	0,553	0,678	1,000	1,000	1,000
Vittoria-Romana-Molise	5010113	0,471	0,441	0,301	0,778	0,031	0	0,276	0,177	0,264	0,518	0,291	0,267
Ticinese- Genova	4300653	0,471	0,322	0,301	0,764	0,050	0,647	0,327	0,214	0,275	0,830	0,226	0,463
Magenta-Sempione	6462340	0,706	0,347	0,333	0,806	0,020	0,346	0,254	0,266	0,342	0,602	0,527	0,569
Bovisa- Dergano	4287308	0	0,080	0,301	0,780	0,009	0,232	0,037	0,058	0,091	0,208	0,340	0,054
Affori- Bruzzano- Comasina	6752643	0,088	0,089	0	0,755	0,026	0,229	0,056	0,069	0,036	0	0,216	0,003
Niguarda- Ca' Granda- Bicocca	7406993	0,206	0,107	0	0,758	1,000	0,196	0,132	0,165	0,030	0,372	0	0
Monza- Padova	8607093	0,118	0,127	0	0,635	0,052	0,347	0	0,109	0,137	0,094	0,396	0,127
Città Studi- Argonne	5410113	0,588	0,244	0,202	0	0,001	0,960	0,657	0	0,247	0,555	0,270	0,617
Feltre- Carnia- Ortica	9057557	0,324	0,117	0	0,473	0	0,132	0,067	0,015	0,028	0	0,215	0,022
Forlanini- Taliedo	8920960	0,324	0	0	0,950	0,088	0,000	0,209	0,016	0,001	0,091	0	0,008
Corvetto- Rogoredo-Vigentina	19125525	0,176	0,083	0,186	1	0,013	0,027	0,062	0,000	0,015	0,038	0,127	0,038
Chiesa Rossa- Gratosoglio	12560173	0,235	0,072	0,321	0,911	0,012	0,001	0,013	0,016	0,000	0,148	0,039	0,006
Barona- Ronchetto Naviglio	11473729	0,118	0,122	0,301	0,922	0,015	0,072	0,073	0,080	0,006	0,057	0,042	0,032
Lorenteggio- Inganni	6935379	0,353	0,189	0,068	0,512	0,031	0,343	0,189	0,147	0,123	0,140	0,140	0,274
Baggio- Forze Armate	19210400	0,147	0,091	0	0,909	0,103	0,041	0,012	0,041	0,004	0	0,076	0,018
San Siro- QT8- Gallaratese	16611956	0,382	0,247	0,008	0,921	0,140	0,123	0,058	0,102	0	0,059	0,205	0,057
Vialba- Certosa- Quarto Oggiaro	13253084	0,176	0,102	0	0,891	0,026	0,199	0,082	0,038	0,075	0,257	0,110	0,023
Soglia (mediana)		**0,324**	**0,124**	**0,194**	**0,771**	**0,028**	**0,231**	**0,107**	**0,106**	**0,083**	**0,178**	**0,216**	**0,055**

Source : elaboration of the author.

Table A.1.9. Individual indices (normalized) within 2006 EW index

Areas	n. of households	Inequality		Poverty	
		Complementary of Gini index (normalized)	**Gini index (row)**	**Complementary of Poverty diffusion index (normalized)**	**Poverty Diffusion Index (row)**
Centro Storico	42.456,00	0,000	0,604	1,000	0,140
Greco- Zara	37.741,00	0,512	0,505	0,437	0,177
Venezia- B. Ayres	26.789,00	0,155	0,574	0,681	0,161
Vittoria-Romana-Molise	35.909,00	0,360	0,535	0,434	0,178
Ticinese- Genova	31.507,00	0,351	0,536	0,433	0,178
Magenta-Sempione	52.323,00	0,102	0,584	0,788	0,154
Bovisa- Dergano	18.398,00	0,814	0,447	0,026	0,205
Affori- Bruzzano- Comasina	22.672,00	0,981	0,414	0,233	0,191
Niguarda- Ca' Granda- Bicocca	23.839,00	0,960	0,419	0,336	0,184
Monza- Padova	51.647,00	0,844	0,441	0,042	0,204
Città Studi- Argonne	51.112,00	0,466	0,514	0,516	0,172
Feltre- Carnia- Ortica	15.076,00	0,904	0,430	0,426	0,178
Forlanini- Taliedo	11.450,00	1,000	0,411	0,000	0,206
Corvetto- Rogoredo-Vigentina	36.445,00	0,805	0,449	0,196	0,193
Chiesa Rossa- Gratosoglio	25.436,00	0,888	0,433	0,123	0,198
Barona- Ronchetto Naviglio	24.906,00	0,936	0,423	0,179	0,195
Lorenteggio- Inganni	40.020,00	0,740	0,461	0,339	0,184
Baggio- Forze Armate	39.177,00	0,980	0,415	0,294	0,187
San Siro- QT8- Gallaratese	44.631,00	0,412	0,524	0,323	0,185
Vialba- Certosa- Quarto Oggiaro	40.466,00	0,902	0,430	0,113	0,199
Soglia (mediana)		**0,810**		**0,329**	

Source : elaboration of the author.

Table A.1.10. Individual indices (normalized) within 2006 SW index.

	Normalization by population	Local police stations	Pharmacies	guardians, social keepers and "portierati"	Minors, families (centers)	Disabled (centers)	Mental health (centers)	Elders (centers)	Neighbor hood stores	Religious centers	CAG, CAM	Associations	Special sports fields	Cultural centers, neighborhood libraries
Centro Storico	78354	1	1	0,622	0,270	0,123	0,295	0,965	1	1	0,295	1	0,216	1
Greco- Zara	69848	0,291	0,306	0,224	0,303	0,138	0	0,247	0,493	0,147	0,248	0,335	0,166	0,132
Venezia- B. Ayres	48856	0,195	0,531	0,000	0,427	0	0,473	0,127	0,740	0,019	0,118	0,253	0,014	0,047
Vittoria-Romana-Molise	64912	0,316	0,371	0,349	0,319	0,148	0,356	0,169	0,676	0	0	0,191	0,199	0,071
Ticinese- Genova	56381	0,440	0,178	0,093	0,363	0	0	0,314	0,478	0,185	0	0,171	0,203	0
Magenta-Sempione	99072	0,310	0,184	0,018	0,438	0,583	0,233	0,282	0,249	0,015	0	0,208	0,061	0,093
Bovisa- Dergano	34073	0,071	0,250	0,051	0,622	0,283	0,679	0	0,372	0,158	0	0	0,365	0,068
Affori- Bruzzano- Comasina	47084	0,122	0,019	0,222	0,505	0,614	0,491	0,515	0,150	0,114	0,246	0,292	0,814	0,098
Niguarda- Ca' Granda- Bicocca	47664	0,447	0,183	0,804	0,480	0,809	0,485	0,748	0,153	0,109	0,243	0,202	0,855	0,097
Monza- Padova	96668	0,077	0,112	0,180	0,443	0,299	0,239	0,065	0,619	0,185	0,299	0,185	0,322	0,024
Città Studi- Argonne	93803	0,081	0,173	0,074	0	0,308	0,247	0,224	0,336	0,074	0,062	0,176	0,162	0,098
Feltre- Carnia- Ortica	28903	0,765	0,223	0,121	0	1	0,800	1	0,112	0,241	0,200	0,190	0,346	0
Forlanini- Taliedo	23129	0,630	0,333	0,301	1	0,833	1	0,761	0,467	0,546	1	0,059	1	0
Corvetto- Rogoredo-Vigentina	70166	0,234	0,145	0,298	0,314	0,137	0,330	0,489	0,105	0,201	0,330	0,098	0,547	0,066
Chiesa Rossa- Gratosoglio	51143	0,413	0,094	0,443	0	0,565	0	0,387	0,133	0,235	0,565	0,269	0,703	0,045
Barona- Ronchetto Naviglio	51289	0,336	0	0,747	0,460	0,564	0,451	0,538	0,101	0,310	0,225	0,080	0	0,090
Lorenteggio- Inganni	76428	0,007	0,178	0,251	0	0,252	0,303	0,504	0,162	0,006	0,378	0,090	0,715	0,121
Baggio- Forze Armate	82093	0,383	0,035	0,509	0,585	0,469	0,282	0,262	0	0,224	0,423	0,084	0,272	0,028
San Siro- QT8- Gallaratese	89163	0	0,264	0,254	0	0,432	0,519	0,592	0,029	0,182	0,065	0,154	0,530	0,103
Vialba- Certosa- Quarto Oggiaro	80108	0,442	0,180	1,000	0,566	0,481	0,289	0,413	0,291	0,335	0,289	0,086	0,861	0,144
Soglia (mediana)		**0,313**	**0,182**	**0,252**	**0,395**	**0,370**	**0,316**	**0,400**	**0,270**	**0,183**	**0,244**	**0,180**	**0,334**	**0,080**

Source : elaboration of the author.

Table A.1.11 – Combination of composites (min-max normalized) and related poverty (wellbeing) profiles

	Physical dimension	Economic dimension	Social dimension	# poverty profile	Corresponding description (short)
Centro Storico	1,000	0,446	1,000	1	Well equipped, both in terms of basic and aggregation/ assistance services; reduced poverty / inequality.
Greco- Zara	0,323	0,359	0,143	4	Well-equipped, both in terms of basic and aggregation/ assistance services; high poverty/inequality
Venezia- B. Ayres	0,602	0,171	0,080	3	Well equipped with basic services, lacking services for aggregation and assistance; high poverty / inequality
Vittoria-Romana-Molise	0,296	0,099	0,137	3	Well equipped with basic services, lacking services for aggregation and assistance; high poverty / inequality
Ticinese- Genova	0,411	0,083	0,107	3	Well equipped with basic services, lacking services for aggregation and assistance; high poverty / inequality
Magenta-Sempione	0,450	0,261	0,105	3	Well equipped with basic services, lacking services for aggregation and assistance; high poverty / inequality
Bovisa- Dergano	0,075	0,177	0,044	6	Not well equipped (both with basic and aggregation/ assistance services), high poverty / inequality.
Affori- Bruzzano- Comasina	0,000	0,806	0,155	8	Well equipped with services for aggregation and assistance, lacking basic services; low poverty / inequality.
Niguarda- Ca' Granda- Bicocca	0,224	0,944	0,339	1	Well equipped, both in terms of basic and aggregation/ assistance services; reduced poverty / inequality.
Monza- Padova	0,089	0,253	0,049	6	Not well equipped (both with basic and aggregation/ assistance services), high poverty / inequality.
Città Studi- Argonne	0,379	0,417	0,000	3	Well equipped with basic services, lacking services for aggregation and assistance; high poverty / inequality
Feltre- Carnia- Ortica	0,041	1,000	0,363	8	Well equipped with services for aggregation and assistance, lacking basic services; low poverty / inequality.
Forlanini- Taliedo	0,047	0,446	0,525	8	Well equipped with services for aggregation and assistance, lacking basic services; low poverty / inequality.
Corvetto- Rogoredo-Vigentina	0,055	0,447	0,120	7	Not well equipped, both in terms of basic and aggregation/ assistance services; low poverty / inequality.
Chiesa Rossa- Gratosoglio	0,068	0,463	0,210	8	Well equipped with services for aggregation and assistance, lacking basic services; low poverty / inequality.
Barona- Ronchetto Naviglio	0,073	0,640	0,189	8	Well equipped with services for aggregation and assistance, lacking basic services; low poverty / inequality.
Lorenteggio- Inganni	0,121	0,579	0,049	2	Well equipped with basic services, lacking services for aggregation and assistance ; low poverty / inequality.
Baggio- Forze Armate	0,009	0,906	0,167	8	Well equipped with services for aggregation and assistance, lacking basic services; low poverty / inequality.
San Siro- QT8- Gallaratese	0,120	0,000	0,046	3	Well equipped with basic services, lacking services for aggregation and assistance; high poverty / inequality
Vialba- Certosa- Quarto Oggiaro	0,077	0,471	0,342	8	Well equipped with services for aggregation and assistance, lacking basic services; low poverty / inequality.
Thresholds (median)	**0,104**	**0,446**	**0,142**		

Source : elaboration of the author.

Table A.1.12: Correlation coefficients between the individual indicators, the pillars and 2006 PW (and expected signs)

Pillar	Sub pillar	Indicator	Desired polarity	Correlation with 2006 PW	Correlation with the pillar
Housing and Environment	Housing	crowding index	-	-0.9159	-0.7204
		average price/sq mt	+	0.9273	0.8362
		average rent/month	+	0,7851	0,8260
	Environment	public green/ land size	+	**-0.0078 ***	0.2596 *
		environmental criticality index	-	-0.4363	**0.0898 ***
Infrastructure and Services	Services	education facilities	+	0,8468	0,9204
		health facilities	+	0,9272	0,9285
		cultural facilities	+	0,9443	0,8935
		commercial facilities	+	0,9628	0,9600
	Infrastructure	tram stops	+	0,8423	0,8855
		metro and railway	+	0,7859	0,8729
		Parkings	+	0,8437	0,9420

Note: as already mentioned in the text, with n=20 the correlation coefficient is statistically significant when it is roughly greater than 0.4. Hence the two "opposite" polarities (marked in bold) should be interpreted as zero correlation. In other words, the ratio between the availability of public green and the available land size seems to be not correlated with the 2006 PW index but with the related pillar, while the environmental criticality index seems to be correlated with the 2006 PW index and not with the pillar.

Source : elaboration of the author.

Table A.1.13: Correlation coefficients between the individual indicators, the pillars and 2006 SW (and expected signs)

Pillar	Sub pillar	Indicator	Desired polarity	Correlation with 2006 SW	Correlation with the pillar
Assistance		Pharmacies	+	0,6790	0,2325 *
		informal care	+	0,4827	0,5486
		minors care	+	0,1999 *	0,4621
		disabled care	+	0,2199 *	0,6733
		mental health	+	0,2310 *	0,7021
		elders care	+	0,7236	0,7484
Aggregation		neighbor shops	+	0,4149	0,4774
		religious centers	+	0,9041	0,8174
		CAG/ CAM	+	0,4143	0,6695
		associations	+	0,7136	0,5975
		multipurpose sports fields	+	0,1965 *	0,4696

Source : elaboration of the author.

Table A.1.14: 2006 PW (row) ranking and average shift in areas rankings under combinations of uncertainty inputs.

	PW ref	**Rank PW ref**	PWa (z-score)	Rank (PWa)	Rs (PWa)	PWb (EQELEM)	Rank (PWb)	Rs (PWb)	PWc (GME)	Rank (PWc)	Rs (PWc)	PWd (housing/ environment excluded)	Rank (PWd)	Rs (PWd)	PWe (infr/ services excluded)	Rank (PWe)	Rs (PWe)
Centro Storico	**0,825**	**1**	2,598	1	0	0,836	1	0	82,261	1	0	0,890	1	0	0,760	1	0
Greco- Zara	**0,359**	**6**	0,312	6	0	0,369	6	0	35,449	6	0	0,416	5	1	0,302	10	4
Venezia- B. Ayres	**0,551**	**2**	0,382	5	3	0,594	2	0	48,796	2	0	0,808	2	0	0,295	12	10
Vittoria-Romana-Molise	**0,341**	**7**	0,178	9	2	0,332	7	0	33,669	7	0	0,289	7	0	0,392	5	2
Ticinese- Genova	**0,420**	**4**	0,471	2	2	0,421	4	0	41,973	4	0	0,426	4	0	0,414	4	0
Magenta-Sempione	**0,447**	**3**	0,464	3	0	0,441	3	0	44,558	3	0	0,415	6	3	0,478	2	1
Bovisa- Dergano	**0,188**	**13**	-0,186	17	4	0,181	12	1	18,322	11	2	0,146	10	3	0,230	18	5
Affori- Bruzzano- Comasina	**0,137**	**20**	-0,397	20	0	0,128	19	1	12,735	16	4	0,087	14	6	0,186	20	0
Niguarda- Ca' Granda- Bicocca	**0,291**	**8**	0,383	4	4	0,264	8	0	24,082	8	0	0,128	11	3	0,453	3	5
Monza- Padova	**0,198**	**11**	-0,309	19	8	0,194	11	0	19,638	10	1	0,173	9	2	0,223	19	8
Città Studi- Argonne	**0,397**	**5**	0,122	10	5	0,414	5	0	38,506	5	0	0,495	3	2	0,300	11	6
Feltre- Carnia- Ortica	**0,165**	**18**	0,241	7	11	0,149	17	1	13,376	14	4	0,068	15	3	0,261	15	3
Forlanini- Taliedo	**0,169**	**17**	0,224	8	9	0,149	18	1	11,629	17	0	0,046	17	0	0,291	13	4
Corvetto- Rogoredo-Vigentina	**0,174**	**16**	-0,006	13	3	0,153	16	0	11,571	18	2	0,044	18	2	0,305	9	7
Chiesa Rossa- Gratosoglio	**0,183**	**15**	-0,079	15	0	0,158	15	0	10,347	19	4	0,032	19	4	0,335	7	8
Barona- Ronchetto Naviglio	**0,187**	**14**	0,001	12	2	0,164	14	0	12,892	15	1	0,052	16	2	0,322	8	6
Lorenteggio- Inganni	**0,220**	**9**	-0,185	16	7	0,216	9	0	21,850	9	0	0,194	8	1	0,246	17	8
Baggio- Forze Armate	**0,143**	**19**	-0,252	18	1	0,124	20	1	8,445	20	1	0,028	20	1	0,258	16	3
San Siro- QT8- Gallaratese	**0,219**	**10**	0,102	11	1	0,197	10	0	17,509	12	2	0,088	13	3	0,350	6	4
Vialba- Certosa- Quarto Oggiaro	**0,189**	**12**	-0,064	14	2	0,177	13	1	17,282	13	1	0,112	12	0	0,267	14	2
Rs = AVERAGE (RankPW- RankPW ref)					**3,2**			**0,3**			**1,1**			**1,8**			**4,3**

Note: the cells marked in grey are those considered under the median value and therefore indicative, according to the initial theoretical framework, of a condition of scarcity within the PW indicator. The Rs score measures the average shift in areas rankings under a given uncertainty input (a=normalization; b= weighting; c= aggregation; d, e= exclusion of one pillar or subdimension at the time) and basically reveals that the major source of uncertainty in the formulation of the PW indicator is due to the exclusion of the infrastructure/ services pillar, while the other factors seem do not particularly alter the final ranks.

Source : elaboration of the author.

Table A.1.15: 2006 PW (row) ranking, optimal and worst ranks under all combinations of uncertainty inputs

(ordered from the greater to the lowest PW)	Physical CI ref	# poverty profile	Rank ref	Best rank	Worst rank	volatility
Centro Storico	0,825	1	1	1	1	0
Venezia- B. Ayres	0,551	3	2	2	12	10
Magenta-Sempione	0,447	3	3	2	6	4
Ticinese- Genova	0,420	3	4	2	4	2
Città Studi- Argonne	0,397	3	5	3	11	8
Greco- Zara	0,359	4	6	5	10	5
Vittoria-Romana-Molise	0,341	3	7	5	9	4
Niguarda- Ca' Granda- Bicocca	0,291	1	8	3	11	8
Lorenteggio-Inganni	0,220	2	9	8	17	9
San Siro- QT8- Gallaratese	0,219	3	10	6	13	7
Monza- Padova	0,198	6	11	9	19	10
Vialba- Certosa- Quarto Oggiaro	0,189	8	12	12	14	2
Bovisa- Dergano	0,188	6	13	10	18	8
Barona- Ronchetto Naviglio	0,187	8	14	8	16	8
Chiesa Rossa- Gratosoglio	0,183	8	15	7	19	12
Corvetto- Rogoredo-Vigentina	0,174	7	16	9	18	9
Forlanini- Taliedo	0,169	8	17	8	18	10
Feltre- Carnia- Ortica	0,165	8	18	7	17	10
Baggio- Forze Armate	0,143	8	19	16	20	4
Affori- Bruzzano- Comasina	0,137	8	20	14	20	6

Note: areas are ordered by ranks and those characterized by a low value of 2006PW are marked in grey (see taxonomy introduced in § 1.5).
Source : elaboration of the author.

Table A.1.16: 2006 EW (row) ranking and average shift in areas rankings under combinations of uncertainty inputs.

	EWref	**Rank ref**	EWa (z-score)	Rank (EWa)	Rs (EWa)	EWb (GME)	Rank (EWb)	Rs (EWb)	EWc (poverty index excluded)	Rank (EWc)	Rs (EWc)	EWd (inequality index excluded)	Rank (EWd)	Rs (EWd)
Centro Storico	**0,500**	**10**	1,262	5	5	10,000	19	9	0,6040	20	10	0,1400	1	9
Greco- Zara	**0,474**	**12**	0,955	10	2	47,264	7	5	0,5052	13	1	0,1774	5	7
Venezia- B. Ayres	**0,418**	**16**	0,884	14	2	32,540	14	2	0,5740	18	2	0,1612	3	13
Vittoria-Romana-Molise	**0,397**	**17**	0,719	16	1	39,508	10	7	0,5345	16	1	0,1776	6	11
Ticinese- Genova	**0,392**	**18**	0,704	17	1	38,999	11	7	0,5362	17	1	0,1777	7	11
Magenta-Sempione	**0,445**	**13**	1,009	9	4	28,349	16	3	0,5843	19	6	0,1541	2	11
Bovisa- Dergano	**0,420**	**15**	0,624	19	4	14,440	18	3	0,4468	10	5	0,2047	19	4
Affori- Bruzzano- Comasina	**0,607**	**4**	1,278	4	0	47,826	6	2	0,4145	2	2	0,1909	13	9
Niguarda- Ca' Granda- Bicocca	**0,648**	**2**	1,444	2	0	56,802	2	0	0,4186	4	2	0,1841	10	8
Monza- Padova	**0,443**	**14**	0,701	18	4	18,773	17	3	0,4410	9	5	0,2036	18	4
Città Studi- Argonne	**0,491**	**11**	1,040	8	3	49,076	5	6	0,5139	14	3	0,1721	4	7
Feltre- Carnia- Ortica	**0,665**	**1**	1,532	1	0	62,060	1	0	0,4295	6	5	0,1781	8	7
Forlanini- Taliedo	**0,500**	**10**	0,858	15	5	10,000	19	9	0,4109	1	9	0,2064	20	10
Corvetto- Rogoredo-Vigentina	**0,500**	**9**	0,938	11	2	39,675	9	0	0,4485	11	2	0,1934	14	5
Chiesa Rossa- Gratosoglio	**0,505**	**8**	0,923	13	5	32,997	13	5	0,4325	8	0	0,1983	16	8
Barona- Ronchetto Naviglio	**0,558**	**5**	1,106	7	2	40,974	8	3	0,4232	5	0	0,1945	15	10
Lorenteggio- Inganni	**0,540**	**6**	1,115	6	0	50,086	4	2	0,4610	12	6	0,1839	9	3
Baggio- Forze Armate	**0,637**	**3**	1,393	3	0	53,651	3	0	0,4147	3	0	0,1869	12	9
San Siro- QT8- Gallaratese	**0,367**	**19**	0,585	20	1	36,475	12	7	0,5245	15	4	0,1850	11	8
Vialba- Certosa- Quarto Oggiaro	**0,508**	**7**	0,927	12	5	31,929	15	8	0,4298	7	0	0,1989	17	10
Rs = AVERAGE (RankEW- RankEW ref)				Rs	2,3			4,05			3,2			8,2

Note: the cells marked in grey are those considered under the median value and therefore indicative, according to the initial theoretical framework, of a condition of scarcity within the EW indicator. The Rs score measures the average shift in areas rankings under a given uncertainty input (a=normalization; b= aggregation; c, d= exclusion of one pillar or subdimension at the time).

Source : elaboration of the author.

Table A.1.17: 2006 EW (row) ranking, optimal and worst ranks under all combinations of uncertainty inputs

(ordered from the greater to the lowest EW)	Economic CI ref	# poverty profile	Rank ref	Best rank	Worst rank
Feltre- Carnia- Ortica	0,665	8	1	1	8
Niguarda- Ca' Granda- Bicocca	0,648	1	2	2	10
Baggio- Forze Armate	0,637	8	3	3	12
Affori- Bruzzano- Comasina	0,607	8	4	2	13
Barona- Ronchetto Naviglio	0,558	8	5	5	15
Lorenteggio- Inganni	0,540	2	6	6	12
Vialba- Certosa- Quarto Oggiaro	0,508	8	7	7	17
Chiesa Rossa- Gratosoglio	0,505	8	8	8	16
Corvetto- Rogoredo-Vigentina	0,500	7	9	11	14
Centro Storico	**0,500**	**1**	**10**	**1**	**20**
Forlanini- Taliedo	**0,500**	**8**	**10**	**1**	**20**
Città Studi- Argonne	0,491	3	11	4	14
Greco- Zara	0,474	4	12	5	13
Magenta-Sempione	0,445	3	13	2	19
Monza- Padova	0,443	6	14	9	18
Bovisa- Dergano	0,420	6	15	10	19
Venezia- B. Ayres	0,418	3	16	3	18
Vittoria-Romana-Molise	0,397	3	17	6	16
Ticinese- Genova	0,392	3	18	7	17
San Siro- QT8- Gallaratese	0,367	3	19	11	20

Note: areas are ordered by ranks and those characterized by a low value of 2006EW are marked in grey (see taxonomy introduced in § 1.5).
Source : elaboration of the author.

Table A.1.18: 2006 SW (row) ranking and average shift in areas rankings under combinations of uncertainty inputs

	Social CI ref	**Rank ref**	SWa z-score	Rank Swa	Rs Swa	SWb EQELEM	Rank SWb	Rs SWb	SWc GME	Rank SWc	Rs SWc	SWd assistance excluded	Rank SWd	Rs SWd	SWe aggregation excluded	Rank SWe	Rs SWe	SWf safety excluded	Rank SWf	Rs SWf	SWg leisure excluded	Rank SWg	Rs SWg
Centro Storico	**0,812**	**1**	2,362	1	0	0,676	1	0	78,685	1	0	0,901	1	0	0,849	1	0	0,749	1	0	0,749	1	1
Greco- Zara	**0,226**	**10**	-0,150	9	1	0,233	14	4	21,575	5	5	0,234	7	3	0,209	11	1	0,204	11	1	0,257	13	6
Venezia- B. Ayres	**0,183**	**15**	-0,328	15	0	0,227	16	1	15,303	14	1	0,157	15	0	0,167	15	0	0,179	17	2	0,228	15	14
Vittoria-Romana-Molise	**0,221**	**11**	-0,196	11	0	0,243	11	0	19,224	9	2	0,200	10	1	0,224	10	1	0,190	14	3	0,272	10	11
Ticinese- Genova	**0,201**	**13**	-0,286	14	1	0,186	19	6	10,954	17	4	0,216	8	5	0,199	13	0	0,122	20	7	0,268	11	7
Magenta-Sempione	**0,200**	**14**	-0,275	13	1	0,206	18	4	17,282	11	3	0,170	14	0	0,231	9	5	0,163	18	4	0,236	14	10
Bovisa- Dergano	**0,158**	**19**	-0,452	19	0	0,224	17	2	12,800	15	4	0,106	19	0	0,151	16	3	0,187	16	3	0,188	17	17
Affori- Bruzzano- Comasina	**0,234**	**9**	-0,165	10	1	0,323	6	3	19,743	8	1	0,181	13	4	0,205	12	3	0,272	5	4	0,280	9	6
Niguarda- Ca' Granda- Bicocca	**0,360**	**5**	0,309	5	0	0,432	3	2	29,798	3	2	0,285	5	0	0,376	4	1	0,331	4	1	0,448	4	3
Monza- Padova	**0,161**	**17**	-0,439	16	1	0,235	13	4	10,721	19	2	0,141	16	1	0,108	20	3	0,190	15	2	0,207	16	13
Città Studi- Argonne	**0,128**	**20**	-0,552	20	0	0,155	20	0	12,180	16	4	0,114	18	2	0,117	19	1	0,144	19	1	0,138	20	20
Feltre- Carnia- Ortica	**0,377**	**3**	0,380	3	0	0,384	5	2	17,188	12	9	0,328	3	0	0,430	3	0	0,247	6	3	0,502	3	1
Forlanini- Taliedo	**0,487**	**2**	0,804	2	0	0,610	2	0	22,852	4	2	0,415	2	0	0,445	2	0	0,440	2	0	0,650	2	2
Corvetto- Rogoredo-Vigentina	**0,210**	**12**	-0,251	12	0	0,253	10	2	18,309	10	2	0,185	12	0	0,195	14	2	0,202	12	0	0,259	12	10
Chiesa Rossa- Gratosoglio	**0,272**	**6**	-0,016	6	0	0,296	8	2	20,481	7	1	0,280	6	0	0,235	8	2	0,225	8	2	0,347	6	4
Barona- Ronchetto Naviglio	**0,257**	**7**	-0,061	7	0	0,300	7	0	21,120	6	1	0,190	11	4	0,295	6	1	0,231	7	0	0,313	8	7
Lorenteggio- Inganni	**0,162**	**16**	-0,440	17	1	0,228	15	1	10,870	18	2	0,133	17	1	0,125	18	2	0,213	10	6	0,175	19	15
Baggio- Forze Armate	**0,242**	**8**	-0,131	8	0	0,273	9	1	16,654	13	5	0,204	9	1	0,256	7	1	0,195	13	5	0,313	7	7
San Siro- QT8- Gallaratese	**0,160**	**18**	-0,442	18	0	0,240	12	6	9,086	20	2	0,098	20	2	0,149	17	1	0,213	9	9	0,178	18	12
Vialba- Certosa- Quarto Oggiaro	**0,362**	**4**	0,331	4	0	0,414	4	0	32,794	2	2	0,320	4	0	0,358	5	1	0,335	3	1	0,434	5	4
Rs = AVERAGE (RankSW-RankSW ref)					0,3			2			2,7			1,2			1,4			2,7			8,5

Note: the cells marked in grey are those considered under the median value and therefore indicative, according to the initial theoretical framework, of a condition of scarcity within the SW indicator. The Rs score measures the average shift in areas rankings under a given uncertainty input (a=normalization; b= weighting; c= aggregation; d, e, f, g = exclusion of one pillar or subdimension at the time)

Source : elaboration of the author.

Table A.1.19: 2006 SW (raw) ranking, optimal and worst ranks under all combinations of uncertainty inputs

(ordered from the greater to the lowest SW)	Social CI ref	# poverty profile	Rank ref	Best rank	Worst rank
Centro Storico	0,812	1	1	1	1
Forlanini- Taliedo	0,487	8	2	2	4
Feltre- Carnia- Ortica	0,377	8	3	3	12
Vialba- Certosa- Quarto Oggiaro	0,362	8	4	2	5
Niguarda- Ca' Granda- Bicocca	0,360	1	5	3	5
Chiesa Rossa- Gratosoglio	0,272	8	6	6	8
Barona- Ronchetto Naviglio	0,257	8	7	6	11
Baggio- Forze Armate	0,242	8	8	7	13
Affori- Bruzzano- Comasina	0,234	8	9	5	13
Greco- Zara	0,226	4	10	5	14
Vittoria-Romana-Molise	0,221	3	11	9	14
Corvetto- Rogoredo-Vigentina	0,210	7	12	10	14
Ticinese- Genova	0,201	3	13	8	20
Magenta-Sempione	0,200	3	14	9	18
Venezia- B. Ayres	0,183	3	15	14	17
Lorenteggio- Inganni	0,162	2	16	10	19
Monza- Padova	0,161	6	17	13	20
San Siro- QT8- Gallaratese	0,160	3	18	9	20
Bovisa- Dergano	0,158	6	19	15	19
Città Studi- Argonne	0,128	3	20	16	20

Note: areas are ordered by ranks and those characterized by a low value of 2006SW are marked in grey (see taxonomy introduced in § 1.5).
Source : elaboration of the author.

2. Exploratory Spatial Data Analysis of the distribution of incomes in the 180 neighbors of Milan, 2000–2006.

2.1. Introduction

2.1.1. Motivation

This second essay focuses on the distribution of one the most traditional measure of economic poverty and wellbeing, i.e. income, refining the analysis illustrated in the previous essay and considering the most detailed partition of Milan into 180 areas, or neighbors. The intent is primarily to illustrate the space-time dynamics of the average per capita income weighted by the equivalent number of households components in each area. The economic dimension, in fact, has been partially underrepresented in the previous essay, in favour of both the physical and the social dimensions. Special attention has been therefore paid, in empirical terms, to the presence and location of spatial clusters (and therefore to the association between similar values of average per capita income among neighbouring areas), as well as spatial outliers.

The measurement of concentration has a long tradition in statistics (Gini 1921, 1955) and especially the consequences of *poverty* concentration have drawn considerable attention in developed countries in recent decades. Many urban studies have found a clear positive correlation between poverty concentration and to an array of social phenomena, such as public health issues, social exclusion, inequalities and, more recently, some attention has been devoted also on its impact on social wellbeing of children (Duncan, Duncan, Okut, Strycker, and Hix-Small 2003).

As I will argue later, spatial concentration relies on the assumption that not only the level of the observed variable is relevant, but also its position

and distribution *in space*. The first essay of this thesis has anticipated some significant evidence of the fact that "space matters" in Milan: for instance, many of the most vulnerable population groups are subjected to centrifugal forces pushing them to the outer boundaries of the city or to the hinterland and, according to many recent studies, poverty concentration may foster segregation processes or exacerbate the existing inequalities, reducing opportunities for social mobility and affecting the nature and quality of relations between groups in society (Zajczyk 2005).

During almost the past 2 decades, there has been an increasing interest in literature upon the depiction of the so called (poverty) "hot spots"[45] as a way to look at the local concentration patterns of a given variable or index and to their effects within cities (e.g. Cooke, 1999; Holloway, Bryan, Chabot, Rogers, & Rulli, 1999; Massey, Gross, & Shibuya, 1994; Shaw, Gordon, Dorling, Mitchell, & Smith, 2000). Research has been performed even on many emerging economies such as the Chinese one, with respect to urban inequalities (Chan, 1996; Gu and Kesteloot, 2002; Gustafsson and Zhong, 2000; Fan and Taubmann, 2002; Khan and Riskin, 2001; Qian and Wong, 2000; Solinger, 1999, 2001; Wang, 2002; W.P. Wu, 2002, 2004; F.L. Wu, 2004). On the other hand, very little research has been made with respect to *spatial distribution* of poverty within a city even if, as pointed out by Myint,

> << a typical urban context normally performs a wide variety of social, economic, cultural, and political functions. However, the terms social, economic, cultural, and political are not completely

[45] A hot spot is considered as an area with a greater than average local concentration of poverty, or an area where people register a higher than average risk of vulnerability. According to a definition given by Greene, concentrated urban poverty means localization of the poors into a small number of neighbors, rather than being dispersed across the whole city (Greene, 1991). "Hot spots" have been largely used in literature in order to explore the relationship between poverty and crime, either in descriptive and causality terms: some refer to hot spot *addresses* (Eck and Weisburd, 1995; Sherman, Gartin, and Buerger, 1989), others refer to hot spot *blocks* (Taylor, Gottfredson, and Brower, 1984; Weisburd and Green, 1994), and others examine *clusters of blocks* (Block and Block, 1995). Crime analysts, in particular, look for concentration of individual events that might indicate a series of related crimes. They also look at small areas registering a great deal of crime or disorder, even though there may be no common offender. They finally observe neighborhoods and neighborhood clusters concerned with high crime and disorder levels and try to link them to underlying social conditions (A. R. Gonzales, R. B. Schofield, S.V. Hart, 2005).

> independent, but intersect and interrelate. […] The examination of where different activities are located within a city, how they are related, and what generalizations can be made about their spatial patterns and arrangements is an important step towards understanding internal activities, interaction among functional units, and growth and development in an urban system >> (Myint 2008).

A complementary trend still receiving less attention is the spatial distribution of the most affluent population within the same urban area (Coulton et al., 1996), with a very few exceptions such as, for instance, a study by Webster, Glasze, and Frantz (2002) discussing the impacts on the global spread of gated communities[46] and the implications for urban social and spatial structure. The conclusion that many draw from such findings is that, since "space matters", then the solutions should be geographically "area-based" (Johnston, Voas, and Poulsen 2003)[47]. In addition, Johnston et al. (2003) also argue that it is important to use measures of geographic concentration that depict the degree and regime of clustering at a so detailed level that area-based policies can be more efficiently targeted and implemented.

[46] Strictly speaking, a gated community is any residential area which physically restricts the entrance of nonresidents. By this definition, gated communities have existed mostly throughout the United States for over a century. Although each gated community and each neighborhood charter differs, most share a few common characteristics: physical barriers to entry and movement, the privatization and communal control of public spaces, and privatization of public services such as trash removal and police forces. As pointed out by the authors, "also in Europe there are, so far, relatively few private residential neighborhoods. Nevertheless, an increase in this kind of housing is apparent in some countries. Starting in the 1980s guarded residential complexes appeared on the Mediterranean coast of Western Europe (Spain and France), offering exclusive second homes as well as all-year dwellings. At about the same time, complexes started to appear in major cities. Numbers of suburban gated settlements were rising in Madrid and in Greater Lisbon during the 1990s. In Britain, Webster (2001) distinguishes three forms of complex: upgraded social housing estates transformed by gates, concierges, and innovative local management institutions; smart city-centre condominium-style developments; and small gated suburban developments of no more than 300 homes. In the metropolitan regions of Vienna (Paal, 1998) and Berlin (Glasze, 2001) developers have attempted to introduce gated housing projects to real estate markets. Anecdotal evidence suggests that guarded residential complexes are emerging in Central-east and Eastern European, sometimes as developments of former exclusive compounds of the ruling elite. This phenomenon remains largely unexplored." (Webster, Glasze and Frantz 2002).

[47] See, for example, Pastor (2001),Young (2000); for a debate on the argument's validity, see McCulloch (2001) and Dorling and coauthors (2001).

2.1.2. Unsolved topics and the ESDA approach

In order to study poverty concentration, some conventional poverty mapping and SME (small area estimation) techniques are widespread implemented, inspired by, among other works, Elbers, C., J. Lanjouw, and P. Lanjouw (2003). These techniques are often used for the formulation of policies in developing countries, enabling to compare the existing surveys on households with the general census of the population and generating an estimate of the standard of living. Crossing the information obtained with Geographic Information System (GIS) technology is then possible to obtain poverty maps even for the smallest administrative units. Unfortunately, such techniques assume the concept of *homogeneous* space, which is rarely seen in practice, and do not take into account the total components and dependencies that characterize the spatial data, especially those emerging from social interactions and unobserved factors (such as the status of the soil, rather than air pollution, etc.). Ignoring the space component, the analysis may be distorted on the econometric field and fail in the formulation of *ad hoc* policies.

Exploratory Spatial Data Analysis (ESDA) approach, by contrast, captures the spatial relationships between areas, through the use of weights matrices and a proper definition of neighborhood according to a certain degree of interrelation between units of observation. It is easy to understand how this approach allows analysis at a higher level of accuracy, particularly in the processes of inference and, above all, a full description of the spatial distribution of those variables of interest by identifying a concentration trend or the presence of *multiple* spatial regimes, either not stable (Haining 1990, Bailey and Gatrell 1995; Anselin 1998a,b, Le Gallo and Ertur 2003). In general terms, ESDA explains how environment (or space) "matters" for the empirical analysis of the concentration of poverty under the basic evidence of *spatial autocorrelation* (which is the lack of independence between geographical observations and so presence of spatial concentration) and *spatial heterogeneity* (which is related to different correlation behaviors in space and so presence of different regimes of spatial concentration)[48].

[48] Spatial autocorrelation is based upon the fact that, within a geographical reference area, "everything is related to everything else, but near things are more related than distant

Nevertheless, the spatial relationships and the interpretation of the variables themselves (in this case incomes) are influenced by the choice of the criterion of spatial aggregation of information[49].

The essay is organized as follows. In § 2.2 I review current research on poverty concentration in urban contexts, with the emphasis on the limits of some conventional measurement techniques of poverty concentration and the potentials of ESDA approaches, including the spatial autocorrelation tests (global Moran's I) and the tests for local clustering and instability (LISA). The use of different weighting matrices is recommended, in order to verify the robustness of the results and to test the validity of some concepts of distance between the most commonly used in literature. In § 2.3 I elaborate and discuss the spatial statistics introduced and in § 2.4 I draw some concluding remarks.

2.2. Concentration of poverty in urban areas: literature review

During the post-war period, urban dynamics have exhibited complex spatial patterns including both population spread and employment suburbanization from the central city towards the suburbs, both in US and European metropolitan areas. An important literature, based on North-American metropolitan areas, has highlighted the strong link existing between this process of suburbanization and the reinforcement of socio-spatial concentration under the form of segregation against poor populations

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things", according to the so called "First Law of Geography" (Tobler 1979). In other words, nearby regions should yield a correlation with one another. In economic agglomerations, for instance, it is quite common to observe not only a high concentration of economic activities in the centre, but also at the peripheries level, since they are also affected by network and transmission effects. In other words, economic activity tends to cluster in space (Le Gallo/Ertur 2003). The second spatial effect, heterogeneity, results from the existence of spatial autocorrelations. Following the concept of time series analysis, this effect is also referred to as spatial non-stationarity (Kosfeld/Eckey/Türck 2007).

[49] For instance, depending on whether one considers the 180 functional areas of Milan, rather than the former 20 areas of administrative decentralization, or the current 9, the assumptions underlying the autocorrelation and the contiguity concept might vary and so many areas would interact with some and not with others. This is also known as Modifiable Areal Unit Problem or MAUP (Magrini 2004).

living in the central cities (Kain, 1992; Ihlandfeldt and Sjoquist, 1998). On the contrary, [as may be the case of Milan], European cities do not usually follow this pattern: populations with high income remain localized in and near the city center, while periphery mainly concerns households with modest incomes (Le Gallo and Gaschet 2005).

2.2.1. The a-spatial contribution

Two of the main concepts which are commonly associated to poverty concentration are *concentration threshold* and *segregation*. The first concept (i.e. concentration threshold) directly relates to the definition of poverty itself: we may consider as poor those individuals or families earning less than some level of income (Coulton et al., 1996), or spending more than a certain proportion of its income because of other demographic characteristics that are strongly correlated with poverty (Greene, 1991). According to a broader concept of poverty, poors are those not able to afford the basic capabilities of life, either economic and social (Sen, 1985). In particular, if the proportion of poor people living in the considered census tract exceeds some arbitrarily fixed threshold of the census tract population, then the census tract is categorized as having a high poverty rate, so an area of concentrated poverty (Orford 2002). This method is known as the *concentration threshold*, firstly adopted in a study by Jargowsky (1996) focusing on the incidence of concentrated poverty and the ranking of the census tracts. Similar research has been undertaken in the UK, even combining several measures of material deprivation with appropriate weighting into a single measure of multiple deprivation, obtaining a means of catching concentrated poverty at the ward level (IMD 2007). However, a major problem with the *concentration threshold* method is that it is highly dependent upon arbitrary choices. So by changing these thresholds, even by a small percentage, it is possible to change the incidence of concentrated poverty. Secondly, inequality among incomes refers to a measure of dispersion in the distribution, but not with how this dispersion is organized spatially. In other words, it is not possible to understand the correlation patterns related to the distribution of such inequality.

The index of dissimilarity, indicated conventionally by the letter D (Duncan and Duncan, 1955), associates the phenomenon of poverty concentration to the concept of *segregation*, particularly in the urban contexts (eg Massey & Denton, 1988) or, in the literature related to urban poverty, to the distribution of the poor within cities. In particular, an index equal to the minimum, i.e. 0, corresponds to the maximum dispersion of the poor, while an index equal to the maximum, i.e. 1, corresponds to total concentration of the poor in a given segment or portion of the city. In other words, D can be interpreted as the share of the poor population which would have to move to a new neighborhood to achieve an even distribution of population types (rich and poor) across all neighborhoods (Rey and Folch 2009). Unfortunately, this index cannot be referred to more than two groups (rich/poor, black/white, men/women) and it is not spatial. An index of 0.5, for instance, may suggest that the area is considered inhabited by a half from a group of only Italians and by the other half by a group of only foreigners, or by a mix of the two groups at 50%, or under any other combination that generates a total score of 0.5. One of the most interesting adjustment of this index has been introduced by Morrill in 1991, who has taken explicitly into account the space and reduced the initial D by an amount related to the exposure population in neighboring areas, where the presence of any residents of population is considered a contributor to greater integration and thus a reduction in segregation (Rey and Folch 2009).

Other traditional measures of *a-spatial* poverty concentration include the Gini coefficient, the variance (as a measure of variability), the coefficient of variation, the standard deviation of logarithms, Theil entropy measures, the mean absolute deviation from the median. We briefly recall here, as suggested by Sen, that all these measures satisfy the principles of anonymity, invariance, Pigou-Dalton condition, decomposability and sensitivity (Sen, 1985). However, as was also the case of the dissimilarity index, some of these requirements lose sense in case of spatial concentration. Arbia (2001) suggests then to consider a spatial distribution based on the simultaneous consideration of both concentration in an a-spatial sense and polarization, through the employment of the so called GI (Gini- I Moran's) scatter plot.

2.2.2. The spatial contribution

During the past two decades, developments in the field of spatial econometrics (Anselin 1988, 1996, 2003) have contributed to the debate on the measurement of concentration in two important outcomes, as witnessed also by numerous papers published on applied economics and econometrics journals[50]. First, studies in a variety of social science disciplines have demonstrated the value gained by explicitly considering spatial effects in explanatory statistical models. Such studies can be found in criminology (Baller, Anselin, Messner, Deane, & Hawkins, 2001), economics (Case, Rosen, & Hines, 1993; Holtz-Eakin, 1994), agricultural economics (Nelson, 2002), land use and land cover change (Bell & Irwin, 2002; Mertens, Poccard-Chapuis, Piketty, Lacques, & Venturieri, 2002; Muller & Zeller, 2002; Munroe, Southworth, & Tucker, 2002; Nelson & Geoghegan, 2002; Vance & Geoghegan, 2002), environmental and resource economics (Anselin, 2001b; Bockstael, 1996; Simmons et al., 1973; Walker, Moran, & Anselin, 2000), adoption/diffusion studies (Case, 1992), geographic patterns of suicide (Baller & Richardson, 2002), and real estate analysis (Can & Megbolugbe, 1997; Pace, Barry, & Sirmans, 1998), insurance (Williams and Heins, 1976), technology (Hultzer et al., 1983), engeneering (Diamond, 1981), finance (Arbia, 2002), and many others (a review may be found in RSS, 1999). Secondly, these contributions have been made and enriched thanks to the progressive updating of softwares for processing and visualizing spatial data including, to name just the major ones, GeoDa and ArcGis (Anselin, 1999; Goodchild, Anselin, Appelbaum, & Harthorn, 2000)[51].

The idea behind this new approach is, precisely, to include a priori the spatial structure of a given variable, i.e. the *average income in a given neighbor*, for its measurement and not, as often happens, to be deducted later from a map. In this way, in fact, we run the risk of underestimating

[50] Among the main ones with respect to this field I recall here Econometrica, Econometric Reviews, Econometric Theory, Journal of Applied Econometrics, Journal of Business and Economic Statistics, Journal of Econometrics, Review of Economics and Statistics.

[51] Because of the large variety and number of disciplines included, the very last references in this paragraph have been omitted in the appendix (being most of them not related with the topic explored in the present essay). They are all available upon request.

locally the phenomenon of interest and estimate properly, laying the groundwork for the formulation of *ad hoc* policies (Newby, 1982). In general terms, it is assumed that proximity facilitates a significant interaction between adjacent areas, with a number of interesting and certainly not negligible effects. Just to recall some of them: positive or negative externalities from neighboring areas, including their tendency to employ relatively similar systems of welfare for productive purposes (ceramic districts) or, within the U.S., the fiscal spillovers between public schools in neighboring districts.

2.2.3. The ESDA approach

Among the major statistical tests used to capture the spatial structure of variables or indices of interest there are some essentially inspired by those concentration measures introduced earlier, such as the Mean Center[52], the Standard deviation distance (SD)[53] and the Standard deviation ellipse[54].

Together with these, several approaches in Distance Analysis and in Spatial Econometrics can be applied to test for clustering in poverty distributions, using the basic principles of hypothesis testing and mainstream statistics. In particular, whether the initial assumption (H_0)

[52] The Mean Center can be used as a relative measure to compare spatial distributions between different poverty characteristics (i.e., infrastructural poverty, socioeconomic poverty, symbolic poverty) or against the same poverty type for different periods of time (i.e., for measuring spatial shifts in the income poverty). Based on such assumptions, the Spatial Mean Center (SMC) provides the average location of a set of point locations: whatever the points in a spatial database represent, each point may be defined operationally by a pair of coordinates (x, y), for its location in a two-dimensionally space. With the use of a coordinate system, the spatial mean center can be obtained by computing the mean of the x coordinates and the mean of the y coordinates.

[53] The Standard deviation distance (SD) explains the level and alignment of dispersion in the poverty data (which is greater with greater SD). It is possible, for instance, to use standard distance measure to demonstrate how distributions of socio-economic units deviate from their spatial mean centers. Standard distance is expressed in distance units, which are dependent on the projection system employed. Please refer to Lee and Wong (2000) for more details.

[54] The standard deviation ellipse depicts the levels of dispersion, since its size and shape help explain the degree of dispersion, and its alignment helps to explain the poverty type's orientation. There are three components in describing an SDE: the angle of rotation, the deviation along the major axis (the longer one), and the deviation along the minor axis (the shorter one). Please refer to Lee and Wong (2000) for more details.

reveals a completely random distribution of poverty or wellbeing (CSR pattern), the alternative hypothesis (H_1) requires a particular type of autocorrelation among the residuals that justifies the existence of systematic effects of contagion among the areas, well beyond a random logic. Some tests for clustering are based on the distance analysis, sometimes according to the need to identify *second-order* characteristics of the distances between points[55]. If there are patterns or clusters of data, the distribution of phenomenon may be related more to a local pattern, rather than a global pattern and the commonly used methods belong to Distance Analysis. However, if on one hand such center-graphic measures are relatively easy to calculate, on the other they are globally (rather than locally) descriptive and can be corrupted by outliers (Orford 2002).

Spatial autocorrelation tests are adopted, then, to verify whether the distributions of point events are related to each other. In formal terms, spatial autocorrelation (SA) is the correlation of one variable or index Z (say per capita income) with itself, but in another place (for example between Centro Storico neighborhood, i, and Greco-Zara neighborhood, j):

$$SA = Corr\ [(Z(s_i), Z(s_j)] \quad (1)$$

A positive spatial autocorrelation exists if the variable (or index) of interest takes, in a given area, similar values when compared with adjacent areas, rather than in remote areas. In formal terms, a positive autocorrelation means that nearby objects in the plan tend to have similar values of Z or, in other words, tend to *concentrate*. The concept of "closeness" is quite significant: according to the definitions we choose, it is possible to build a corresponding weighting matrix and identify with precision the effects of contagion. Here, it is useful to return briefly to the taxonomy proposed by Arbia (2006).

A first definition of closeness takes into account, for example, the notion of *critical cut-off*. Two regions or areas are considered neighbors if they fall

[55] *First order* properties identify the global, or dominant pattern of distribution – where is it centered, how far it spreads, any orientation. *Second order* (local) properties identify sub regional, or neighborhood patterns within the overall distribution.

within a certain geographic linear distance, indicated conventionally with d_{ij}.

A second definition goes back to the notion of "nearest neighbor", according to which two areas are close if they minimize the distance between them:

$$d_{ij} = \text{Min}\,(d_{ij})\ ,\ \forall\ i, k \tag{2}$$

Finally, according to the concept of neighborhood based on contiguity (which characterizes the discrete variables), the proximity is determined by the adjacency between polygons, then the sharing of at least one border. In particular a contiguous "queen" weighting matrix defines the bordering areas on the basis of adjacency of an edge or even a summit, unlike the "rook" matrix of weights limits the proximity only to an edge.

In this work, the global spatial autocorrelation (SAC) has been tested through a test of Moran, as widely recommended in literature (Levine, 2002; Bailey and Gatrell, 1995; Anselin, 1992; Ebdon, 1985), comparing then the value assumed by the average per capita income in a given area with the closest ones, on the basis of the importance that each neighbor has. Once tested the robustness of results through the use of three alternative matrices (two more based on distance and one on contiguity), particular attention has been finally paid to the results of tests for local clustering and instability (LISA).

2.2.4. The Global Moran's I

According to the formulation of Kelejian and Prucha (2001), we have considered a regression model, where disturbances follow a spatial autoregressive model (SAR) (1,1) :

$$y_N = X_N \beta + u_N\,, \tag{3}$$

$$u_N = \rho W_N u_N + \varepsilon_N\,, \tag{4}$$

where $\varepsilon_{i,N}$ are i.i.d. with E $\varepsilon_{i,N}$ =0 and $E\varepsilon_{i,N}^2 = \sigma^2$.[56]

If û denotes the OLS residuals, the Moran I test statistic will then test, as anticipated in the introductory part, $H_0 : \rho = 0$ against $H_1 : \rho \neq 0$:

$$I = \frac{\hat{u}'W\hat{u}}{N^{-1}\hat{u}'\hat{u}\left[tr((W'+W)W)\right]^{1/2}} \qquad (5)$$

The results in Kelejian and Prucha (2001) imply that I is distributed as a normal with mean zero and variance equal to one.

In matrix form, using a notation reported by Anselin (1988) and Le Gallo and Ertur (2003), Moran's I statistic may be written as :

$$I_t = \frac{n}{S_0}\frac{z'_t Wz_t}{z'_t z_t} \text{ , t=1, 2, 3} \qquad , \qquad (6)$$

where z_t is the vector of the n observations for year t in deviation from the mean. W is the spatial weight matrix, that is the one selecting neighbors and indicates how important each neighbor is. The elements w_{ii} on the diagonal are set to zero, since a single region cannot be the neighbor of itself, while the remaining elements w_{ij} measure (how important is) the spatial connection between two different regions, i and j. S_0 is a factor equal to the sum of all w_{ij}. Moran's I_t statistic indicates, again, the level of linear association between z_t (vector of observed values) and Wz_t (vector of spatially weighted averages of neighbors), that is the *spatially lagged vector*[57]. Values of I larger (rather than smaller) than the expected value indicate positive (rather than negative) spatial autocorrelation.

[56] For simplicity of notation, we will drop the index N referring to the dependency on the sample size. Let also $\hat{u}$ denote the OLS residuals.

[57] In time series analysis we define the lag operator as $L(X_{t_i}) = X_{t_{i-1}}$. In a spatial context the concept is of difficult extension due to the multilateralism of proximity in space. A lagged value can be any of the neighbors, according to the neighborhood definition chosen and, so, from $L\left[X(s_i)\right] = \frac{1}{\eta_i}\sum_{s_j \in N(i)} X(s_j)$, we obtain after quick calculations $L\left[X(s)\right] = W * X(s)$.

As previously mentioned, in literature there are many types of matrix W, corresponding to as many definitions of distance: binary contiguity matrices, binary spatial weight matrices with a distance-based critical cut-off, and more sophisticated distance-based ones. Critical cut-off may differ between areas, or be fixed. The choice of the best spatial weight matrix, given the data and the purposes of the study, is one of the most controversial methodological issues in exploratory spatial data analysis and spatial econometrics (Anselin 1988; Florax and Rey 1995). In general terms, it is always convenient to check the robustness of the results using different types of matrices, such as the distance-based ones with, for instance, a different number of neighbors or such that w_{ij} equals a certain distance in kilometers between each centroid (location i) to all others centroids (location j) or a certain number of hours taking to drive from location i to location j. Main recent references for these last are Artis, Miguelez and Moreno (2009) and Cañadas (2008). As pointed out by Le Gallo, it is also possible to generalize into more accessible indicators, since various functional forms are also available, the most used being the inverse exponential function or a function of the inverse of the distance (Le Gallo 2003). Such a methodology has been extensively used and mainly applied to agglomeration dynamics in urban areas by, among others, Guillan and Le Gallo (2006), Lafourcade and Mion (2007) and Barbaccia, Davì and Lòpez-Bazo (2009)[58].

2.2.5. The Local Moran scatterplot

The spatial autocorrelation is summarized, on the basis of observations, using a diagram or plot called Moran scatterplot (Anselin 1996), which describes the behavior of the spatial lag Wz_t , compared to the vector of original values, z_t. The four different quadrants of the diagram correspond to as many types (or regimes) of correlation of a given index, measured in an area and in neighboring ones. In particular: (i) the upper right quadrant indicates a concentration trend (typical) between an area characterized by a high index (say, rich) and others equally characterized by a high index (quadrant HH-I), (ii) the upper left quadrant indicates a concentration trend

[58] The paper (forthcoming) is part of a larger research and has been officially lauched during the SEA World Conference on Spatial Econometrics held in Barcelona the last 9th-10th July 2009, under the title "Measurement of Agglomeration and Spatial Effects".

(atypical) between an area characterized by a low index (say, poor) and areas characterized by a high index (quadrant LH-II), (iii) the lower left quadrant indicates a concentration trend (typical) between an area characterized by a low index (say, poor) and others equally characterized by a low index (quadrant LL-III), (iv) the lower quadrant right indicates a concentration trend (atypical) between an area characterized by a high index (say, rich) and others characterized by a low index (quadrant HL-IV). Those areas in the upper-right quadrant, or in the lower left quadrant, are said to contribute to SAC. However, since Moran scatterplot does not give any significant indications on spatial clustering, it cannot be considered as a LISA in the sense of Anselin (1995).

2.2.6. Local Indicators of Spatial Association (LISA)

Anselin (1995) defines local indicators of spatial association (LISA) those particular statistics that: (i) for each observation, offer a clear indication relative to the concentration of a given variable of interest, (ii) are proportional, once added up to a global indicator of spatial association.

With reference to our research, firstly it is useful to get a local Moran statistic, defined for each area i at time t as:

$$I_{i,t} = \frac{(x_{i,t} - \mu_t)}{m_0} \sum_j w_{ij}(x_{j,t} - \mu_t), \text{ with } m_0 = \sum_i (x_{i,t} - \mu_t)^2 / n \quad (12)$$

with x_{it} the observation and μ_t the mean of observations across regions in year *t*. A positive value of the statistic I_{it} indicates spatial clustering of similar values.

Secondarily, by combining the last information with those from global Moran diagram, we identify the so-called Moran cluster map and the corresponding Moran map of significance[59].

[59] In particular, the cluster map summarizes, for each area, the corresponding significant regime of spatial autocorrelation (if any) between HH, HL, LL and LH. The map of significance clarifies, for the same areas, the corresponding p-value.

2.3. Empirical results

The main results relate, as anticipated, to the distribution of the poorest neighbors (as well as the richest) between 2000 and 2006 and to their tendency to generate spatial clusters (rather than spatial outliers).

2.3.1. Poor and rich neighbors in Milan (2000-2006)

From 2000 to 2006 the average economic wellbeing in Milan (measured in terms of average of per capita incomes declared, weighed for the components of the household) and the number of families seem to grow (with the only exception of 2003), even if the number of family components decreases from 1,85 to 1,75. According to official data from the Municipality of Milan, in 2000 the average per capita income was around € 19.500 and families were 636.440, while in 2006 the average per capita income was around € 25.260 and families were 673.673. At a first glance to Figure A.2.1, the study area seems to be relatively stable, increasing the wellbeing progressively, with the only exception of 2003 (when on average income shift from € 22.210 in 2002 to € 21.738).

In order to localize the most disadvantaged (as well as the most affluent) areas, we have then performed a choropleth quantile map and displayed for each neighbor its average per capita income according to nine possible ranges. In other words, the 180 discrete areas have been ordered on a sliding scale, based on the values of the average per capita income registered. Those neighbors characterized, on average, by higher values of per capita income (last range) have been marked by lighter greys (up to white), while areas of progressively lower per capita incomes (i.e. poorer) have been identified by darker ones. Each quantile contains an equal number of areas: for example, in the first range are located the 20 areas (indicated in the legend in brackets) characterized, on average, by the lower income and so on until the ninth range, that includes those 20 areas with, on average, the higher per capita income.

It has emerged, as it was logical to expect, a considerable heterogeneity persisting during the years. As shown in Figure A.2.5 in the appendix, in 2000 the poorest neighbors belong to the broader areas of (according to the

20 subdivision) Quarto Oggiaro and some border districts in San Siro- QT8- Gallaratese, Bovisa-Dergano, Affori-Bruzzano-Comasina, Niguarda-Ca' Granda-Bicocca, Barona-Ronchetto sul Naviglio, Baggio- Forze Armate, some border districts between Forlanini-Taliedo and Corvetto- Rogoredo-Vigentina and the most extreme periphery of Monza- Padova. The richest neighbors are located instead in the city centre and in a few districts in San Siro[60].

The picture is almost time- invariant, with only a few exceptions: as shown in Figure A.2.6, in 2006 some districts of Barona- Ronchetto sul Naviglio slightly improve (even if still considered poor), while Quarto Oggiaro, Baggio- Forze Armate and the extreme peripheries of both Niguarda-Ca' Granda-Bicocca and Monza- Padova consolidate during the years their economic disadvantage, reducing heterogeneity between neighbors.

2.3.2. Spatial clusters and spatial outliers

Before the analysis, an appropriate matrix of weights, conventionally labeled W, has been created. Following a previous study by Orford (2002) and Le Gallo and Ertur (2003), we have referred to two different concepts of closeness to capture the spatial relationships between neighbors and verify the robustness of the results, for a total of 4 different matrices performed. Since, according to previous definitions, weights matrices represent the spatial proximity between two neighbors, binary matrices may be used to measure whether or not one neighbor is adjacent to another one using the first-order queen's case (i.e. two areas are considered neighbors if they shared common boundaries, including diagonal boundaries). Distance-based matrices with a fixed number (k) of neighbors, on the other hand, are based on the k-nearest neighbors calculated from the great circle distance between each area's centroids. Generally, as pointed out also by Le Gallo and Ertur (2003) and Miguelez et al. (2009), fixing an equal number of neighbors for all subareas is helpful to avoid certain methodological problems that may occur when the number of neighbors is allowed to vary. For instance, using other contiguity criteria, such as the ones based on commercial exchanges

[60] Maps of Milan with the 9, 20 and 180 administrative divisions are available in the appendix (Figures A.2.2 and A.2.3).

(Cabrer-Borràs and Serrano-Domingo 2007) and technological proximity (Moreno et al. 2005) may not be appropriate in a relatively small simple such the one we are working on[61], since endogeneity problems are expected to arise. Conversely, those may be used in more complex contexts involving, for instance, different countries within a continent or a group of states (as in the case of Europe and U.S.).

Since the average number of neighbors for our sample, using first-order contiguity matrices, is 6.1, and the median is located between six and seven neighbors[62], I will perform an ESDA with a distance-based matrix for k= 6. Nonetheless, I will also check the robustness of the results using : (i) a first-order contiguity matrix and (ii) distance-based matrices with k= 4 and k=10 neighbors, since we are working with relatively small areas slightly differing in terms of size.

2.3.3. Global and local spatial autocorrelation of incomes

In order to verify if spatial autocorrelation and spatial heterogeneity characterize the measure of economic wellbeing, i.e. the average per capita income, among different neighbors in Milan, we have performed an ESDA analysis based on Moran's I statistic for such a variable of interest in 2000 and 2006. Geary's index has not been computed, since global Moran's I provided very significant results (p= 0.0001). This implies that areas with

[61] Le Gallo and Ertur (2003) suggest, with respect to a sample of European regions, to consider a k-nearest neighbors calculated from the great circle distance between the districts centroids. Therefore they use different values of k in order to check the robustness of our results. These matrices are preferred to the simple contiguity matrix for various reasons. First, they connect a number of islands such as Sicilia, Sardegna, and Baleares to continental Europe thus avoiding rows and columns inW with only zero values. With a simple contiguity matrix, unconnected observations are indeed implicitly eliminated from the computed global statistics but this leads to a change in the sample size and thus must be explicitly accounted for in statistical inference. Second, with k =10, the United Kingdom is connected to continental Europe and Greece to Italy, thus avoiding the block-diagonal structure of the simple contiguity matrix when ordered by country. The spatial connections between regions belonging to different countries are thus guaranteed. Actually, 24.28% of the 10-nearest neighbors belong to a different country. This ratio increases when we increment the number of nearest neighbors in our robustness analysis. Third, by choosing a fixed number of nearest neighbors, we avoid certain methodological problems that may occur when the number of neighbors is allowed to vary (Le Gallo and Ertur 2003).

[62] The distribution of such neighbors (in terms of number of areas with a minimum of 2 neighbors up to a maximum of 13) is available in the appendix (Figure A.2.4).

similar average per capita income values tend to cluster, although we cannot tell from the only coefficient whether these are clustering of high values (relatively rich neighbors) or low values (relatively poor neighbors), or both. In particular, a weighting matrix based on a first-order connectivity between neighborhoods shows a strong positive spatial autocorrelation, while many other weighting matrices based on distance (and thus on the concept of nearest neighbors) show more varied results, but still significant at p= 0.0001. This latter result suggests, as was also the case of London provided by Orford (2002), that the clustering of neighbors with similar per capita income values is spatially extensive, so not just related to those first-order adjacent ones.

According to previous methodological considerations, we have used a distance-based matrix with k=6 with the maximum of allowed permutations, that is 9999, founding then a Moran's I (standardized) of 14,023 in 2000 and 14,758 in 2006 [63]. In other words, at a level of significance of 0.0001, we have obtained evidence of positive spatial autocorrelation. So the areas with relatively high average per capita income (resp. low) tend to localize close to other areas with relatively high average per capita income (resp. low) more often than if their localizations were purely random.

Having considered the evolution of Moran's I statistic over time (2000-2006) and concluding that standardized values of the statistic remain approximately the same, a globally significant tendency towards geographical clustering of similar areas in terms of average per capita income occurs. Figures A.2.7 and A.2.8 in the appendix respectively display the Moran scatterplots in 2000 and 2006.

According to such plots, in 2000 almost 80% of neighbors in Milan exhibited association of similar values (26.6% in quadrant HH and 53.3% in quadrant LL) and, in 2006, 87.5% of neighbors exhibited the same positive association (29.4% in quadrant HH and 58.2% in quadrant LL). Furthermore, the scatterplots have allowed us to identify outliers, such as neighbors deviating from the global pattern of positive autocorrelation. In

[63] According to Le Gallo and Ertur (2003), Moran's I has to be standardized according to the following formula : (I-E(I))/SD, where E(I) is the expected value and SD the standard deviation of the considered distribution.

2000, 36 areas displayed association of dissimilar values (27 in quadrant LH and 9 in quadrant HL), while in 2006 the number falls up to 22 (19 in quadrant LH and 3 in quadrant HL). The major change between 2000 and 2006 thus concerns a growing polarization between rich and poor clusters of neighbors, even if some districts still persist extremely heterogeneous (such as the area of San Siro, Niguarda- Ca' Granda). All these results may indicate the presence of spatial heterogeneity in the form of two main spatial regimes, the first corresponding to the HH scheme including the areas closest to the city center and the second to the LL scheme including mostly the extreme peripheries (both regimes representing positive spatial association). Both LH and HL areas, displaying atypical spatial association, seem to be too few to make up some more plausible regimes.

LISA were computed to further examine these results. Due to the presence of global spatial autocorrelation, inference must be based on the conditional permutation approach with 9999 permutations (Anselin 1995, Ertur and Le Gallo 2003). The local Moran's I has thus been computed under the form of both Moran significance and Moran cluster maps. We have found that those areas depicted in a grey scale in the significance map are correlated significantly at the local level (respectively at the 0.05 and 0.01 level of significance) and that such local correlation, according to the cluster maps, mainly occurs between the richest (colored in lightest grey and concentrated in the city center) and, even more often, between the poorest areas (colored in darkest grey, concentrated mainly in peripheries). Since only a few areas are significantly in the LH quadrant in 2000 (no one in 2006) and, similarly, only a few areas are significantly in the HL quadrant, evidence for these regimes are thus weaker than for the HH and LL regimes. For example, in 2000 there were only four significant HL areas and 1 LH area versus 23 significant HH areas and 45 significant LL areas. In 2006, the numbers are almost the same, with a slightly increasing of the LL significant areas and the reduction up to only one HL area (San Siro, which was still HL even in 2000).

The richest cluster is almost invariant in its composition (falling from 23 significant members to 20) and still located in the city center. One LH area in 2000, in particular, becomes HH in 2006. The poorest clusters are located

in the peripheries and during the years they consolidate their disadvantage. In 2000, four spatial clusters were quite recognizable, occupying the areas of (i) Baggio-Forze Armate; (ii) Bovisa-Dergano, Affori-Comasina, Niguarda-Bicocca-Ca' Granda, Vialba-Quarto Oggiaro; (iii) Monza-Padova; (iv) Corvetto-Rogoredo, Chiesa Rossa-Gratosoglio, Barona –Ronchetto sul Naviglio. In 2006, a global worsening seems to be registered in the suburbs (especially west and south-west), almost by contagion. The poorest areas seem then to be confined in a circular shape in the extreme suburbs, rather than in separate blocks around the city center. The center- (many) peripheries polarization model appears therefore to be the most relevant feature in our sample with regard to spatial heterogeneity. Figures A.2.9 and A.2.10 in the appendix respectively display the significance maps of the average income in 2000 and 2006, while Figures A.2.11 and A.2.12 show the cluster maps referred to the same two reference years.

As a measure of robustness of the results, I have estimated the global and local measures of spatial autocorrelation changing the W matrix. As mentioned in the very preliminary part of this section, a contiguity-based matrix and two more distance-based matrices with k= 4 and k=10 were created, obtaining similar and still significant results, at the same level of significance of 0.001. Results are summarized in Table A.2.13 in the appendix.

2.4. Concluding remarks

Between 2000 and 2006, space and poverty seems to be somehow related in Milan, at least with respect to the income dimension. The essay has firstly considered the distribution of the average per capita income within 180 neighbors and after having depicted the most disadvantaged and the most affluent according to nine income classes, it has verified, through a spatial exploratory analysis, the presence of spatial autocorrelation between them or, in other terms, their tendency to cluster (rather than disperse).

Tests have shown evidence of a highly significant global spatial autocorrelation between incomes, which features at the same time the most

affluent and, even more often, the poorest areas. The concentration trends are based upon two significant but different regimes of spatial autocorrelation and, more specifically : some typical spatial clusters of relatively poor areas, in the most extreme peripheries of Milan (LL) and a typical cluster of relatively rich neighbors, in the city center (HH). One more scheme is also available from the cluster maps, which relates to some atypical outliers that over the years have taken the main form of some rich neighbors surrounded by some poorer (HL), confined in the largest area of San Siro. The results seem to support the well-known model core-periphery, the latter mostly confined in the extreme suburbs tending, during the years, to assume a circular shape, rather than separate poor blocks, around the city center.

This seems to enlighten two more conclusions to the considerations of the previous essay.

First, it seems to be difficult to draw a sharp boundary between “poor areas” and “areas of wellbeing”. The average per capita incomes registered in each neighbor of Milan tend to concentrate between 2000 and 2006, blurring the strictly administrative boundaries and therefore determining ambiguous spatial relationship between poverty of areas and individual poverty. Any statement like "the neighborhood or area X is definitely poor / not poor, or "poverty is certainly concentrated / dispersed " may be difficult to say empirically, even when one looks at a single indicator, such as income. However, a circular shape of “disadvantage” is clearly recognizable and mostly coincide with the extreme suburbs of Milan.

Secondly, spatial interactions and geographical location seem to be relevant. ESDA appears as a powerful tool to complementarily reveal, together with some a-spatial measures of concentration, the characteristics of each neighbor in relation to those closest in the geographical environment and, thus, recommend policies that properly take into account such effects.

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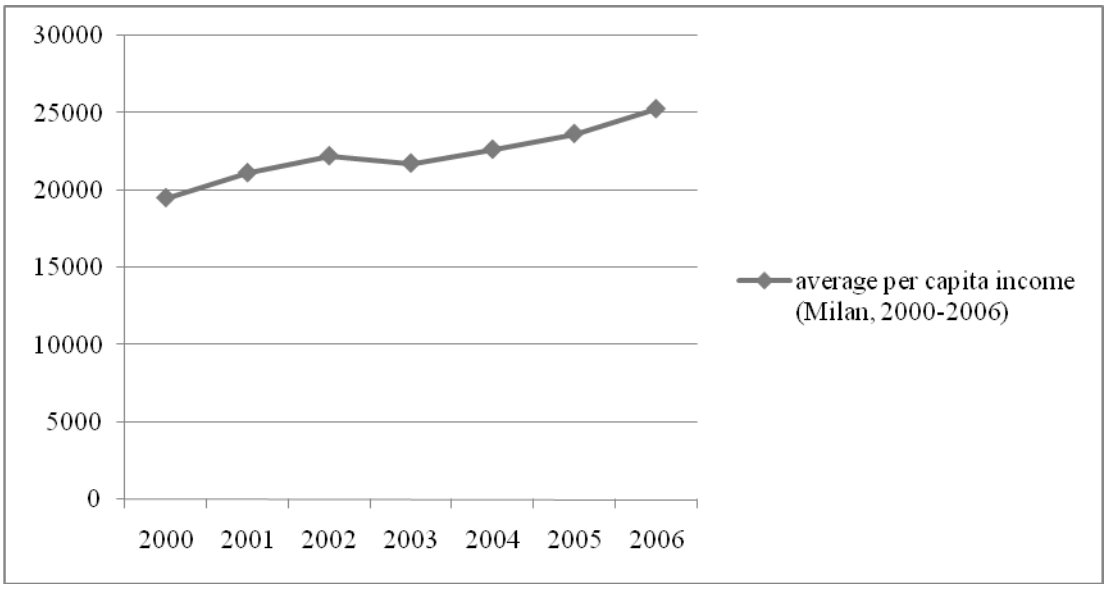
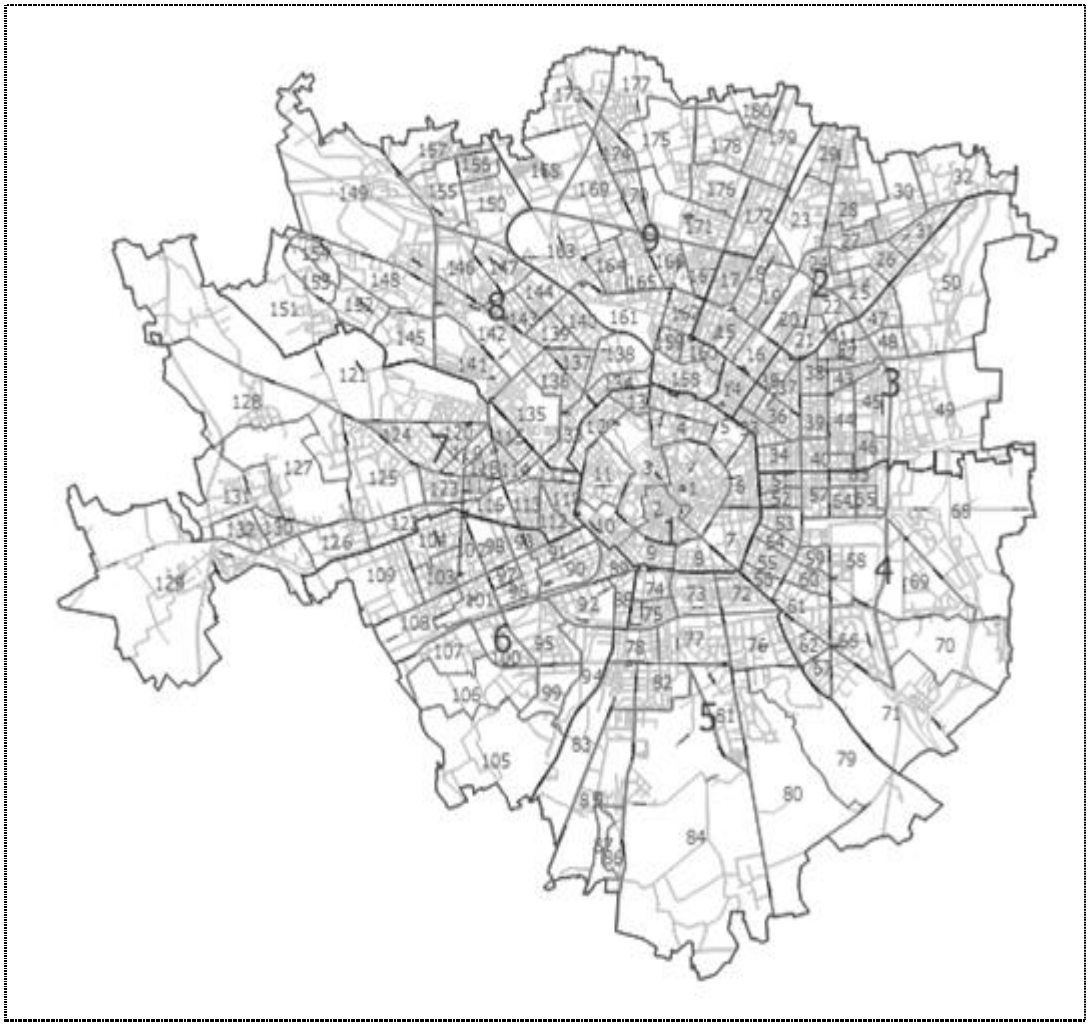
Appendix - ESDA maps and tables

Figure A.2.1 : Average economic wellbeing in Milan (2000-2006)



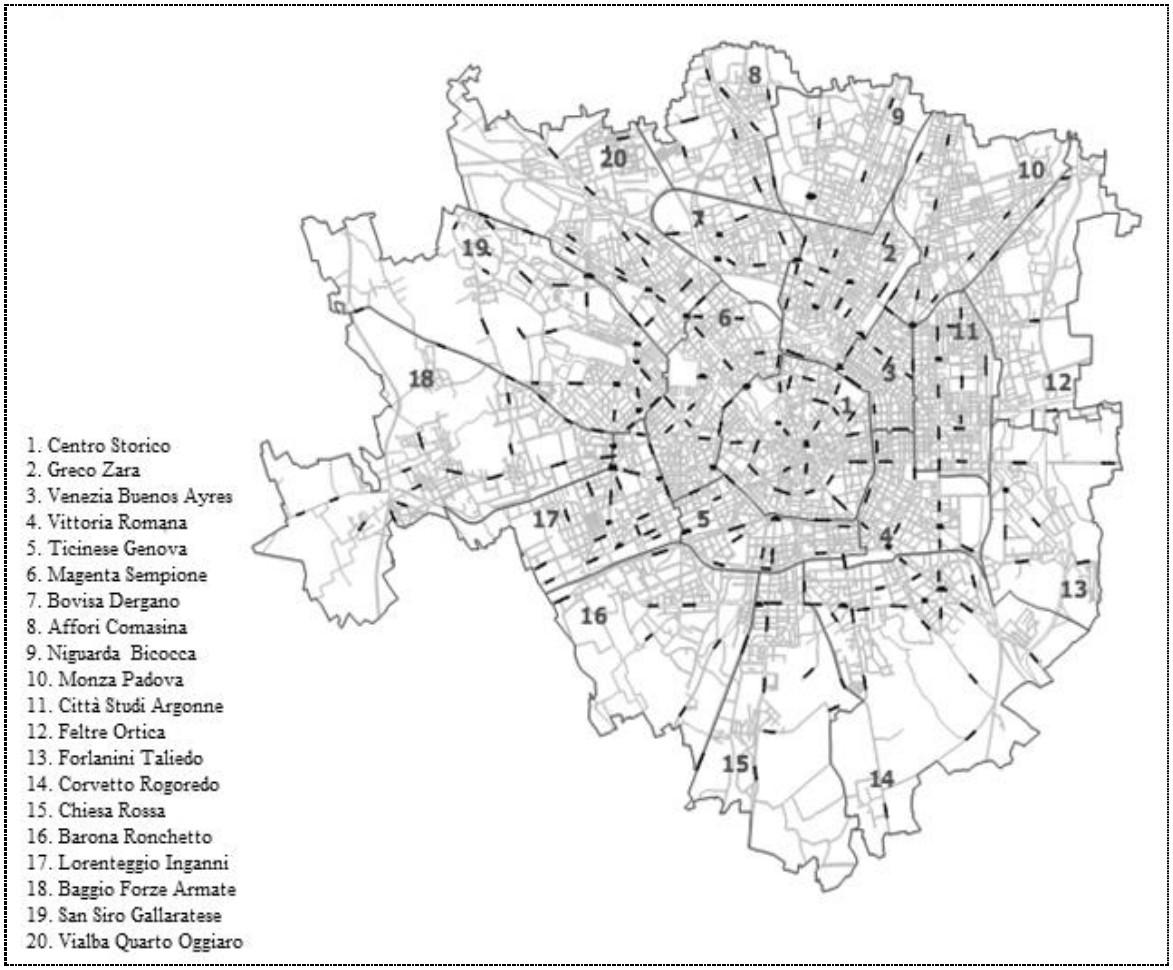
Source: elaboration of the author.

Figure A.2.2 “Aree funzionali” (180, lightest) and administrative units (9, darkest) of Milan



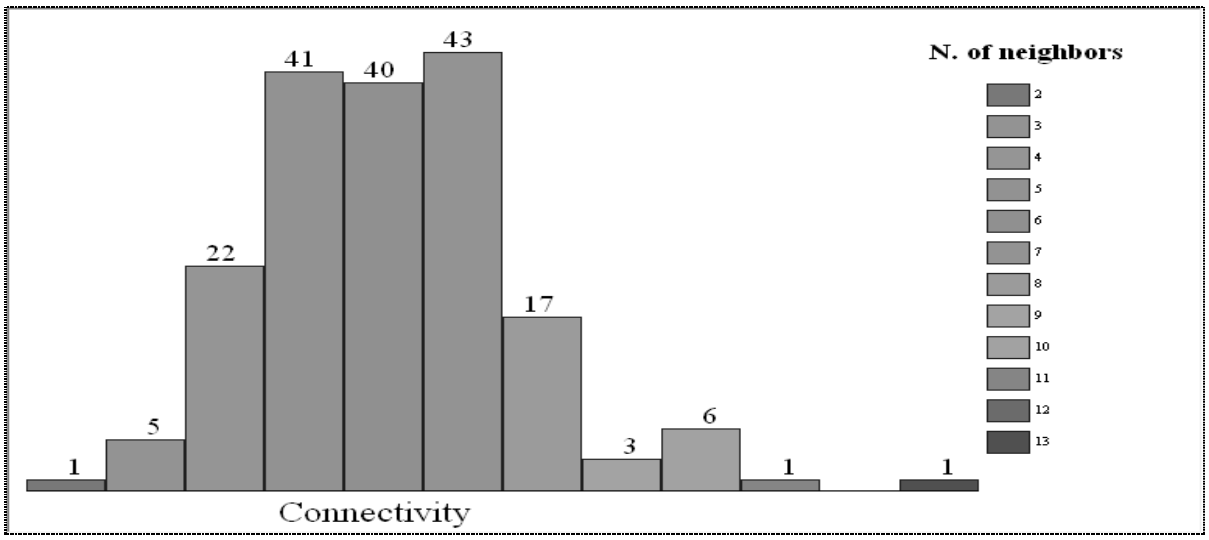
Source: Municipality of Milan.

Figure A.2.3 Former administrative division (20) of Milan



Source: elaboration of the author from a map of Municipality of Milan.

Figure A.2.4 : Distribution of 180 areas under a connectivity-based matrix (queen)



Note: Areas are grouped according to the relative number of neighbors (right column).

Source : elaboration of the author.

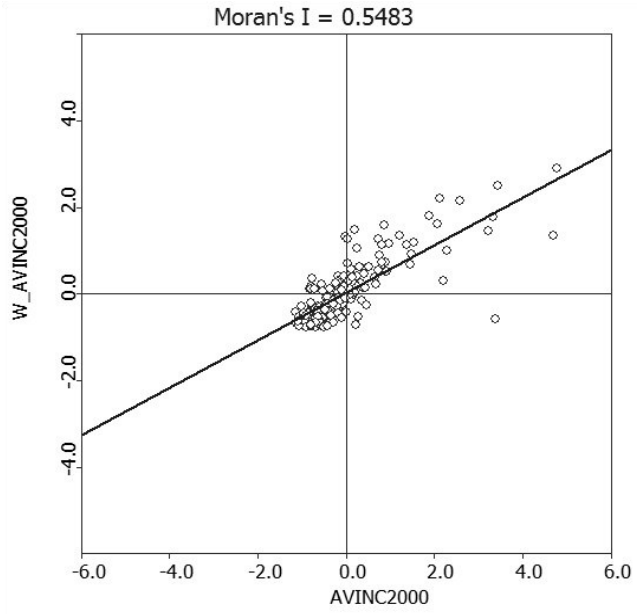
Figure A.2.5 Quantile distribution (9) of the average equivalent income in 2000 in Milan

Source : elaboration of the author.

Figure A.2.6 Quantile distribution (9) of the average equivalent income in 2006 in Milan

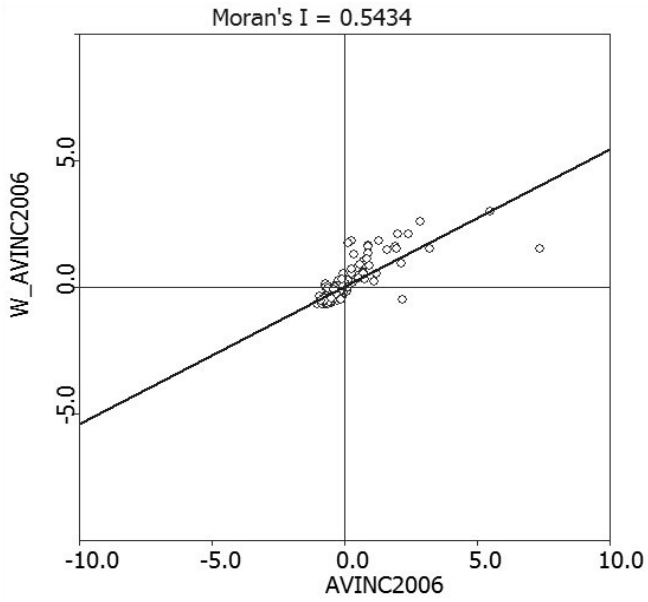
Source : elaboration of the author.
Note: the progressively darkest areas are the poorest.

Figure A.2.7 Moran's I scatterplot of the average per capita income (AVINC) in 2000 in Milan



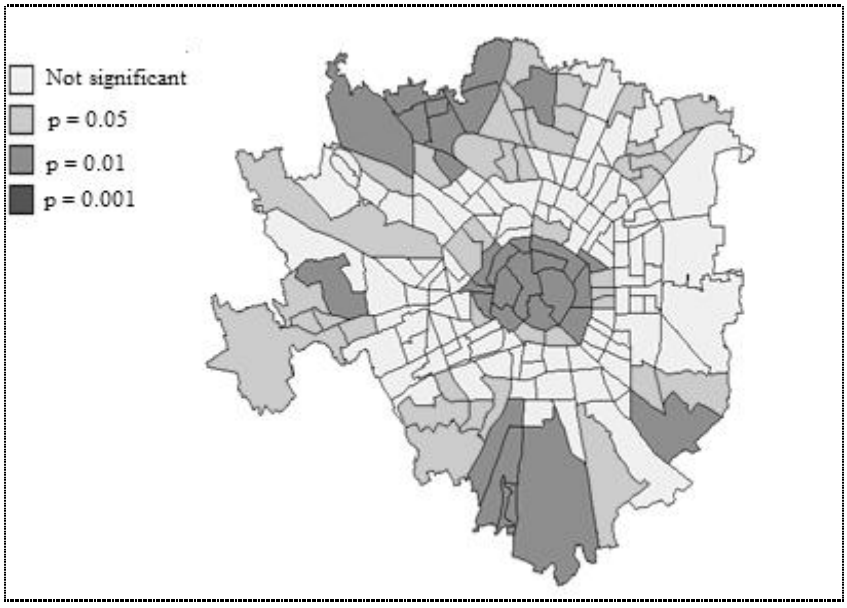
Source : elaboration of the author.

Figure A.2.8 Moran's I scatterplot of the average per capita income (AVINC) in 2006 in Milan



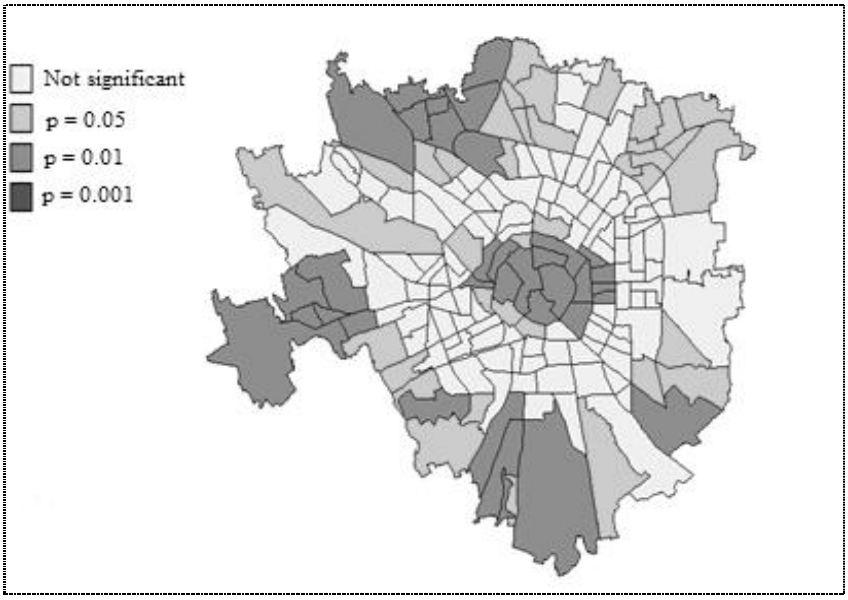
Source : elaboration of the author.

Figure A.2.9 Significance map of the average per capita income in 2000 in Milan.



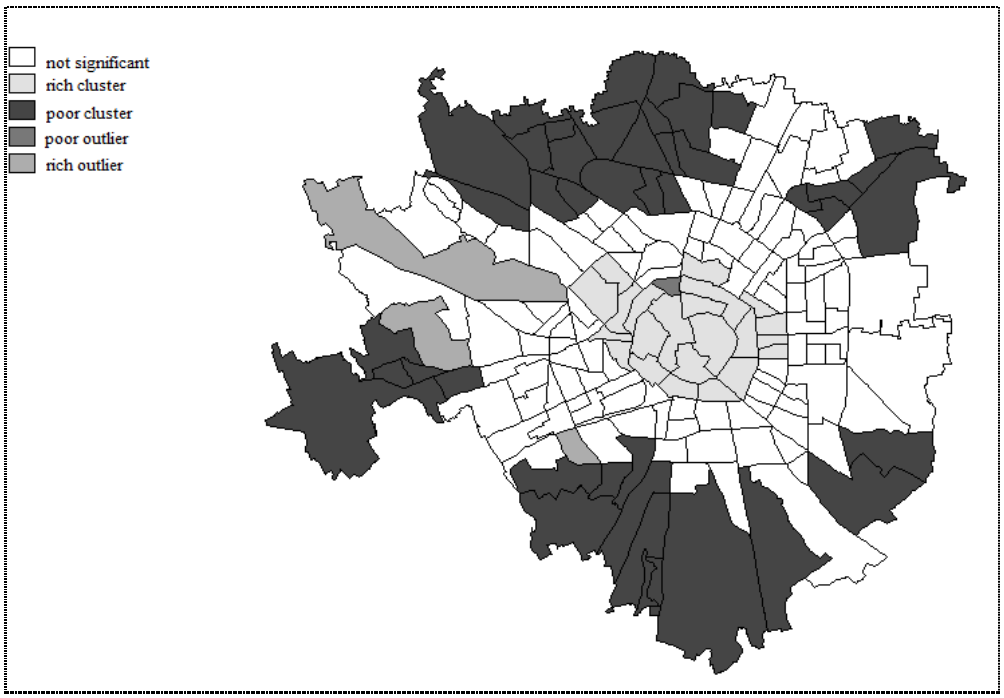
Source : elaboration of the author.

Figure A.2.10 Significance map of the average per capita income in 2006 in Milan



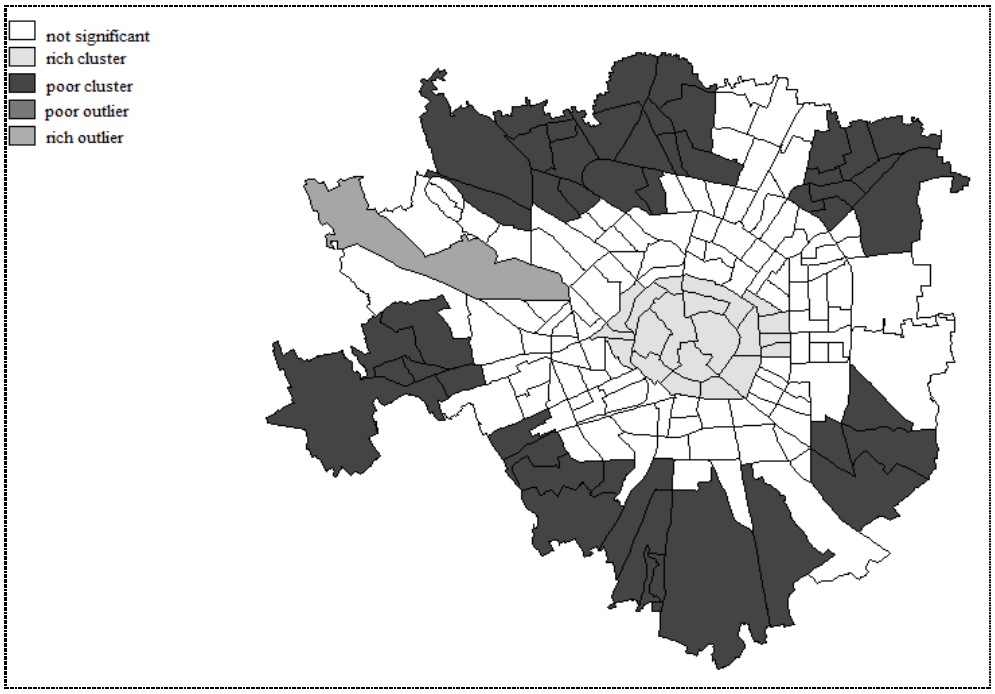
Source : elaboration of the author.

Figure A.2.11 Cluster map of the average per capita income in 2000 in Milan.



Source : elaboration of the author.

Figure A.2.12 Cluster map of the average per capita income in 2006 in Milan.



Source : elaboration of the author.

Table A.2.13 : Moran's I statistics for the average per capita income 2000-2006 (contiguity distance based matrices with k=4,6,10).

	Contiguity		*Distance (k=4)*		*Distance (k=6)*		*Distance (k=10)*	
	I Moran's	I Moran's (S)	I Moran's	I Moran's (S)	I Moran's	I Moran's (S)	I Moran's	I Moran's (S)
2000	0,568	13,683	0,578	12,184	0,548	14,023	0,477	16,077
2001	0,615	14,949	0,617	13,033	0,601	15,541	0,510	17,343
2002	0,575	14,087	0,587	12,582	0,568	14,781	0,479	16,316
2003	0,608	14,724	0,615	13,013	0,595	15,197	0,509	17,197
2004	0,574	14,078	0,584	12,518	0,566	14,795	0,482	16,480
2005	0,553	14,068	0,563	12,408	0,544	14,612	0,467	16,528
2006	0,551	13,777	0,566	12,266	0,543	14,758	0,462	16,226

Note: The expected value for Moran's I statistic is constant for each year : E (I)= - 0.0056. All statistics are significant at **p=0.0001** and computations are based on 9999 random permutations (maximum available).

Source: elaboration of the author.

3. Multidimensional poverty in 180 neighbors of Milan : a confirmatory data based approach

3.1. Introduction

This last essay follows the conceptual framework of the first one, in order to transpose part of the assumptions for the construction of functioning-based indices of wellbeing. The analysis is in fact referred to the most detailed partition of Milan, similarly to the second essay (i.e. 180 neighbors) but considers, rather than only the economic dimension, also the physical and the social ones originally introduced in the first essay. As we have largely pointed out, according to the capability approach (Sen, 1987, 1992), in the evaluation of the "capabilities", great importance has to be devoted to the analysis of the *context* in which the individuals themselves are located. This is true in the traditional *intersection approach*, where multidimensional poverty reflects the accumulation of deprivation in various components, as well as in the *union approach*, where multidimensional poverty is defined as the failure to access to at least one of these dimensions (Luzzi, Flückiger and Weber 2008).

As pointed out by Chiappero-Martinetti (2011) and as already mentioned in this thesis, space can be considered as a direct determinant of wellbeing as well as indirect, in terms of a facilitator of employment opportunities, relationships, accumulation of knowledge. Nevertheless, space *constrains* individual action, preventing or adversely affecting the achievement of goals. A theoretical framework that is appealing in this context is a model which assumes that the different dimensions of poverty or wellbeing are unobservable variables at least collected through a set of indicators (achievements

or, following Chiappero 2011, determinants) and explained by some exogenous variables and conversion factors. Factor analysis, MIMIC (multiple indicators and multiple causes[64]) and structural equation models all fall into this line of reasoning (Krishnakumar 2008). Through these models it is possible to investigate whether the latent variables impact on each other and how they interact depending on such individual and environmental factors. Diversity is taken into account in at least two ways: by a focus on the plurality of functionings (housing quality, income etc.) and capabilities (physical, economic and social wellbeing) as the evaluative space, and by the explicit focus on personal and socio-environmental conversion factors of commodities into functionings, and on the whole social and institutional context which affects the conversion factors and also the capability set directly (Robeyns 2003).

In this essay I am primarily interested to verify the empirical robustness of the theoretical hypothesis on the linkage between space and poverty (which has been extensively illustrated in the first essay), if applied to a more detailed territorial partition (such as the one into 180 functional areas, or neighbors). In particular, the exploratory factor analysis on the available variables allows to test at least two latent constructs as proxies of different facets of the living standard in each of the 180 neighbors of Milan. The first construct seems to deal essentially with material resources, such as education and health facilities, the quality of housing and the environment and the average per capita income. The second construct, on the other hand, includes those facilities fostering relations between people, the sense of community and care towards the most vulnerable groups (small libraries, informal care, centers for households and elders care). This partition seems to encourage the transposition of the "material" latent into both the original *physical* and the *economic* dimensions

[64] This model, initially proposed by Jöreskog and Goldberger (1975) goes further in the theoretical explanation by introducing "causes" of latent factors. According to this model, the observed variables result from the latent factors and the latent factors themselves may be caused (or converted) by other exogenous variables.

mentioned in the first essay and, similarly, the transposition of the "social" latent into the original *social* dimension.

Formally, the goal of this essay is threefold.

Firstly, it aims to perform a preliminary exploratory factor analysis (EFA) in order to determine how, and to what extent, the observed variables are linked to some underlying factors. In particular, I wish to identify and estimate the minimal number of factors explaining covariation among the observed variables[65]. These factors have to be considered as functionings- based measures of poverty, issued from a certain opportunity set based on both individual and environmental information. As mentioned, I will also verify the correspondence between the dimensions used *à priori* in the first essay (according to a typically theory driven approach) with those resulting from the factor analysis.

Secondly, after having consolidated knowledge of the underlying latent variable structure, I postulate relations between the observed measures and the underlying factors, and then I test this hypothesized structure statistically. I perform a confirmatory factor analysis (CFA), since I would argue for the loading of items designed to measure each of the chosen latent dimension of poverty. The model would then be evaluated by statistical means to determine the adequacy of its goodness of fit to the sample data[66].

Thirdly, I introduce a cluster analysis as alternative aggregation rule to identify similar neighborhoods according to the estimated latent *material* and *social* poverty. Similarly to the previous essay, the attempts is to explore the concentration patterns (therefore admitting a relation between space and poverty) given a wider range of variables

[65] Factor analysis has been widely used in the operationalization of the Capability Approach (Balestrino and Sciclone, 2001; Chiappero Martinetti, 2000; Krishnakumar, 2007; Lelli, 2001; Vero, 2006). For the usage of factor analysis within the functionings approach, see Shokkaert and Van Ootegem (1990), Knox Lovell *et al*. (1993) and Delhausse (1995).

[66] For more discussions on CFA, see e.g. Byrne 1998, Bollen 1989, Hayduk 1987, Long 1983.

(rather than considering only income). Following Chiodelli (2009), I finally introduce a typology of policies, to be implemented according to both *people* and *place* components.

This third essay is organized as follows. In § 3.2 I have briefly described the data available for the 180 neighbors of Milan (to be considered, according to the capability approach, as potential functionings of such areas), grouping them according to the conceptual framework adopted in the first essay of this thesis[67]. In § 3.3 I have conducted a preliminary factor analysis to explore the relationships among these functionings-based measures and the latent factors, given the distribution of the former between the 180 areas. I have introduced a suitable conceptual framework to analyze poverty in Milan and included a comparison with the original one introduced in the first essay. In § 3.4 I have introduced a confirmatory factor analysis and estimated the hypothesized measurement model. This could be considered also as the first part of a full latent variable model, being hopefully subject of further research since it requires much more information on the side of the exogenous factors, such as some indicators of policy and public expenditure which are, unfortunately, not available in practice at a so detailed level of disaggregation as the case of the 180 neighbors of Milan is. In § 3.5 I have introduced the cluster analysis to identify the groups of neighbors according to the functionings-based measures obtained and to define a poverty typology based on "being a poor neighbor" under both the intersection and union approach. In § 3.6 I have provided some policy recommendations, suggesting a possible correspondence between poverty types and policy types. § 3.7 concludes.

3.2. The dataset and the sample

The dataset has to be considered as the product of both official surveys conducted by public and private local bodies (extensively

[67] For further details please refer to the first essay.

mentioned in the first essay of this thesis) and a cross sectional survey conducted in the same year (2006) by the research group of the project "Cities, wellbeing and poverty: multidimensional poverty profiles for integrated public actions", in each of the 180 neighbors of Milan. I only recall that most of the official data come from the geographic information system of the municipality of Milan, the General Census of Population 2001 (especially as regards historical buildings including museums, schools, hospitals), some local real estate agencies (such as Gabetti), public health agencies and specialized websites. The only information on income were drawn from the database AmeRIcA. The main objective of the dataset is, similarly to that of the first essay, to further understanding the social and economic determinants of poverty at the neighbor level in Milan, as interdependent combination of both *place* and *people* based components. According to the reformulation of the accepted theoretical framework into multiple latent constructs, major topics of this cross sectional survey were, on one hand, the presence of public services, the quality of housing, the average household net income and, on the other hand, the presence of aggregation facilities able to enhance relations and to foster the sense of identity and social cohesion at the neighbor level. This level of disaggregation was considered preferable to the others available (20 former areas of decentralization, current 9 areas or 88 NIL[68]) for evident reasons of statistical significance. However, the combination of some relevant requirements (sufficiently broad and balanced in both two dimensions coverage; level of disaggregation as to cover the 180 areas; recent data) has heavily influenced the construction of our dataset, which reports only 10 variables over the 27 available at the original level of

[68] The Italian acronym "Nuclei di Identità Locale" stands for a very recent subdivision, adopted by the Municipality of Milan in December 2009 for planning purposes. The basic idea of this new approach is inspired by an idea of a relation-based society, that can accept and systematize the differences between and within the different neighbors of a city. Identity is thus concerned not only as a principle revolving solely around one subject and in general aimed to celebrate the individual components, nor it is intended as a simple legacy of a single story. Each neighbor may be defined on the basis of some typical relation patterns, which are different from one area to another and which can move over the time thus shaping any possible combination of communities and spaces (Russi 2009).

disaggregation (20 areas of decentralization). It is also important to note that data in our possession allowed us to operate with reference to indicators of an objective nature (broken down to the 180 observational units), leaving the important issue of subjective perception for possible future developments of this research.

3.2.1. The physical dimension of wellbeing

Information on physical wellbeing considers four variables. According to the original conceptual framework, this dimension is basically expressed with respect to the total surface of each area, rather than on the population[69]. The first variable is a composite indicator of the availability of health facilities, included hospital and clinics, while the second considers the availability of cultural and leisure facilities (museums, theatres, cinemas, sports fields). The third variable is a composite indicator accounting for many typologies of education facilities (nurseries, primary and secondary schools, universities and research centers) and, finally, the fourth variable refers, still as a composite measure, to the housing quality (on both the average price for sale and the average rent per month). In conclusion, both the two pillars included in the analysis in the first essay (i.e. housing and environment; infrastructure and services) are also considered in this contribution, with the only exception of the sub-pillar related to environment and of some infrastructure related to mobility and commercial services.

3.2.2. The economic dimension of wellbeing

The only variable available for the original economic dimension is the average income, measured (coherently with the previous essays) at the household level and therefore already weighted by the equivalent number of components. However, the income dimension has been further refined since it has been considered the average *net* income, being the most informative of the real perception of the economic living standard in each area.

[69] For any consideration of relevance and for consulting the data selection process please refer to the first essay of this thesis.

3.2.3. The social dimension of wellbeing

Information on social wellbeing, in line with the conceptual framework expressed in the first essay, is basically weighted by the population (or population subgroups) of residents in each area. This dimension actually includes 5 variables. The first variable is a synthetic index that summarizes information on the availability of police stations, including only municipal police, carabinieri and state police with the exception, however, of the national civil defense, military and financial police[70]. The second variable collects information on the availability of libraries at the neighbor level and could be considered a proxy for leisure activities, which are an important means of relaxation, creativity and pleasure, and therefore also important aspects of well-being (Robeyns, 2003; Nussbaum, 2003). The last three variables are indicative of the pillar related to "assistance and care", including information on the number of portierati and social portiers, on the number of centers for households and minors care, on the number of centers for elders care. With respect to the original conceptual framework of the first essay, this dimension may be considered as the most underrepresented, since many of the information available at the level of the former 20 areas of decentralization are not extendable to the 180 partitions of Milan.

3.3. Exploratory factor analysis

The exploratory factor analysis underlines two main assumptions. On one hand, I assume that the various components of poverty are not treated separately, but selected on the basis of their relative importance in the sample. The idea is very similar to that of Slottje (1991), who suggested that, when measuring the quality of life across countries, the indicators could be weighted by the variance of individual attributes. To this end, he used the method of principal

[70] As mentioned in the first essay, the basic underlying idea is that these structures represent an important element of security and control of the area, with a social function also.

component analysis. On the other hand, since latent variables are approximated by multiple indicators that might be interpreted as *functionings* or as *information about functionings* (Bizzotto 2010) and coherently with the fundamental role of the non-mechanic nature of capabilities, such indicators can be introduced in the model through a factor analysis. As pointed out by Luzzi, Flückiger and Weber (2008), each factor constitutes a set of "capabilities" referred to the neighbor, be it the average economic wellbeing, the average housing environment, the opportunities for social interactions, etc. Through a reduction of a set of - logically connected - variables to a few representative components (orthogonal between them), factor analysis allows to explain most of the original variance with minimum information loss. In other words, the extracted factors summarize the entire information that was already contained in the original data, and each factor can be interpreted on the basis of its correlation with the original variables (Balestrino and Sciclone 2001).

Following the matrix notation of Luzzi, Flückiger and Weber (2008), each measured variable x is due to some *unobserved* common factors f and an idiosyncratic affect s :

$$x = Af + s \tag{1}$$

where the vector x includes all observed (standardized) variables, A is the matrix of factor loadings, f is the vector of latent factors and s is the unique effects of the variables.

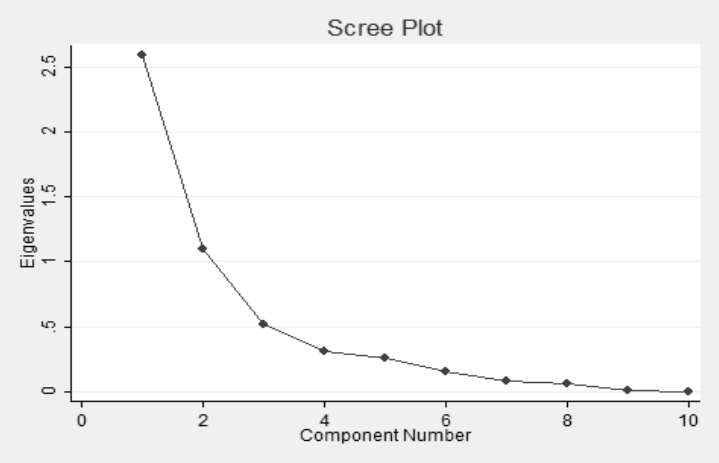
In order to choose the appropriate number of latent factors, we rely on statistical tools commonly used in factor analysis, although we are aware to have fallen into a certain degree of arbitrariness. We have firstly considered the *eigenvalue* criterion (Table 3.1), which should be close to or larger than one. According to this rule, in our preliminary exercise only two factors seem to be suitable to be extracted. The second was the *scree plot test* criteria, which seems to suggest to consider up to the first three factors (Figure 3.1). As a result, we have chosen to extract the first two components, explaining almost 73% of the total variance.

Table 3.1. Results of the extraction of the first five (out of the ten available) factors (unrotated)

Factor	Eigenvalue	Proportion	Cumulative
Factor1	**2.60156**	0.5116	**0.5116**
Factor2	**1.10121**	0.2166	**0.7282**
Factor3	0.51362	0.1010	0.8292
Factor4	0.30761	0.0605	0.8896
Factor5	0.25807	0.0507	0.9404

Source: elaboration of the author.

Figure 3.1 Scree plot - Graphical results of the extraction of factor components.



Source: elaboration of the author.

I have therefore applied a rotation of the factors, in order to provide a more meaningful solution for the loading matrix (Everitt and Dunn, 2001). I opted for an oblique (*promax*) rotation, since it seems more suitable to hypothesize that the common latent factors of wellbeing are correlated. The loadings presented in Table 3.2., following the conceptual framework and notation of the first essay, seem to confirm, at a glance, the adequacy of the transposition of those variables

belonging to the “physical” and “economic” dimension into a unique latent construct and, similarly, the transposition of the “social” variables into another one.

Table 3.2. *Oblimin*-rotated common components matrix

Variable	Factor1	Factor2
Health facilities	0.2117	-0.0768
Cultural facilities	**0.6094**	0.1202
Police	0.1048	**0.7219**
Neighbor libraries	0.3418	0.3992
Education facilities	**0.4142**	-0.1932
Income	**0.8411**	-0.0383
Housing	**0.8475**	0.1248
Informal care	-0.1068	0.3077
Elders care	-0.0950	0.3199
Households care	0.0079	**0.4686**

Extraction method: Factor Analysis, two factors extracted.
Note: Bold indicates high loadings scores (greater than |0.4|).

Source: elaboration of the author.

In conclusion, factor analysis suggests the plausibility of a multidimensional structure to explore the broader concept of wellbeing, in particular distinguishing between one *physical* component (which seems to be related to the functional context and to the average economic standard of living of its residents) and one *social* component (which seems to be more related to a *symbolic* context, able to foster relations of care, aggregation, identity). On one hand, this hypothesis is evidently in contrast with a theory postulating that local wellbeing may be treated as a unidimensional structure, so that all facets are embodied within a single construct. If we refer to the wide literature on quality of life in urban areas, that unidimensional structure approach tends to be, for instance, the favorite conceptual framework behind the construction of some recent multidimensional

indicators of wellbeing[71]. On the other hand many other studies, in the same disciplines, underline the importance of considering different dimensions separately and so including multiple latent constructs as an effort to explain complexity[72].

3.4. A measurement model

3.4.1. Conceptual framework

The exploratory factor analysis allows to consider two latent constructs to explore wellbeing in Milan. These seem to be referred, respectively, to a functional, or *material*, space (including both the former physical and economic dimensions of the first essay) and to a symbolic, or *social*, space (including the former social dimension). This conclusion, however, seems to be in line with most of the recent descriptive work undertaken on the urban environment of Milan, with particular respect to the selection of the most suitable dimensions and related variables[73]. In the next paragraphs, an overview of the two proposed latent constructs is provided, adopting the original conceptual framework extensively illustrated in the first essay.

3.4.1.1. Material wellbeing

The latent *material wellbeing*, at least with respect to the variables selected, is indicative of a purely *physical* relationship between poverty and space and collects two different traditions of though and research. On one hand, following the first essay, it is inspired by the theoretical studies of urban planning, urban geography and

[71] The most known unidimensional constructs are the basis of three international surveys, which are performed annually, as we have extensively pointed out in chapter 2. We briefly recall the Basic Capabilities Index (BCI) – previously "Quality of Life Index"- by Social Watch, the Global Quality of Living Report Global by Mercer Human Resource Consulting, the Economist Intelligence Unit (EIU).

[72] These indices have been illustrated in the first essay. Between the most significant I recall the European Quality of Life Survey (EQLS) by the European Foundation for the Improvement of Living and Working Conditions (Eurofound), the Quality of Life Project in New Zealand's six largest cities, the Calvert-Henderson Quality of Life Indicators (2000).

[73] Please refer to §1.3.3.

sociology[74]. In this perspective, great importance is devoted to the context in which social phenomena are manifested and the physical space is clearly understood as a *functional organization* in terms of provision of services (such as health facilities, education facilities, transports). Poverty is purely conceived in terms of lack of private and public spaces, poor quality building maintenance, poor accessibility of services, spatio-temporal isolation of the neighborhood with respect to the city, poor environmental quality.

On the other hand, material wellbeing may be also influenced by those people living in the area of study, following the theory of *social morphology* of Durkheim and, later, of the Chicago school and its studies of human ecology[75]. In this framework, the attention shifts to the specific local assets as main explanation for social phenomena and the physical space becomes a container of hardship and social marginalization. Poverty, therefore, means spatial concentration of particularly disadvantaged people.

3.4.1.2. Social wellbeing

The latent construct of *social wellbeing*, transposing the social dimension of the first essay, has to be considered as inspired by the discipline of environmental psychology[76]. Assuming that physical space is the basis for a symbolic representation means that it potentially fosters (urban) identity through functions of "recognition, meaning, expressive-requirement, mediating change, anxiety and defense" (Proshansky, Fabian and Kaminoff 1983). In this framework, poverty refers to the loss of meaning attributed to the places and basically becomes synonym of "anonymity". The most suitable indicators for a such dimension of wellbeing are not easy to be found. Ideally, preferences should be accorded to those revealing the lack of benchmarks, the presence of anonymous spaces, the frequent turnover

[74] Please refer to the first essay of this thesis for most detailed references.

[75] Please refer to the first essay of this thesis for most detailed references.

[76] Please refer to the first essay of this thesis for most detailed references.

of business, the lack of aggregation and care services which may consolidate identity and promote mutual and spontaneous relations among people.

3.4.2. Elements and assumptions

As mentioned in the introductory part of this essay, one of the most appealing approach to test the factorial validity behind a conceptual construct comes from the structural equation models, originally developed by Jöreskog and Goldberger (1975), Keesling (1972) and Wiley (1973)[77] and then formalized in the LISREL (Linear Structural Relationships) model. Within this framework, each latent variable – Material Wellbeing, Social Wellbeing – is measured by multiple indicators, representing imperfect signals of the underlying construct, as they are subjected to measurement errors. Indicators are referred to as "reflective", as they are manifestation of the latent factor, implying that a variation in the latent variables determines a variation in all functioning measures (Maccagnan 2010). For the purpose of investigating the latent wellbeing in Milan, we estimate a measurement model with two latent factors (one related to material wellbeing and one related to social wellbeing), leaving the structural part for subsequent research[78]. These factors, however, are likely to be correlated, as they may be affected by some common exogenous factors (for instance by some indicators of policy or public expenditure), or because of the presence of unobserved heterogeneity (for instance between the residents of each area).

[77] Structural equation models are widely used for many different applications. Wide reviews are discussed from the point of view of sociology (Bielby & Hauser, 1977); psychology (Bentler, 1986); and economics (Aigner, Hsiao, Kaptein, & Wansbeek, 1984). General estimation procedures have been established in psychometrics and econometrics (Bollen, 1989).

[78] As widely mentioned, in order to estimate also the structural part of the model, we would have needed some additional information on the exogenous causes of latent wellbeing in urban areas, such as, for instance, indicators of policy or public expenditure. These are actually not available at a so detailed level of territorial partition.

According to the factor analysis, five variables have been chosen as functionings of the latent Material Wellbeing and five variables have been chosen as functionings of the latent Social Wellbeing.

Table 3.3 and Table 3.4. summarize the two sets of information and introduces a notation based on the following equation:

$$y^a = \Lambda^a y^*_a + \zeta_a \tag{2}$$

For each neighbour, or area (a), the measurement part links the latent variables (y^*) to their indicators, that are included in the vector y. Since all the variables chosen as indicators are continuous, the functional form has been considered as linear. Factor loadings (λ) give the magnitude of the expected change in the observed indicator for one unit change in the latent variable. The vector of error terms of the measurement part of the model is ζ . The variance-covariance matrix across the error terms of the indicators of the two latent constructs, ζ_a , is indicated by Θ^a_ξ and is diagonal, as the errors are assumed to have covariance equal to zero, indicating that any correlation across the indicators is driven by the common factor.

Table 3.3. Variables of the Measurement Model for "Material Wellbeing"; "Social Wellbeing"

Vector	Partition	Element	Description
Latent variables			
y^*		y^*_1	Latent Material Wellbeing
		y^*_2	Latent Social Wellbeing
Indicators			
Y		$y_{1,1}$	Availability in the neighborhood of health facilities (clinics, hospitals, emergency), over the total surface (in ha).
		$y_{1,2}$	Availability in the neighborhood of education facilities (nurseries, primary schools, secondary schools, universities and research centers), over the total surface (in ha).
	y_1	$y_{1,3}$	Availability in the neighborhood of cultural and sports facilities (museums, cinemas, theatres, sportsfields), over the total surface (in ha).
		$y_{1,4}$	Housing quality, as combination of information on both the average rental fee/month (bilocal) and the average sale price/ square meter.
		$y_{1,5}$	Average net income (weighted by the equivalent number of the households components).
		$y_{2,1}$	Availability in the neighborhood of police stations (municipal police, carabinieri and state police, with the exception of the national civil defense, military and financial police) over the total resident population.
		$y_{2,2}$	Availability in the neighborhood of libraries (district libraries, libraries with a loan service, media centers, with the exception of foreign libraries and archives), over the total resident population.
	y_2	$y_{2,3}$	Availability in the neighborhood of portierati, social keepers, guardians, over the total resident population.
		$y_{2,4}$	Availability in the neighborhood of centers for households and minors assistance and care, over the total resident households.
		$y_{2,5}$	Availability in the neighborhood of centers for elders assistance and care, over the total resident elders.

Source: elaboration of the author.

Table 3.4. Notation of the Measurement Model for "Material Wellbeing"; "Social Wellbeing".

Symbol	Dim.	Definition
Variables		
y^*	2x1	Vector of latent endogenous variables
Elements of y^* :		
y_1^*	1x1	Latent variable : Material Wellbeing
y_2^*	1x1	Latent variable : Social Wellbeing
Y	10x1	Vector of functionings, indicators of latent variables
Partitions of y:		
y_1	5x1	Vector of functionings, indicators of Material Wellbeing
y_2	5x1	Vector of functionings, indicators of Social Wellbeing
Coefficients		
Λ	10x2	Matrix of measurement loadings
Partitions of Λ:		
Λ_1	5x2	Matrix of measurement loadings for Material Wellbeing
Λ_2	5x2	Matrix of measurement loadings for Social Wellbeing
Error terms		
Z	10x1	Vector of error terms of the measurement model
Partitions of y:		
ζ_1	5x1	Vector of error terms of the measurement model relating to Material Wellbeing
ζ_2	5x1	Vector of error terms of the measurement model relating to Social Wellbeing
Covariance matrices		
Θ	10x10	Covariance matrix for the residuals in the measurement equations

Source: elaboration of the author.

3.4.3. Estimates for factor loadings

Table 3.5. displays the factor loadings and the standardized factor loadings resulting from the confirmative factor analysis. The factor loadings (λ) give the magnitude of the expected change in the observed indicator for one unit change in the latent variable; they represent the effects of the latent Material and Social Wellbeing on outcomes. We show both the results of the unstandardized solution and of the completely standardized solution, as the former provides also estimates of the standard errors and of the significance of the parameters, while the latter facilitates making comparisons among variables measured in different metrics. The average net income and the availability of libraries in the neighborhood have been conventionally chosen as the base indicators respectively for Material Wellbeing and Social Wellbeing. They are the indicators which provide the scale of the others and of the latent variable and therefore for this reason their coefficients are imposed to be equal to one. All the loadings are positive and highly significant for both latent variables. Among the indicators for Material Wellbeing, factor loadings range from 0.896 for the indicators of housing quality, to 0.180 for the pure availability of health facilities (hospitals and clinics). In particular we observe that to the higher factor loadings are associated those variables with a qualitative information (rather than purely quantitative) or, at least, variables collecting information about *different* facilities according to the principle of substitution, such as the case of cultural activities available (museums, theatres, cinemas, sports fields). Similar results can be observed with regard to the Social Wellbeing, with factor loadings ranging from 0.658 to 0.228. The greatest effect on the latent, in particular, is due to the indicators of availability of centers for households and minors care and assistance and of availability of police stations. Informal care seems, on the other hand, to contribute much less, being a prerogative of the peripheries rather than being a common practice among all the neighbors.

Table 3.5. Parameter Estimates: Measurement Model

	Material Wellbeing			*Social Wellbeing*		
	Unstd. Sol.		**CS Sol.**	Unstd. Sol.		**CS Sol.**
	Lambda	S.E.	**Lambda**	Lambda	S.E.	**Lambda**
Income	1	-	**0.808**			
Education	0.666***	(0.157)	**0.331**			
Culture	0.980***	(0.112)	**0.647**			
Housing	1.173***	(0.106)	**0.896**			
Health	0.298**	(0.131)	**0.180**			
Libraries				1	-	**0.636**
Police				1.971***	(0.386)	**0.658**
Informal care				0.503**	(0.206)	**0.230**
Elders care				0.728**	(0.301)	**0.228**
Households care				1.398***	(0.338)	**0.427**

Legend: Unstd. Sol. = Unstandardized Solution; CS Sol. = Completely Standardized Solution (bold)
* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level
Standard errors in parenthesis.

Source: elaboration of the author.

Table 3.6. provides the RMSEA and the RMR of our model, together with the correlation coefficient among the two latent variables. Neither the RMSEA nor the RMR of the model manage to fall below the critical value of the 0.08. The RMR measure, in particular, abundantly falls below 0.05, indicating an adequate fit of the model. Finally, as expected, the correlation coefficient among the latent variables is positive and statistically significant, claiming the complementarity among the two latent factors to measure the overall functionings based measure of wellbeing.

Table 3.6. Goodness of fit and correlation among latent variables

RMSEA	0.074
RMR	0.002
Correlation coefficient among latent variables	0.632***
	(0.001)

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level
Standard errors in parenthesis.

Source: elaboration of the author.

3.5. Cluster analysis

After having tested the two latent sub-constructs of material and social wellbeing, in this paragraph I perform a cluster analysis in order to group the most homogeneous areas according to the two functionings based measures of wellbeing issued from the factor analysis (i.e. material and social). With the agglomerative hierarchical clustering method we have partitioned the original population into subsets (clusters), so that the data in each subset ideally share some common characteristics. At the beginning every neighbour is considered as a separate group, until all observations belong to the same group and hence creates a hierarchy of clusters[79]. In this work, we have computed a similarity index as the Euclidean distance between the scores and followed the Ward's linkage[80] method to

[79] For a complete description of cluster analysis please refer to Everitt, Landau and Leese (2001) and to Everitt and Dunn (2001).

[80] Ward's linkage is one method (among others) for hierarchical cluster analysis, which is considered most suitable for quantitative variables, rather than binary. The linkage function, specifying the distance between two clusters, is computed as the increase in the "error sum of squares" (ESS) after fusing two clusters into a single cluster. Ward's Method seeks to choose the successive clustering steps so as to minimize the increase in ESS at each step and therefore, basically, it looks at cluster analysis as an analysis of variance problem, instead of using distance metrics or measures of association. Using Ward's method we will start out with all sample units in *n* clusters of size 1 each. In the first step of the algorithm, (*n – 1)* clusters are formed, one of size two and the remaining of size 1. The error sum of squares and r^2 values are then computed. The pair of sample units that yield the smallest error sum of squares, or equivalently, the largest r^2 value will form the first cluster. Then, in the second step of the algorithm, (*n – 2*) clusters are formed from that (*n – 1*) clusters. These may include two clusters of size 2, or a single cluster of size 3 including the two items clustered in step 1. Again, the value of r^2 is maximized. Thus, at each step of the algorithm clusters or observations are combined in such a

compare groups of areas. Following Luzzi, Flückiger and Weber, since the agglomerative hierarchical clustering methods leave open the choice of the final number of clusters, many stopping rules can help this decision (which is, otherwise, purely arbitrary). If possible, the number of clusters will be chosen such that the information loss is limited while the difference between the clusters is maximized[81]. Both the pseudo-F index (Calinski and Harabasz, 1974) and the pseudo-t^2 (Duda and Hart, 1973) are displayed in Table 3.7. Considering these values and searching a compromise between the two measures, we have opted for 6 clusters. The pseudo-F is in fact maximized for ten clusters, whereas the pseudo t^2 is maximal for five groups, indicating the presence of six clusters. Since the pseudo-F is also high for six clusters, this latter seems to be the most suitable compromise.

Table 3.7. Pseudo-F index and the pseudo-t^2

Number of Clusters	**Calinski/ Harabasz pseudo-F**	**Duda/Hart pseudo t^2**
1	-	121.00
2	121.00	111.00
3	124.68	125.12
4	135.36	19.78
5	174.00	143.11
6	**188.70**	**14.74**
7	196.62	27.34
8	210.41	26.69
9	218.96	23.61
10	224.10	72.88

Source: elaboration of the author.

way as to minimize the results of error from the squares or alternatively maximize the r^2 value. The algorithm stops when all sample units are combined into a single large cluster of size *n* .

[81] "Large values of the pseudo-F index (Calinski and Harabasz, 1974) indicate distinct clustering and one must therefore maximize this statistic. The opposite is true for the pseudo-t^2 (Duda and Hart, 1973), and one should choose the number of clusters so that this index is low and has much larger values next to it. It is advisable to look for a consensus among the two statistics, that is, local peak of the pseudo-F statistic combined with a small value of the pseudo-t^2 statistic and a larger value of the latter for the next cluster fusion (Luzzi, Flückiger and Weber, 2008, p.70)

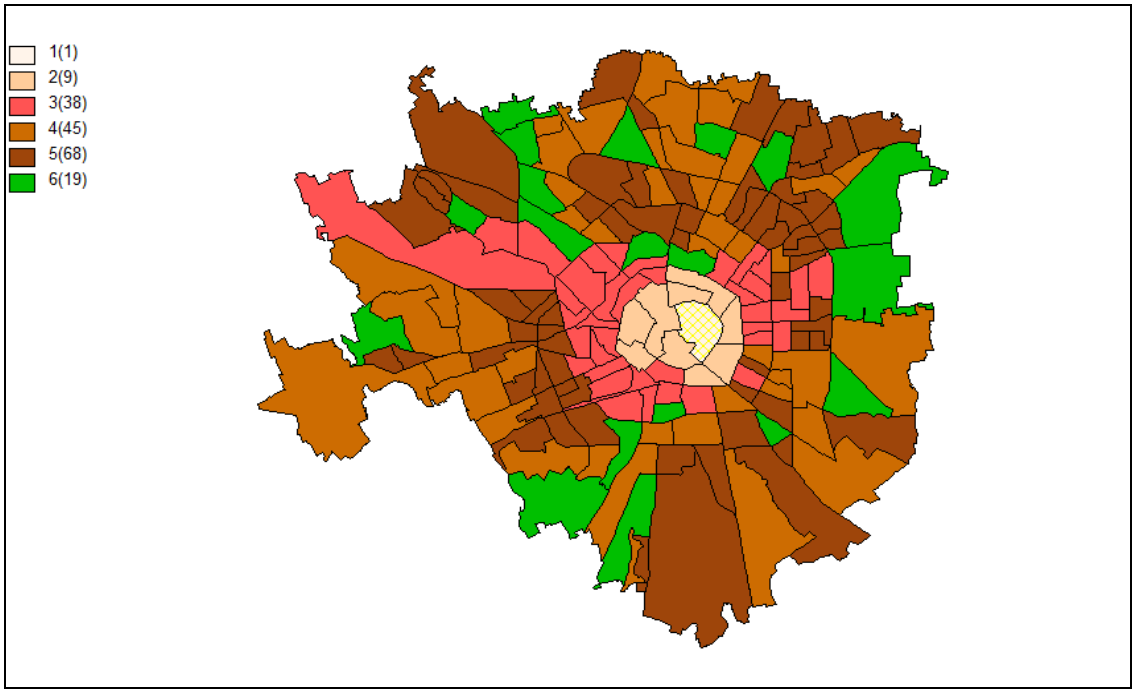
The dendrogram in Figure A.3.1 of the appendix presents graphical information concerning which neighbors (and how many, in parenthesis) are grouped together to different levels of similarity. Figure 3.2 depicts each area according to its membership to one specific cluster (out of the six available) while table 3.8 shows the average scores (mean and median) of the areas pertaining to each cluster.

Tab. 3.8. Mean and median scores on the factors Material wellbeing and Social Wellbeing, by cluster

	Mean		Median			
Cluster	**Material wellbeing**	**Social wellbeing**	**Material wellbeing**	**Social wellbeing**	**Obs.**	**%**
1	6.041	5.245	6.041	5.245	1	0.556
2	2.695	0.756	2.584	0.992	9	5.000
3	0.636	- 0.270	0.617	- 0.449	38	21.111
4	- 0.479	0.146	- 0.500	0.126	45	25.000
5	- 0.372	- 0.527	- 0.363	- 0.546	68	37.778
6	- 0.400	1.443	- 0.428	1.304	19	10.556

Source: elaboration of the author

Figure 3.2. Map of 180 areas, by cluster



Source: elaboration of the author.

As a result we obtain four possible ideal type of clusters, displayed in Table 3.9.

The first type (TYPE A) includes the two largest groups (cluster 4 and cluster 5) and has been depicted in brown on the map. It collects, respectively, the 25% and almost the 38% of the total sample and is characterized by relatively poor neighbors, both in material and social terms. Cluster 5 (dark brown), in particular, seem to be particularly deprived since it registers a disadvantage in both the dimensions, while those neighbors belonging to cluster 4 (light brown) mainly register, on average, a deprivation due to Material Wellbeing. These areas depicted in brown largely correspond to the peripheries of Milan, where the provision of public services is not adequate and/or the environment general perception is not particularly satisfactory. Secondly, these areas are characterized by a particularly low average income, thus probably indicating the presence of vulnerable groups such as young couples, unemployed, households with more than 5 components, elders, foreigners. On the other hand, in some of these areas (depicted in light brown) the "social" component of wellbeing is

still acceptable, indicating the presence of leisure-targeted facilities, police stations, centers for elders and minors care.

The second type (TYPE B) includes the two smallest groups (cluster 1 and cluster 2) and has been depicted in pink on the map. It collects, respectively, only one neighbor and the 5% of the total sample and is characterized by relatively rich neighbors, both in material and social terms. Cluster 1 (light pink), including only the city center, seems to be particularly rich since it registers very high scores in both the dimensions. On the other hand, those neighbors belonging to cluster 2 (pink) register, on average, very high scores on material wellbeing (suggesting the availability of basic services, a globally good environment perception and a per capita income relatively high) and a medium score on Social Wellbeing. These areas depicted in pink largely correspond to the city center of Milan.

The third type (TYPE C) includes only one group (cluster 3) and has been depicted in red on the map. It collects almost the 21% of the total sample and is characterized by neighbors which register, on average, high values for the material wellbeing (suggesting, as the previous type, the availability of basic services, a globally good environment perception and a per capita income relatively high) and low values for social wellbeing. These areas depicted in red largely correspond to the first western and eastern peripheries of Milan, with the exception of part of San Siro, which seems to be the ideal conjunction between a rich center and many relatively poor peripheries.

The last type (TYPE D) includes the remaining cluster 6 and has been depicted in green on the map. It collects more than the 10% of the total sample and is characterized by neighbors which register, on average, high values for social wellbeing (suggesting the availability of police stations, centers for minors and elders care, libraries) and low values for material wellbeing (suggesting, on the contrary, a scarce availability of basic services and a per capita income relatively low). These areas depicted in green are sparse within the city and may also be considered comparable, at least looking to our sample, to cluster 4. Nevertheless although registering similar

low values for material wellbeing, cluster 6 collects, on average, the second best score for social wellbeing, while cluster performs relatively better.

Table 3.9. Four types of areas (three types of poor areas, in bold)

Social wellbeing	*Material wellbeing* Low	*Material wellbeing* High
Low	**Clusters 4, 5 (TYPE A)**	**Cluster 3 (TYPE C)**
High	**Cluster 6 (TYPE D)**	Clusters 1, 2 (TYPE B)

Source: elaboration of the author.

Being poor in the intersection approach

According to the intersection approach a neighbor may be considered poor if accumulates deprivation in various components (i.e. both material and social wellbeing). According to such definition, poor neighbors are exclusively those belonging to cluster 4 and cluster 5 and, therefore, to type A. Figure 3.3 depicts such areas.

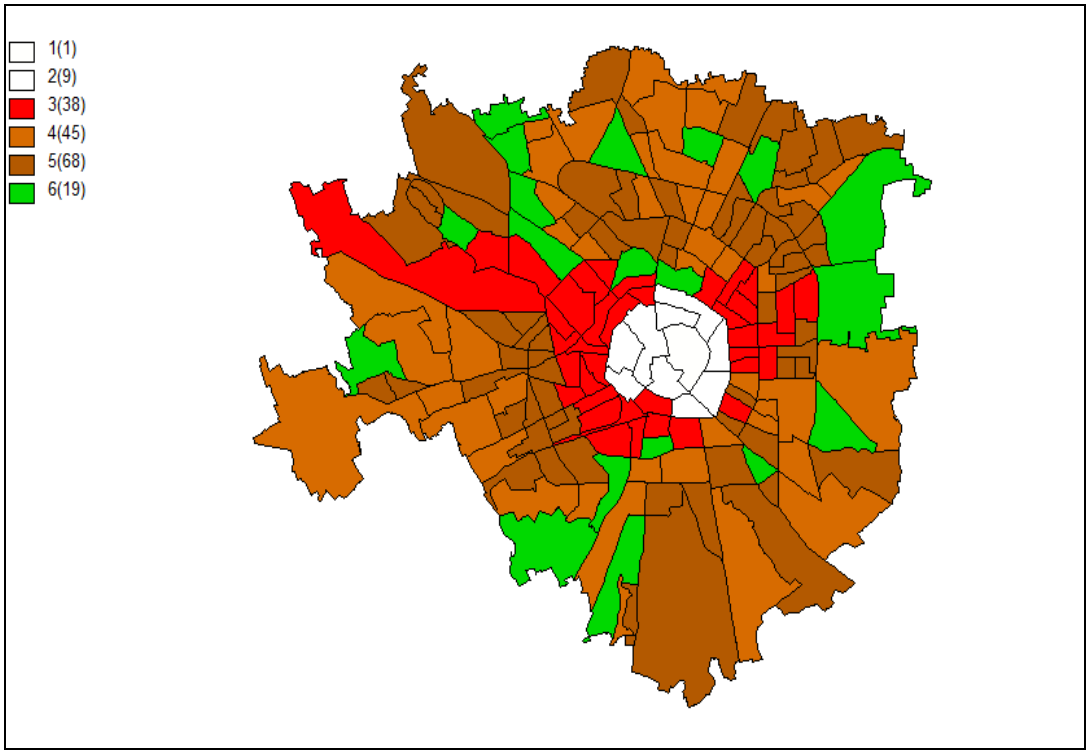
Figure 3.3. Poor areas (intersection approach), by cluster

Source: elaboration of the author.

Being poor in the union approach

In contrast to the intersection approach, in the *union approach* multidimensional poverty is defined as the failure to access to *at least one* of the considered dimensions (i.e. material or social wellbeing). According to such definition poor neighbors are, together with the previously ones defined in the intersection approach, two more types. On one hand, poor areas belong to cluster 3 (and, therefore, to type C), experiencing a deprivation due to the social dimension. On the other hand, those areas included in cluster 6 (and, therefore, in type D), experiencing a deprivation due to the material dimension, are also considered poor. Figure 3.4 displays each type of poor neighbors out of the possible three.

Figure 3.4 Poor areas (union approach), by cluster



Source: elaboration of the author.

3.6. Policy recommendations : *people based* and *place based* components

At this point, it seems useful to provide some general policy recommendations based on the four types of neighbors (or areas). Adopting the definition of multidimensional poverty suggested by the union approach, we assume that three types of relatively poor neighbors (A, C, D) are in a way represented in Milan. Fully aware that the empirical evidence is only one among several reasons for the implementation of policies (and often even the main one), it seems however plausible to suggest a scheme of reference based on the distinction among *people-based* and *place-based* policies. Following Chiodelli and Moroni (2011)[82], assuming that areas with positive values of both material and social dimensions do not require intervention, we will attempt to identify a typology of policies, to be

[82] Please refer to chapter 15 and chapter 16 in Gli spazi della povertà (forthcoming) for a wider description of weaknesses and strengths of both the approaches and a quick overview of some main best practices.

referred to the issued typology of poor neighbors (deprived in the material dimension; deprived in the social dimension; deprived in all the dimensions). As the history of urban policies of Western countries is wide and varied, with significant national differences, however, it is possible to outline nearly a century of efforts to fight urban poverty through the dichotomy "place-oriented policies" and " people-oriented policies". If in the latter the strategy is to focus on individuals to give them power of movement beyond the limits of the district of residence - mainly through the provision of vouchers -, the former supports the development *in situ* of the poorest urban areas, including those particularly degraded by a strictly environmental point of view[83]. Chiodelli (2009)[84], in order to identify a suitable policy profile for each neighbor of Milan (given a certain combination between the physical, economic and social dimensions of wellbeing), introduces the following scheme :

(i) negative physical dimension → pro-place policy[85];

(ii) negative economic dimension → pro-people policy + pro-place policy (with the *people* component, however, predominant) .

(iii) negative social dimension → pro-people policy + pro-place policy (with the *place* component, however, predominant)[86].

[83] The pro-place (otherwise called AID) policies were (and generally are) the prevailing philosophy underlying the policies to combat urban poverty in Italy and Europe. Nevertheless, in the U.S., a different strategy has been adopted in the seventies (i.e. pro-people policies), aimed to encourage the locational choices of individuals and households. For an exhaustive investigation of both *place based* and *people based* policies (taking into account, specifically, the major experimental programs) please refer to Chiodelli (2011) and Chiodelli and Moroni (2011).

[84] Chiodelli, 2009, p. 42 (Italian version).

[85] In cases where the only dimension of poverty is found precisely within the services, housing and infrastructure domains, the actions should focus only on spatial variables and, therefore, be purely pro –place.

[86] The social dimension, originally, was also indicative of a symbolic system able to generate a sense of identity within the people in the neighborhood, to foster social relation and promote participation (Mauri 2011). Therefore, it makes sense to allow those who live this break to move to another residential area which they feel, for various reasons, more suited to their lifestyles. An example is the case of a neighborhood that has experienced an extensive process of settlement of an immigrant community (or a particular segment of the population, e.g. young people). However, as noted in the analysis of the American mobility

Since data have allowed to consider the physical dimension and the economic dimension as parts of the same latent construct (i.e. material wellbeing), the classification mentioned above may be formulated as follows:

(i) negative material dimension → pro-people policy + pro-place policy (equally weighted);

(ii) negative social dimension → pro-people policy + pro-place policy (with the *place* component, however, predominant).

Based on such considerations, the relationship between poverty types (A, C, D) and poverty profiles is displayed, according to a definition of poverty alternatively inspired by the intersection (Table 3.10) or the union approach (Table 3.11).

Table 3.10. Poor neighbors types and policy types, by cluster (intersection approach)

Policy type	*Poverty* type	Cluster
pro-people + *pro-place policy* (pro-place predominant)	A (deprived in multiple dimensions)	4, 5

Source: elaboration of the author.

Table 3.11. Poor neighbors types and policy types, by cluster (union approach)

Policy type	*Poverty* type	Cluster
pro-people + *pro-place policy* (pro-place predominant)	A (deprived in all dimensions) C (deprived in the social dimension)	4, 5 3
pro-people + *pro-place policy* (equally)	D (deprived in the material dimension)	6

Source: elaboration of the author.

programs, those who want or are able to move elsewhere are never the whole poors. For this reason, it is necessary to implement more traditional place-based interventions, which are intended to act specifically on the variables selected.

3.7. Concluding remarks

The conceptual framework of Nuvolati (2011) is definitively tested in the urban context of Milan under two basic approaches. The first one is theory-driven and extensively illustrated in the first essay of this thesis. The second approach is the subject of the present essay and is basically a data-drive approach. I have tested the empirical robustness of such conceptual framework through a factor analysis and under a different territorial partition (i.e. 180 functional areas, or neighbours). I have therefore hypothesized that wellbeing (as well as poverty), although multidimensional, couldn't be considered as a unidimensional construct, and tested for such validity. On one hand the results of the explorative factor analysis confirm, at least with respect to the available variables, the adequacy of transposing the original *physical* and *economic* dimensions into a unique latent construct, which has been defined as *material* since it basically refers to a functional space and to the income as the average measure of residents economic wellbeing. Similarly, the original *social* dimension has been transposed into the concept of *social* wellbeing. On the other hand, the measurement model (i.e. confirmative factor analysis) adds some information about the contribution of each variable to the corresponding latent constructs, signalling the main importance of housing, income and cultural facilities for material wellbeing and that of libraries and police stations for social wellbeing. Correlation between material and social wellbeing is also verified, being positive and significant. The measurement model could be considered as a first encouraging step towards the estimation of a full latent variables model, which could be hopefully the subject of further research. As widely stated, data availability has heavily conditioned the definition of our dataset, since many policy indicators and information on public expenditure in each neighbour of Milan were not disposable. These are actually the base for completing the measurement model with the corresponding structural part. Further research could hopefully include also some subjective perception information on the quality of certain facilities and infrastructure and on their quality of life itself from the residents in each neighbour.

In order to identify which are the poor neighbours according to the two issued functionings-based measures (i.e. material and social wellbeing) we have therefore performed a hierarchical cluster analysis and opted for grouping the whole areas into 6 classes. I noticed at a glance that each cluster tends to group areas which are also in geographic proximity in the urban space, suggesting a sort of "contagion effect" among neighbours. Cluster 1 and cluster 2 have been undoubtedly considered as "rich", since they collect positive scores on both the material and social dimensions. Cluster 1, in particular, may be considered as an outlier with respect to the rest of the city, since it collects systematically only the city centre (with very high scores) even increasing or decreasing the number of clusters. In order to properly depict poor neighbours and suggest appropriate policies we have finally made a distinction between the *intersection* and *union* approaches to multidimensional poverty and between the *pro-place* based and *pro-people* based policies.

As a result, I have found that, according to the intersection approach (i.e. multiple deprivation), poor neighbours are mainly clustered in the peripheries (cluster 4 and cluster 5), affecting almost the 63% of the areas. These areas are settled mainly in northern (Monza-Padova, Niguarda-Ca' Granda, Greco Zara), southern (Corvetto-Rogoredo, Chiesa Rossa-Gratosoglio) and western peripheries (Lorenteggio-Inganni, Baggio-Forze Armate, Vialba-Quartoggiaro). In terms of policies, I finally suggest the integrated adoption of both *pro-people* and *pro-place* policies (with a strong *pro-place* component), since these areas are characterized, on average, by the presence of poor households (in income terms) and, simultaneously, a scarce availability of public services, care networks and facilities for aggregation.

According to the union approach, two more groups of poor neighbours are considered. On one hand, cluster 3 registers satisfactory levels of material wellbeing (i.e. good housing quality, public services provision, high per capita income) but lower levels of social wellbeing (scarce availability of informal care, police stations, facilities for aggregation). This cluster includes almost the 21% of the areas and is settled in the largest areas of Venezia-Buenos Ayres, Ticinese-Genova, Magenta-Sempione,

Città Sudi- Argonne. In terms of policies, I suggest the integrated adoption of both *pro-people* and *pro-place* policies (with a strong *pro-place* component), for the same previously mentioned reasons. On the other hand, cluster 6 registers unsatisfactory levels of material wellbeing (i.e. scarce housing quality, scarce provision of public services, low per capita income) but higher levels of social wellbeing (availability of informal care, police stations, facilities for aggregation). This cluster includes almost the 10,5% of the areas and is settled in the largest areas of Feltre-Carnia-Ortica, Forlanini- Taliedo, Vialba- Certosa- Quartoggiaro, Affori- Bruzzano-Comasina. In terms of policies, I suggest the integrated adoption of both *pro-people* and *pro-place* policies (equally weighted).

As widely pointed out in the introduction, this association between poverty profiles and policy profiles has been proposed on the basis of some recent tentative contributions in this regard (especially suggesting a joint use of *pro-place* policies and *pro-people* policies introduced in Chiodelli 2009) and with the main intent of encouraging greater articulation to the policies against urban poverty in relation to the specific dimensions considered.

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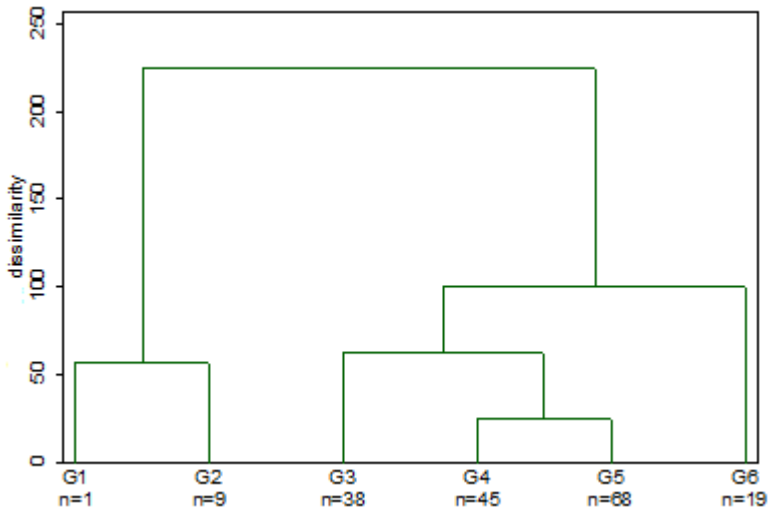
Appendix - Dendrogram

Figure A.3.1- Dendrogram for cluster analysis (cut-value: 6 clusters)



Source: elaboration of the author.

Conclusion.

The linkage between space and poverty is definitively controversial, as well as "unsolved". Many studies are available within many different disciplines (sociology, economics, urban planning) but substantially fail in providing a convincing and unifying framework. In the research project "Cities, wellbeing and poverty: multidimensional profiles for integrated public actions" and partially also in the book "Gli spazi della povertà" (forthcoming) we have attempted to identify a conceptual scheme to theoretically define a taxonomy of urban areas in relation to three relevant specific dimensions: i) infrastructural domain; ii) economic domain; iii) social domain. The desired hypothesis to verify is whether, and to what extent, these profiles are able to capture the complexity of conditions that exist in reality, generated between environmental, socioeconomic and symbolic conditions. This has been the main point of this thesis.

The results obtained seems to confirm the validity and appropriateness of such unifying framework for the multidimensional analysis of the linkage between space and poverty in Milan. The analysis has been conducted throughout two main datasets, the first referred to the former 20 areas of decentralization, collecting 3 dimensions (physical, economic and social) and 27 variables, while the second referred to 180 neighbors, including 2 dimensions (material and social) and 10 variables.

I. On the linkage between poverty and space

In this work, I have accepted the idea that a predetermined list of dimensions could be useful to narrow the field of investigation and to seize, in parallel, some aspects of the linkage between space and poverty. In the first essay I have followed a theory-driven approach for the construction of the dataset, based on the dimensions of poverty suggested by Nuvolati

(physical, socio-economic and socio-symbolic) and referred to consolidated traditions of research (respectively *Social Indicators Research*, human ecology and environmental psychology). Almost the same dimensions have been considered in the third essay, which considers a *material* sub-component and, on the other hand, a *social* one. Material poverty considers the previous physical and economic dimensions, while social poverty considers the previously mentioned social dimension. As a result, in the first latent sub-construct, space is considered both as "functional" and as container of social disadvantage including, as indicators, the quality of housing, the availability of public services (such as schools, hospitals, cultural facilities), the average net income per capita. On the other hand, the spatial sub-construct refers to space as "facilitator" (or not) of relations, exchange of views, dialogue, participation and attention to the most vulnerable segments of the population and includes, as indicators, the availability of police stations, libraries, informal and formal care to elders and households. As expected, correlation between material and social wellbeing is also verified, being positive and significant. Nevertheless, the choice of considering such dimensions (according to a purely theory-driven approach in the first essay and to a purely data-driven approach in the third essay) seems to be also in line with many recent researches concerning Milan (i.e. Diappi, 1998, Zajczyk, 2005). In the second essay, attention has shifted exclusively on the economic dimension, suggesting that even considering only one domain some contagion effects may occur both between the poorest and the richest neighbors. The exploratory spatial data analysis allows to depict a very significant presence of spatial autocorrelation between incomes in Milan, and persistency over time (2000-2006).

In conclusion I suggest, on one hand, the exploration of the linkage between space and poverty as a multidimensional (rather than unidimensional) construct. I recommend to adopt measurement techniques able to properly catch the spatial effects between units of observation, since the linkage space-poverty should be explored both *between* and *within* dimensions (i.e. between the material and social dimensions and within the economic dimension only). On the other hand, I encourage further research

at a very detailed level of territorial partition, i.e. neighbors, within a metropolitan city, since similarities between some areas may justify the adoption of different policy interventions within the same administrative district.

II. On poverty concentration in Milan

At the measurement level, I definitively argue that poverty is mainly *concentrated* (rather than dispersed) in Milan. Since, as pointed out by Sen,

> "concentration itself contributes to the intensification of poverty. So here there is a causal connection, not a purely descriptive" (Sen, 1993: 315),

it seems relevant to understand where some similar neighbor tend to cluster and with respect to which dimensions. In the first essay, areas have been clustered according to their membership to a certain poverty profile, given by the combination between the physical, the economic and the social dimensions. Concentration of profiles is evidently radiocentric, at least with respect to the most represented profiles (8 and 3). On the other hand, with respect to the "under-represented" profiles (i.e. 2, 4, 7) the "archipelago" model seems to be more suitable. Some areas of the first periphery around the city center[87] (characterized by profile 3) are all significantly affected by critical values of inequality, well above the median, and by a scarce availability (compared to the rest of the city) of facilities for aggregation, care, assistance to vulnerable groups, leisure. The extreme peripheries[88] (characterized by profile 8), conversely, are characterized by a lower inequality but lack of basic services, infrastructure and relatively poor housing conditions.

The second essay has revealed the presence of both global spatial autocorrelation between incomes and, therefore, their local tendency to

[87] Venezia-Buenos Ayres, Vittoria-Molise, Ticinese-Genova, Magenta-Sempione, Città Studi-Argonne, San Siro-Gallaratese.

[88] Affori-Bruzzano-Comasina, Feltre-Carnia-Ortica, Forlanini-Taliedo, Chiesa Rossa-Gratosoglio, Barona-Ronchetto sul Naviglio, Baggio-Forze Armate, Vialba-Certosa-Quarto Oggiaro.

cluster (rather than disperse). Autocorrelation features at the same time the most affluent and, even more often, the poorest areas and concentration trends are based upon two significant but different regimes of spatial autocorrelation and, more specifically. On one hand, some typical spatial clusters of relatively poor areas, in the most extreme peripheries of Milan (LL); on the other hand, a typical cluster of relatively rich neighbors, in the city center (HH). The results seem to support, at least with respect to the economic dimension, the core-periphery model. However, it seems extremely difficult (and useless) to draw a sort of boundary between “poor areas” and “rich areas”. The average per capita incomes registered in each neighbor of Milan tend to concentrate between 2000 and 2006, blurring the strictly administrative boundaries. Any statement like "the neighborhood or area X is definitely poor / not poor, or "poverty is certainly concentrated / dispersed" may be difficult to say empirically, even when one looks at a single indicator, such as income.

In the last essay, the two latent dimensions of wellbeing (i.e. material and social) are tested statistically in the territorial partition of 180 neighbors, enlightening the main contribution of each variable as functioning (or information about functioning) of the corresponding unobservable factor. After having computed the two functionings-based measures (i.e. the material score and the social score), the hierarchical cluster analysis allows to group the whole areas into 6 classes. I have noticed at a glance that each cluster includes areas which are also in geographic proximity in the urban space suggesting, similarly to the second essay, a sort of “contagion effect” among neighbours. Cluster 1 and cluster 2 have been considered as “rich”, since they collect positive scores on both dimensions and, similarly to the analyses conducted in the previous essays, they mostly coincide with the area of the city centre. According to the union approach, three “types” of poor neighbours are considered. On one hand, type A and C collect areas which are also geographically closed while, on the other hand, type D includes neighbours which are quite disperse across the city. Type A includes cluster 4 and cluster 5, therefore affecting almost the 63% of the total sample. These areas are poor both in material and social terms and are

settled mainly in northern[89], southern[90] and western[91] peripheries. Type C includes only cluster 3, registering on average satisfactory levels of material wellbeing (i.e. good housing quality, public services provision, high per capita income) but lower levels of social wellbeing (scarce availability of informal care, police stations, facilities for aggregation). This cluster includes almost the 21% of the areas and is settled in the largest areas of Venezia-Buenos Ayres, Ticinese-Genova, Magenta-Sempione, Città Sudi-Argonne. On the other hand, type D includes only cluster 6 and registers unsatisfactory levels of material wellbeing (i.e. scarce housing quality, scarce provision of public services, low per capita income) but higher levels of social wellbeing (availability of informal care, police stations, facilities for aggregation). This cluster includes almost the 10,5% of the areas and is almost dispersed across the wider areas of Feltre-Carnia-Ortica, Forlanini-Taliedo, Vialba-Certosa-Quartoggiaro, Affori-Bruzzano-Comasina.

III. On *people-based* and *place-based* policies

At the policy level, I argue that the adoption of a joint use of two types of policy (i.e. pro-people and pro-place) should be preferred, as designed to address the *spatial dimension of urban poverty* (i.e. the negative effects of the concentration of the poor). This is also coherent with a multidimensional approach to explore the linkage between poverty and space, as well as with the recommendation of harmonizing the information available within a unifying suitable framework for that purpose (such as the one extensively illustrated). On one hand, some place-based components may be suitable to encourage the development *in situ* of the poorest areas while, on the other hand, some people-based components may facilitate mobility across neighbors of the poorest households. Following a tentative intuition of Chiodelli (2009), I have introduced a possible association between *poverty profiles* and *policy profiles*, with the aim of encouraging a greater articulation to the policies against urban poverty in relation to the specific

[89] Monza-Padova, Niguarda-Ca' Granda, Greco Zara.

[90] Corvetto-Rogoredo, Chiesa Rossa- Gratosoglio.

[91] Lorenteggio-Inganni, Baggio-Forze Armate, Vialba-Quartoggiaro.

dimensions considered. As pointed out in the introduction, it seems definitely important examining the linkage between space and poverty both from the descriptive point of view and *in relation to the policies*. Since the very last point is almost ignored in literature, this work recommends further research on weaknesses and strengths of both the approaches (i.e. *pro-people* and *pro-place*), with the intent of stimulating the cooperative effort between many different players for the selection of appropriate actions in relation to individual circumstances.