Project funded by the European Commission under the « Energy, Environment and Sustainable Development Programme » of the 5th Framework Programme, Key Action 4 : City of Tomorrow and Cultural Heritage

SCATTER

Sprawling Cities And TransporT: from Evaluation to Recommendations

Annex to D2 and D3 (Work packages 2 and 3)

Monographic report
Case city Milan

Contract number: EVK4-CT-2001-00063

Date: 15th October 2002

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TABLE OF CONTENTS OF THE MILAN CASE STUDY SYNTHESIS

1. OVERALL PRESENTATION OF THE CITY

1.1 Introduction

Milan region, Lombardia, is situated in the north west of Italy; it covers a surface of 23,861 square Km. and includes 11 Provinces with a total of 1,546 Municipalities and more than 9,100,000 inhabitants. The Milan case city study area corresponds with the Milan Province[1], one of the richest areas in Italy and in Europe. The study area is composed by 187 Municipalities and, for better understand the sprawl phenomenon, was divided in 3 functional and/or institutional areas: the main Municipality (Milan city), the Milan metropolitan area (outer urban ring), composed by the 38 Municipalities surrounding Milan, and the rest of the Province.

A further subdivision of the study area (see figure 2) keep into account the a different zoning of the Milan Province with an aggregation of the Municipality outside Milan based not on concentric rings, but on “development corridors”. Such zones, that have some characteristics of homogeneity, are the north zone (Main Municipalities are Sesto S. Giovanni and the ones located in the Brianza), the east zone (Vimercate and Municipality sourrounding the Adda river), the south zone (mainly rural), the west zone (Magenta and Abbiategrasso) and the northwest zone (Rho Legnano).

2001 data	Municipalities	Surface	Population	Density
Milan	1	182	1,301,551	7,213
Metropolitan area	38	448	1,114,784	2,488
Rest of Province	149	1,337	1,350,257	1,010
Tot. Province	188	1,967	3,766,592	1,915

Table 1: Main figures of the Milan Province

During the last decades, Milan municipality has experienced a radical process of de-industrialisation and a constant loss of population. The transition characteristics of the entire area can be seen in the current asset (and in the changes it had in the last decades) of the economical and productive structures. These aspects can be seen in the major municipality, in the metropolitan area and, in general, in the whole Lombardia region.

Changes in the socio-economic structure of the whole area led (but it is still an on-going process) to changes in the mobility patterns within, and sometimes outside, the metropolitan area: from a centripetal pattern (with focus on Milan) to a centrifugal one (with focus on the metropolitan area). Such changes were not supported by an efficient transport supply, except for the road network (with the building of the external ring roads), and public transport is still designed according to the "historical" radial patterns within the metropolitan area.

The need of new and sometimes different transport services is strongly present in the local political debate and pushes local authorities to implement (or to ask for) new transport infrastructures and services.

[1] Milan Province Includes 188 Municipalities but one of them, San Colombano al Lambro, is located outside the rest of province territory and so outside study area. In 1995, when the new Province of Lodi was established and included part of the Milan Province territory, this Municipality chose not to join the new Province.

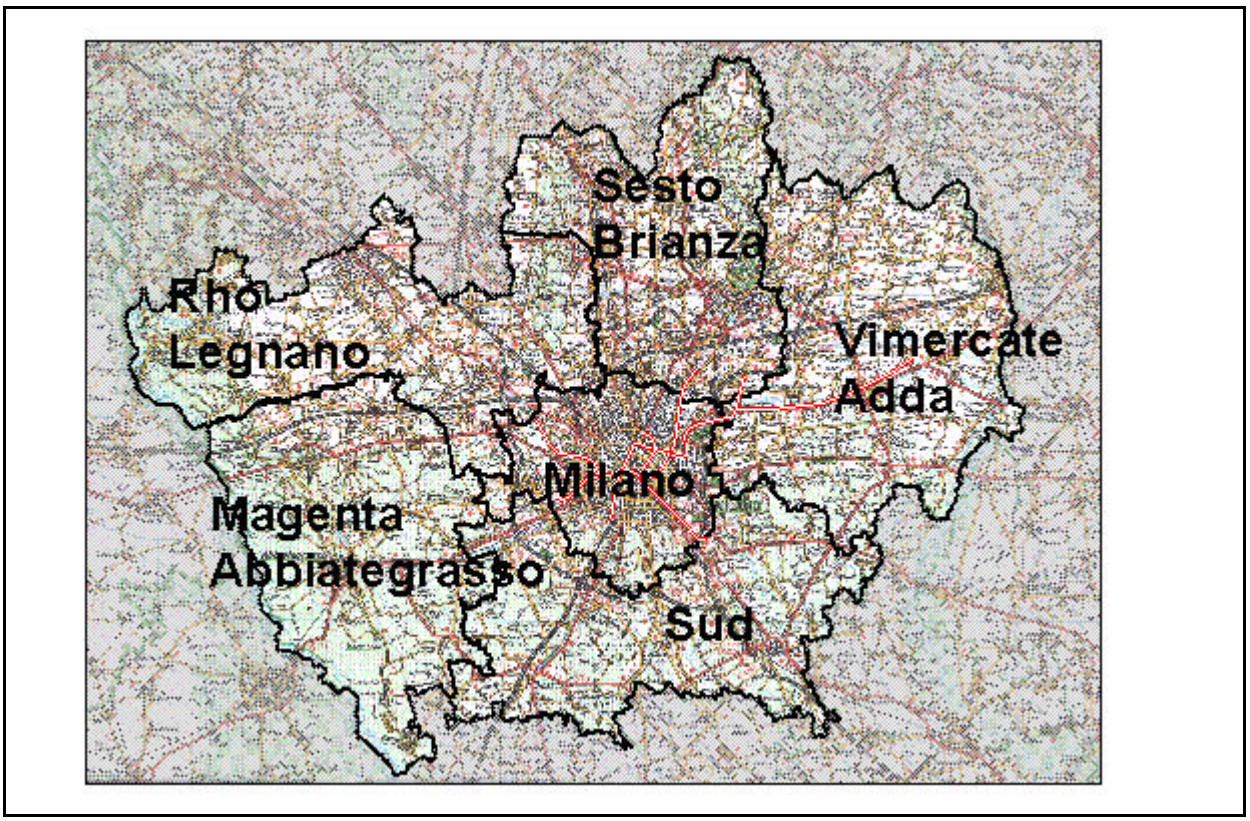

Figure 2: The Milan study area

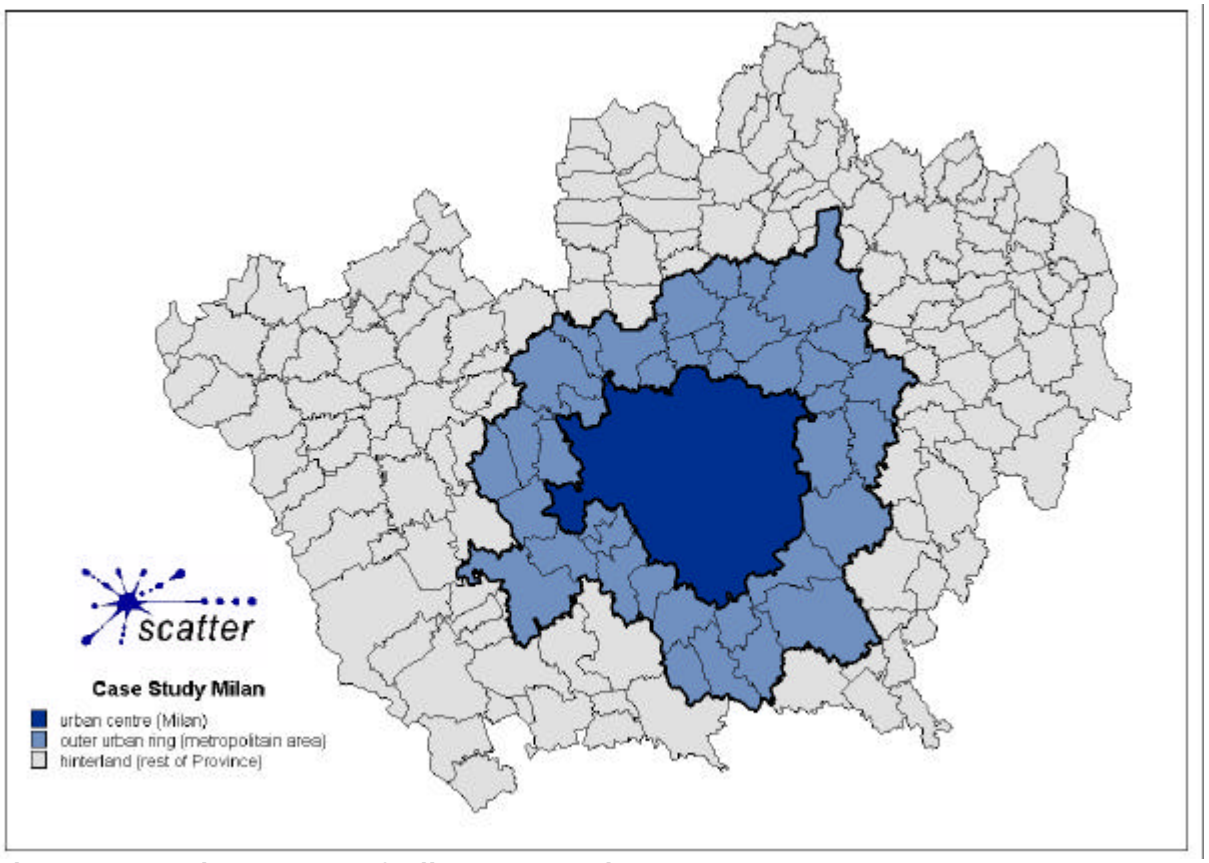

Figure 3: Zoning system of Milan case study

1.2 Population

The population of Milan Municipality is now (Istat, 2000)[2] 1,3 million inhabitants in a surface of 182 square kilometres, with a density of more than 7.000 inhabitants/km^2. The average density of population in the whole province, 1.900 Inhabitants/km^2, is the second one (after Naples) in Italy[3]. In fact the level of urbanisation in the area is very high, with about 70% population living in municipalities of more than 200.000 inhabitants. Such a data is very high if compared with the corresponding figures for Lombardia and north-west Italy (respectively 42,6% and 46,2%), while it is lower than the whole Italian data (52,7%), influenced by the high level of concentration of population in the medium size cities of central and south Italian regions.

As in most important cities of industrialised countries, the phenomenon of the loss of population is statistically relevant. Inhabitants of the Milan Municipality decreased from 1971 to 1986 of about 14%, and from 1986 to 2001 of about 21%. On the other hand, some municipalities in the hinterland have experienced an opposite tendency. In fact nearly all the minor municipality in the study area show an increment of resident population, most of all, as shown in figure 2, the historically rural ones in the south and in the west of Milan (South and Magenta-Abbiategrasso).

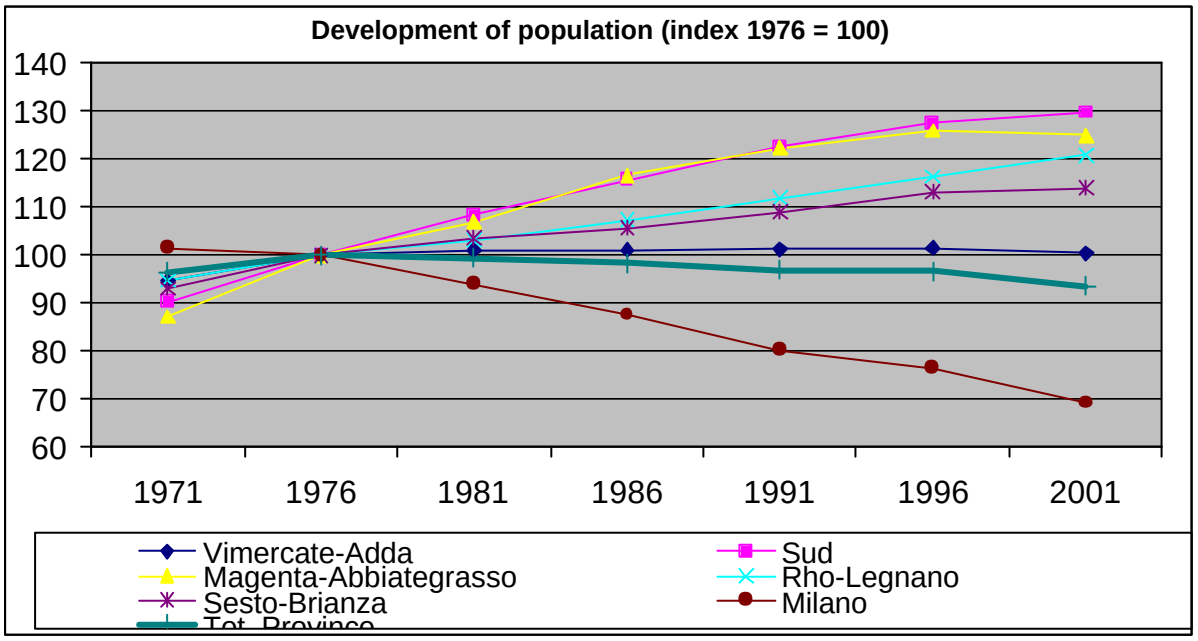

Figure 4: Development of the scaled population shares of the Milan study area

The age structure of population in 2000 shows, as a demonstration of the productivity vocation of the area, a working age rate of population - from 15 to 64 years old - higher than the average Italian data (70,2% v/s 67,6%). The average income in the province of Milan in 1998 (Istituto Tagliacarne), is one of the highest in Italy: € 18.200 against the average Italian data € 13.500.

1.3. Production sectors

With more than 402,000 economic activities on its territory, the province of Milan occupies the first place at national level. The importance of industrial sectors, traditionally very high, is now (Istat, 2000) comparable with national data: 26% (employees 34%) in the Province against 25% (employees 32%) of Italy.

[2] Unioncamere-Istituto Tagliacarrne, Atlante della competitività provinciale 2001, www.unioncamere.it

[3] High population density is one of the characteristics of north-west of Italy. The Milan region (Lombardia) has an average density of 382 inhabitants/kilometre, the north-west Italy of 262 against the Italian average value in of 192 inhabitants/kilometre.

In fact the "strict" industrial sectors have experienced a radical process of de-industrialisation (partially still going on) that induced in Milan a decrease of employees from 1971 to 1991 of nearly 50%. In the metropolitan area this process is still relevant, but have a different temporal dimension. Statistical data show that the de-industrialisation in the outer urban ring began later than in the city of Milan: in the seventies the loss of industrial employees was of about 27% in Milan and "only" 7% in the metropolitan area. In the following decade, the process affected the two areas in a similar way (Municipality -30%, outer urban ring -27%). The location of industrial activities seems to move more and more in the external areas and have now reached municipalities which are outside the metropolitan area and the Province. As shown in figure 4, a large part of the employees living Milan and the north industrialised Province tends to relocate to the external south and west municipalities.

It must be noted that the number of industry employees is now far higher outside the Milan province: in Milan (as seen above) they represent the 34% of total employees, in Lombardia the 40,5%, and if we consider the Lombardia without Milan Province, the 45%. Anyway the de-industrialisation process does not affect the entire production sector. The metropolitan core is still very attractive - 46% of the activities - for the new innovative, high-tech activities, with natural vocation to research and with need of high specialised employees. Moreover 63% of some "traditional" and highly specialised industries (as tailoring, leather, jewellery, graphics and publishing)[4], still choose to locate their activity in the metropolitan core. Thus the industries that seem to move in the external areas are the "mass production" ones, i.e. those which requires wide low cost location and low cost employees with a lower level of specialisation.

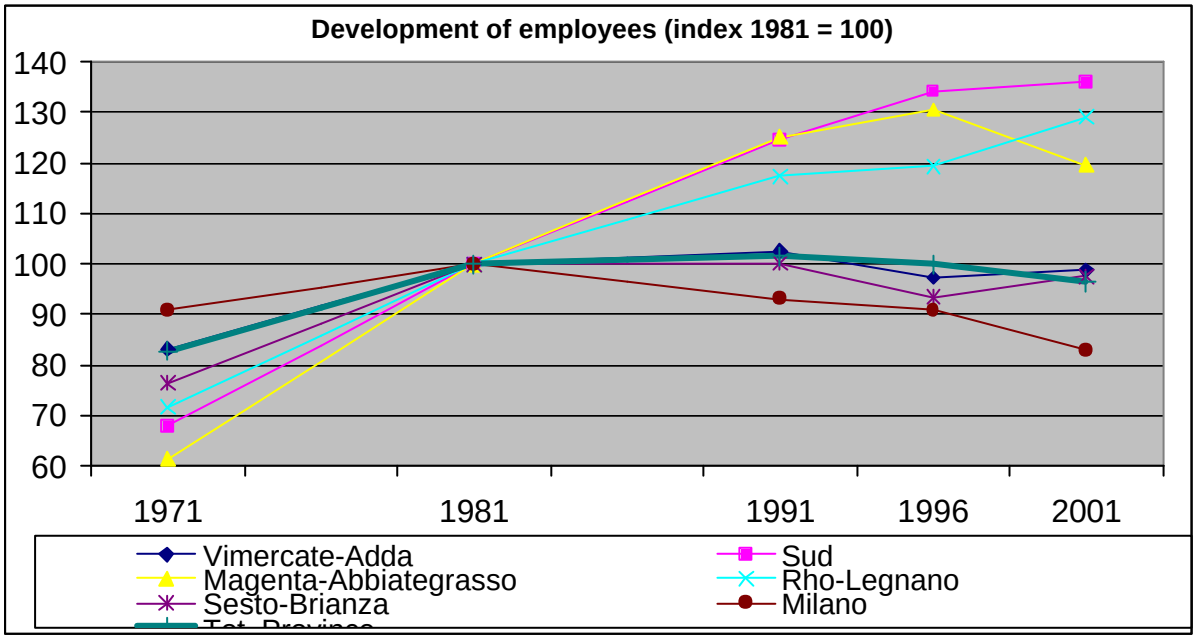

Figure 5: Development of the scaled employees shares of the Milan study area

1.4. Services

Commerce and Services To Business represent in year 2000 (Infocamere), more than 45% of the activities located in the Province (at national level this rate is about 35%). The growth of those sectors at local level began slowly during the seventies (+11%), and had a relevant acceleration in the following decade (e.g. +26% from '80 to '87).

Sectors related to banking and insurance are also very important: in the province these represent the 2,6% of activities against the 1,8% average Italian data. It's important to note that those are the ones with the higher growth rate (+54% in 7 years - from '80 to '87). Little importance have the agricultural sector: 1,4% against 7,1% of Lombardia and 18,8% of Italy.

[4] Perulli, P., Atlante metropolitano, il mutamento sociale nelle grandi città, Il Mulino, Bologna, 1992

It is interesting to note that in the study area the average dimension of activities is bigger than anywhere, in fact in Milan province more than 37% worker is employed in firms with more than 200 employees[5].

1.5. Car ownership

The Milan region has a very high car ownership rate. This is particularly true in Milan Municipality: in year 1999 (ACI data) 0,70 cars per inhabitant and decreases when referred to the province (0,59) or to the region Lombardia (0,57). In any case it is higher than the Italian average figure of 0,55 cars per inhabitant. It must be noted that this data refers to car owned both by physical persons and by economic activities (and many industrial headquarters are located in Milan). In fact the car ownership rates derived from a household survey carried out by ATM (Azienda Trasporti Municipali) in 1995 are sensibly lower in Milan and in some other municipalities of the metropolitan area.

It is also worth to notice that in the area the rate of big cars (more than 2.000 c.c.) is higher than the Italian average rate (4.8% v/s 4.2%), and that the rate of renewal of the vehicle fleet is faster than in any other Italian region[6].

1.6. Commuting trips

The structure of the commuting trips in the province of Milan (1991 Census data, see fig. 7 to fig. 9) shows the role that has the main Municipality in the study area. Milan attracts and generate commuters in all his metropolitan area, but this influence can be better stated for the recent developed Municipality located in the south and in the west of the Province.

It is to note that those zones, that are mainly residential, despite having a number of firms (and consequently of jobs) lower then the areas located in the north of the Province and a lower level in the public transport facilities, are able to attract a relevant number of trips from Milan. This can be explained by the fact that such zones do not have a strong “identity” and/or autonomy or an independent production structure and thus maintain strong relationships with the main Municipality.

[5] In Lombardia and north west Italy this percentage is about 25,5% and in whole Italy 21.5%.

[6] The number of new cars purchased in 1999 is 56/1.000 inhabitants in the Milan province, 50 in Lombardia and 40 in Italy.

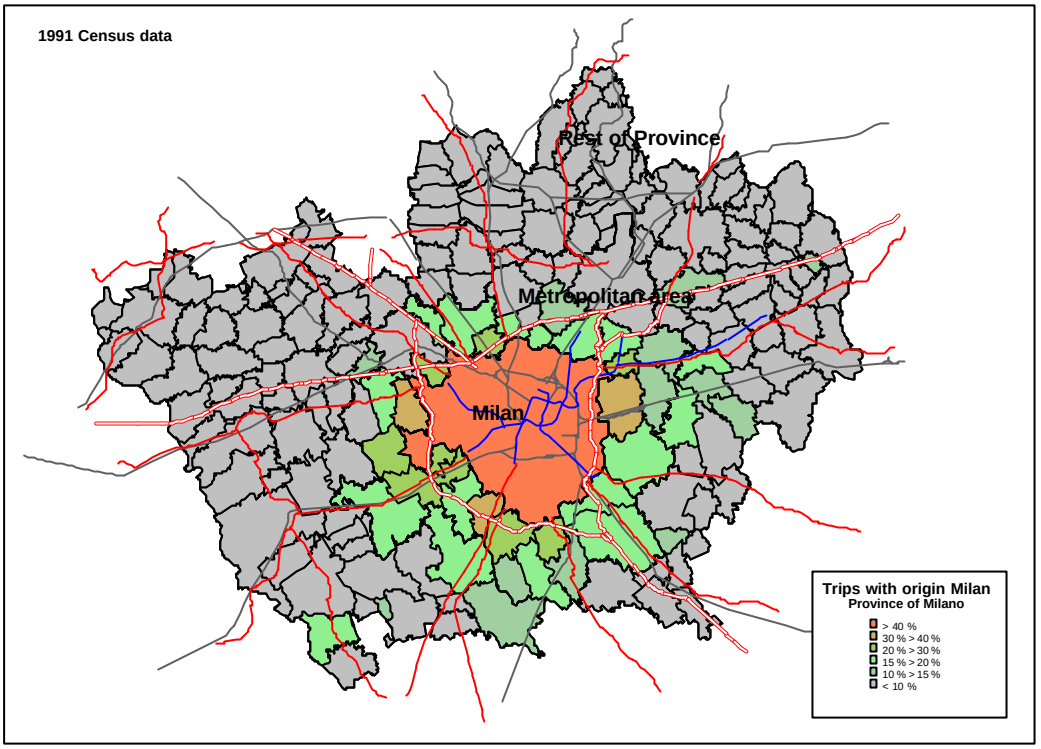

Figure 6: Commuter trips attracted by Milan Municipality

In the industrialized north, where zones have a higher population density, such relationships with Milan can be observed only for the municipalities on the border and for the ones with high public transport facilities, located around the Metro line 3 in the north-east of the study area.

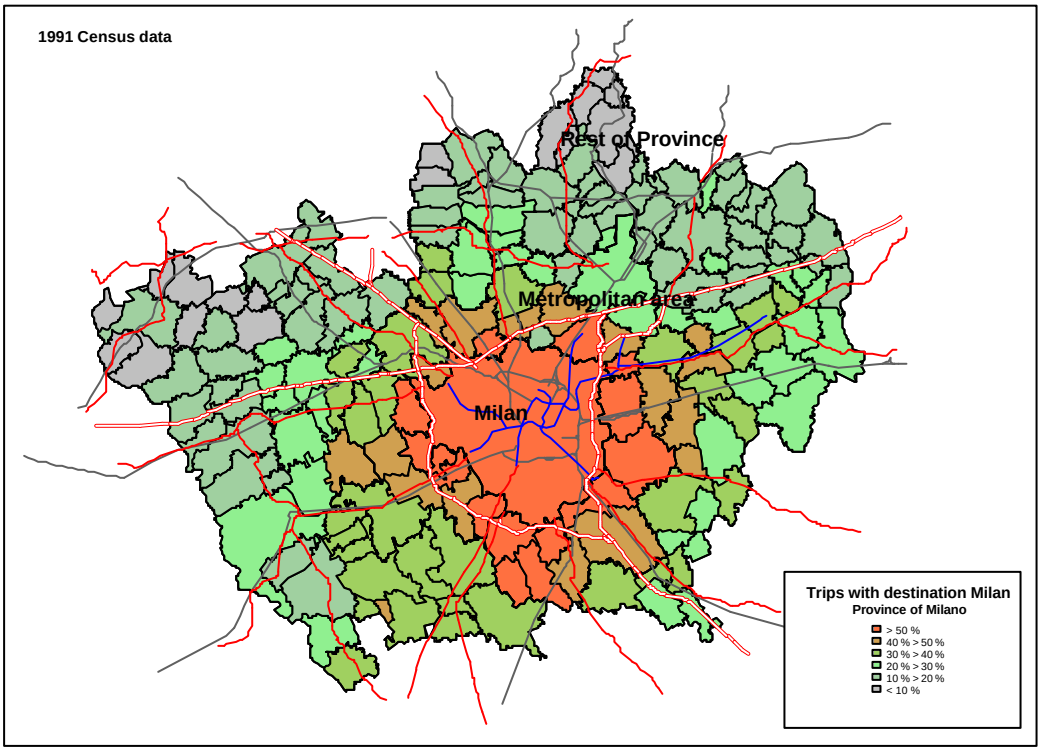

Figure 7: Commuter trips generated by Milan Municipality

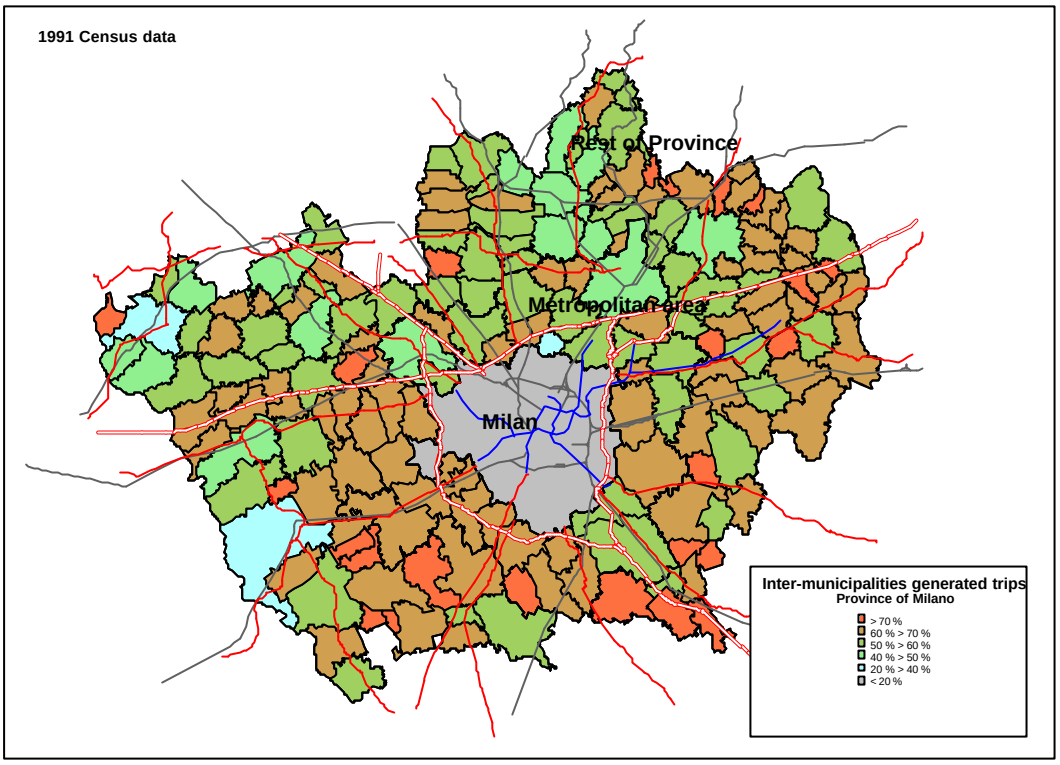

Figure 8: Inter Municipality commuter trips

2. STATISTICAL ANALYSIS (RESULTS OF WP3)

2.1 Development of the average growth rates

In figure 9 the smoothed average annual growth rates of population, employees at the place of work, the total number of dwelling and residential floor prices are showed.

The average growth rate does not reveal the presence of evident economic cycles at this scale, but indeed there is evidence of a common general tendency in the decrease of the growing rate of employees and, less relevant, of population from mid '70. A decrease in absolute numbers of inhabitants can be stated since the late '70 and for the employees since the late '80 (negative annual growth rate).

The growth trends for dwellings and for residential floor prices seem to be not directly correlated to these variables. Considering the whole study area both have a positive tendency despite the null or negative trend of population. This can be attribute to the decrease in the average number of person per households (that leads to a higher consume pro-capita of dwellings) and to the presence, especially in the most central part of the study area, of an increasing number of city-users[7] (i.e. weekly commuters) not detected by census but floor space consuming.

Moreover it can be seen that the average increase of floor price, despite a small decrease in the growth rate in the late '90, is very significant. In this case is to notice that floor space values are very influenced by the variance of the profitability of alternative investment forms.

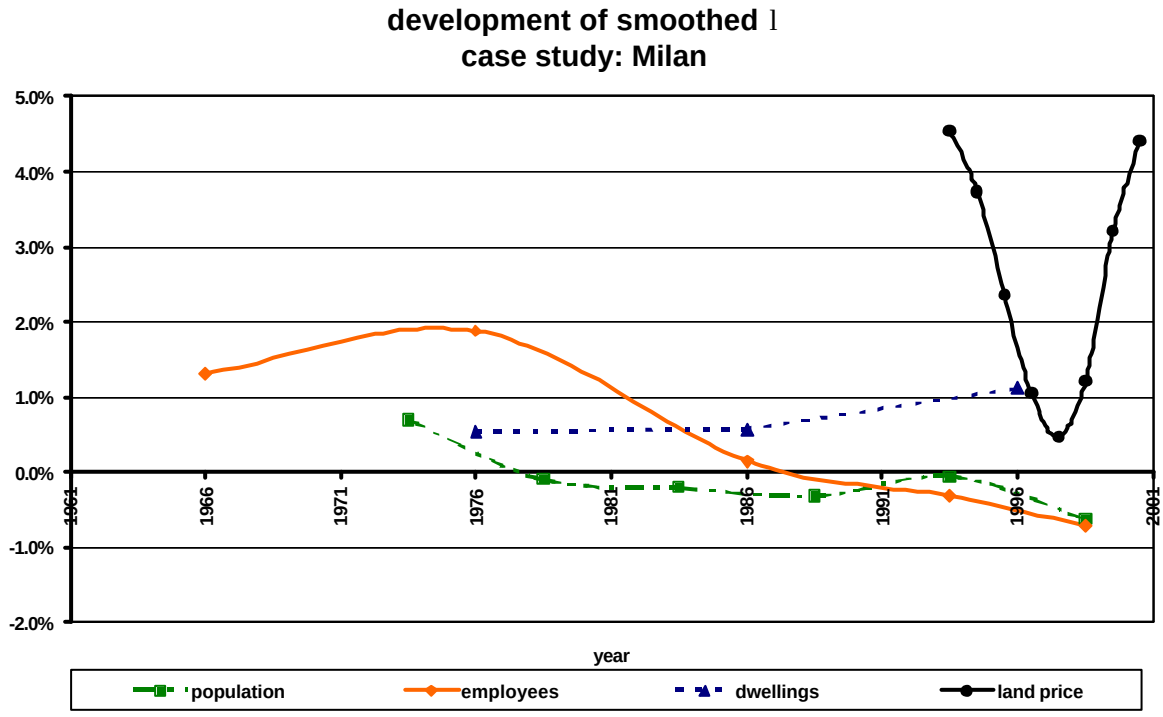

Figure 9: Average annual growth rate of $\tilde{l}^{population}(t)$, $\tilde{l}^{employees}(t)$, $\tilde{l}^{dwellings}(t)$ and $\tilde{l}^{land\ price}(t)$

[7] Martinotti, G., Metropoli, La nuova morfologia sociale della città, Il Mulino, Bologna, 1993; Martinotti, G. et al., La dimensione metropolitana, Il Mulino, Bologna, 1999

2.2 Development of the deviations from the average growth rates

The deviations from the general annual growth path of population, $\tilde{g}^{\,\text{population}}(t)$, (see figure 7), compared with $\tilde{l}^{\,population}(t)$ show that the central Municipality has been loosing population in a quite constant way from mid '70, and that such a population has been moving first in both outer urban ring and hinterland, and then, in the last decade, essentially in the hinterland. Population seems to prefer shifting location preferences in more and more external rings. It is to note that despite the first urban ring follows its own tendency, urban centre and hinterland have a specular behaviour (Figure 10 left top).

The same consideration, about ten years later with a more visible trend, can be noticed in the development of employees at the place of work. From '60 to '80, when the employees growth rate (1% < $\tilde{l}^{\,employees}(t)$ < 2%) was positive, the development was located mainly in the outer urban ring, and partially in the hinterland, where the deviations are between 1 and 3% above the annual growth,. and in the main city. In the last decade, when a decrease in the total number of employees is detected, such decrease is located in the main municipality and in the outer urban ring, while the hinterland, that increases the total number of employees, presents a more and more high value of $g^{\,employees}$ (Figure 10 right top).

These observations make evident the entity of the decentralization process (of population and employees), which have been occurred in the Milan study area since the last decades, and are still going on.

Although a general positive, slowly increasing, growth rate in the total number of dwellings, city centre has had in '70 and '80 negative/null growth rates with a peak in mid '80 (sum of annual deviation and annual growth rate), probably due to the change in land use destinations in the core of the study area. In the same years, outer urban ring and hinterland have had an almost constant and relevant increase of the available dwellings. In the last decade these differences in the deviation values are still visible, but at a lower level: Milan Municipality is now gaining dwellings also in absolute terms, the outer urban ring is now quite near to the average growth rate (but this can be partially explained with the progressive lack of available attractive building areas in such zone) and the deviation value for hinterland is lower than in the past (Figure 10 left bottom).

Deviations from mean values in the case of residential floor spaces show that in the last decade the values in the outer areas was increasing much faster than in the areas surrounding the city centre (data about Milan Municipality are not available for this analysis due to homogeneity problems). But it is interesting to note that in the last years this trend seems to be inverted. The fact that residential floor values rise faster in the hinterland (despite also the supply of available dwellings grows faster in the same zones) means that the demand of such housing location, leading to sprawl, was high. The inversion of the observed phenomenon in the last years is interesting and can, partially, be explained with the renewed interest in more central housing locations (Figure 10 left bottom).

The temporal mean growth rates of $\tilde{g}^{\,\text{population}}(t)$, averaged over the period 1976 to 2000 on the level of communities is depicted in Figure 11. In figure 12 is depicted the temporal mean growth rates of $\tilde{g}^{\,\text{employees}}(t)$. In both figures we can see that the Milan Municipality and the municipalities surrounding Milan on the north side[8] are the ones that mainly lost population and employees. The eastern and southern study area recently developed zones are the ones that were the most attractive for population and employees and so have positive value of $\tilde{g}(t)$.

The spatial pattern indicates that the average growing zones (municipalities) are scattered over the outer urban ring and the hinterland of the Region Milan. However, the urban centre and some

[8] The zones at north of Milan belong to the industrialised area that have had a relevant development before the '70 and for many aspects are very similar to the contiguous main municipality.

adjacent communes have declined (are developing below average). Anyway the patterns showed in pictures 11 and 12 are not completely congruent: in the case of population the average growth rates are distributed among the study area in a quite homogeneous way, with an evident preference for lower density zones in the south-western study area (despite these zones do not have a very efficient public transport network). In the case of employees development the growth rate are more “scattered” over the study area and the influence of transport axes on the zonal attraction is more evident.

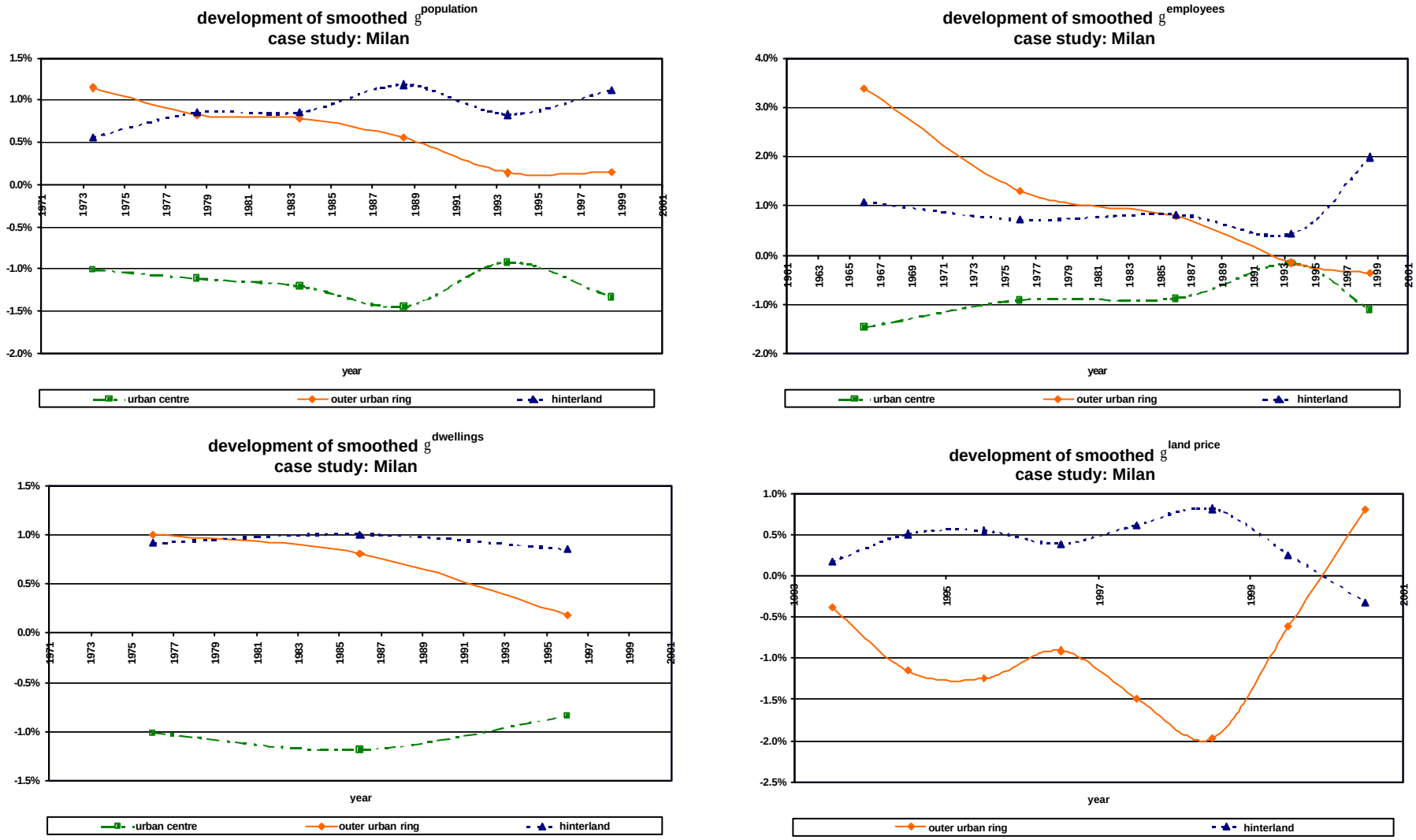

Figure 10: Annual deviations from the average growth rate $\tilde{g}^{\text{population}}(t)$, $\tilde{g}^{\text{employees}}(t)$, $\tilde{g}^{\text{dwellings}}(t)$ and $\tilde{g}^{\text{land price}}(t)$

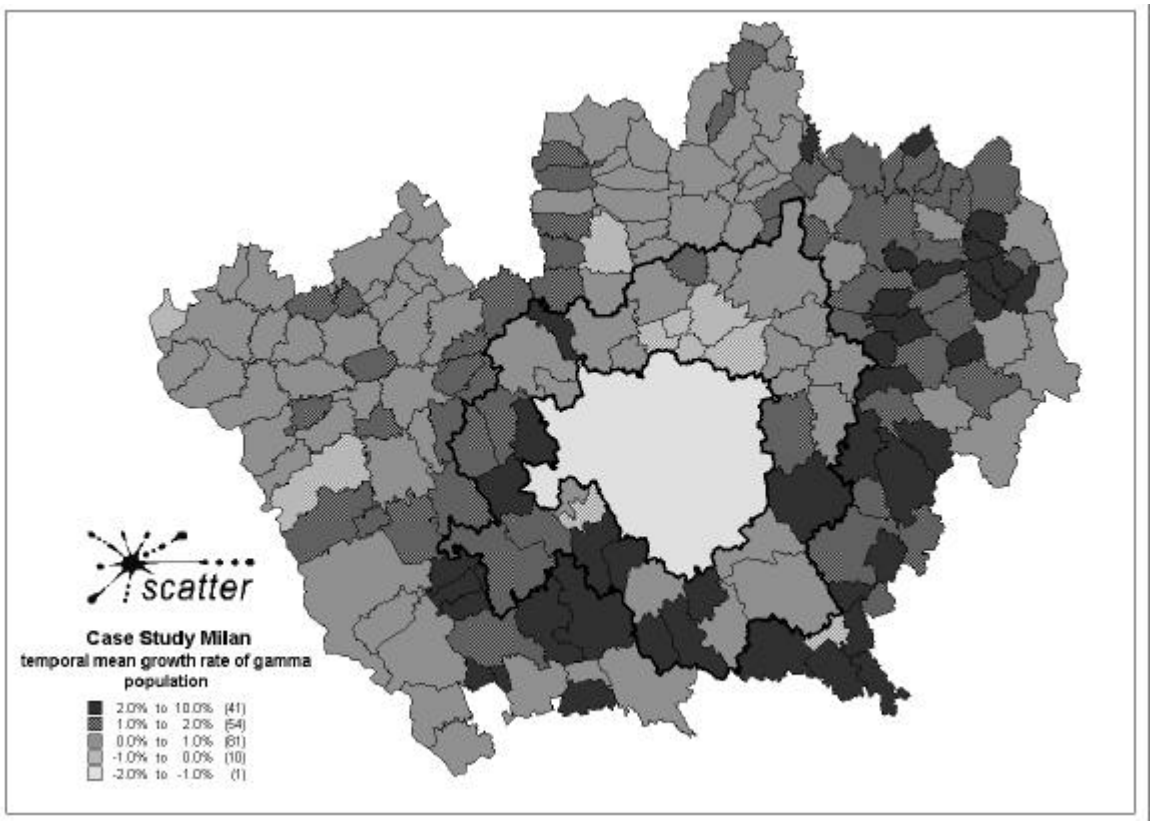

Figure 11: Spatial distribution of the temporal mean growth rate of $\tilde{g}^{\text{population}}$ between 1971 and 2001

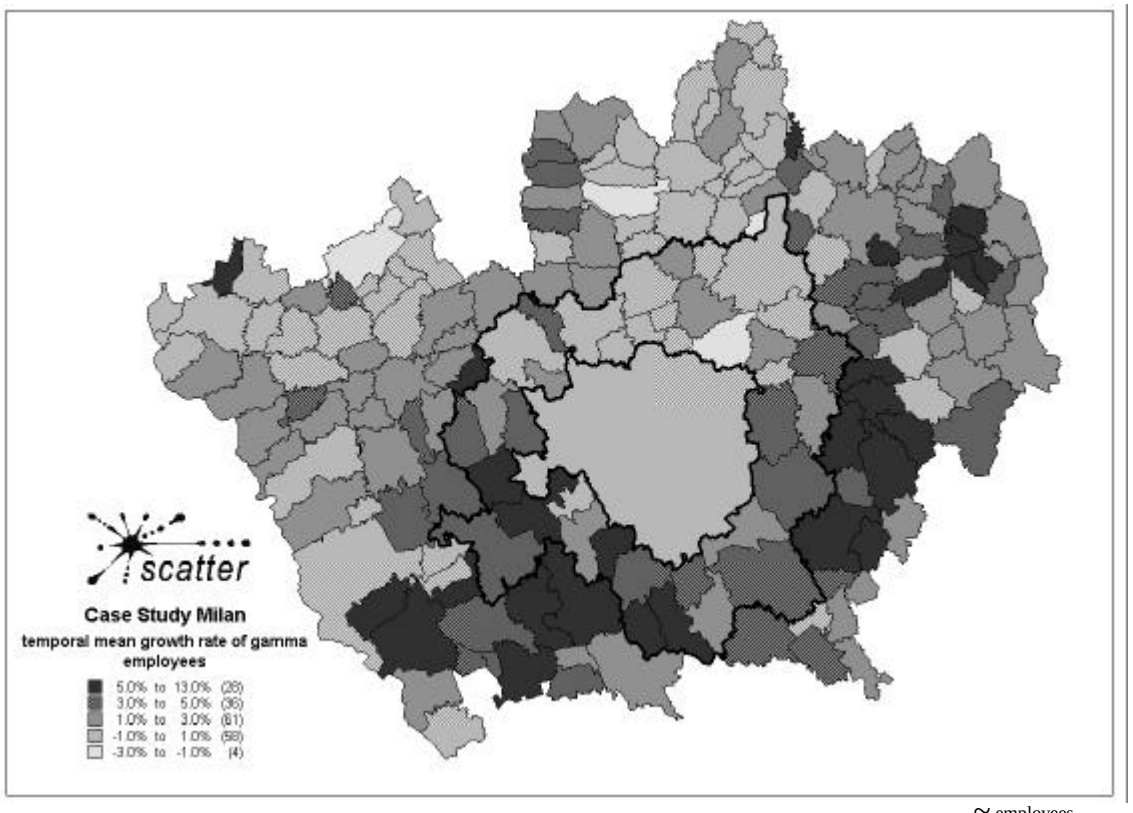

Figure 12: Spatial distribution of the temporal mean growth rate of $\tilde{g}^{\text{employees}}$ between 1961 and 2001

2.3 Development of the concentration-measure H

In Figure 13 the concentration-measure H^{rel} for the four variables population, employees at the place of work, number of dwellings and house prices are shown. All data are scaled to the first year of the data set.

In the Milan study the temporal development of the relative *H*-measure of all variables indicates an increasing de-concentration over the whole investigation period. In fact the concentration-measure *H* for the variable population, employees, number of dwellings and house prices has a very similar behaviour: it increases ts value in an almost linear way, indicating how the de-concentration phenomenon in the study area has had a constant growth. Only for employees variable from '91 to '96 there seems to have been a temporary stop/mitigation of the sprawl process, but after such years it have kept his growth.

The growing of house price variable means that prices in the hinterland rise in relative terms more than the prices in the central municipalities probably due to the increased demand of residential floor space in external areas. It is to note that this indicator has a less linear behaviour over time depending also on the particular (speculative) nature of it.

The conclusion is that a spatial de-concentration effect of all variables (indicators) under investigation in the Milan study exists.

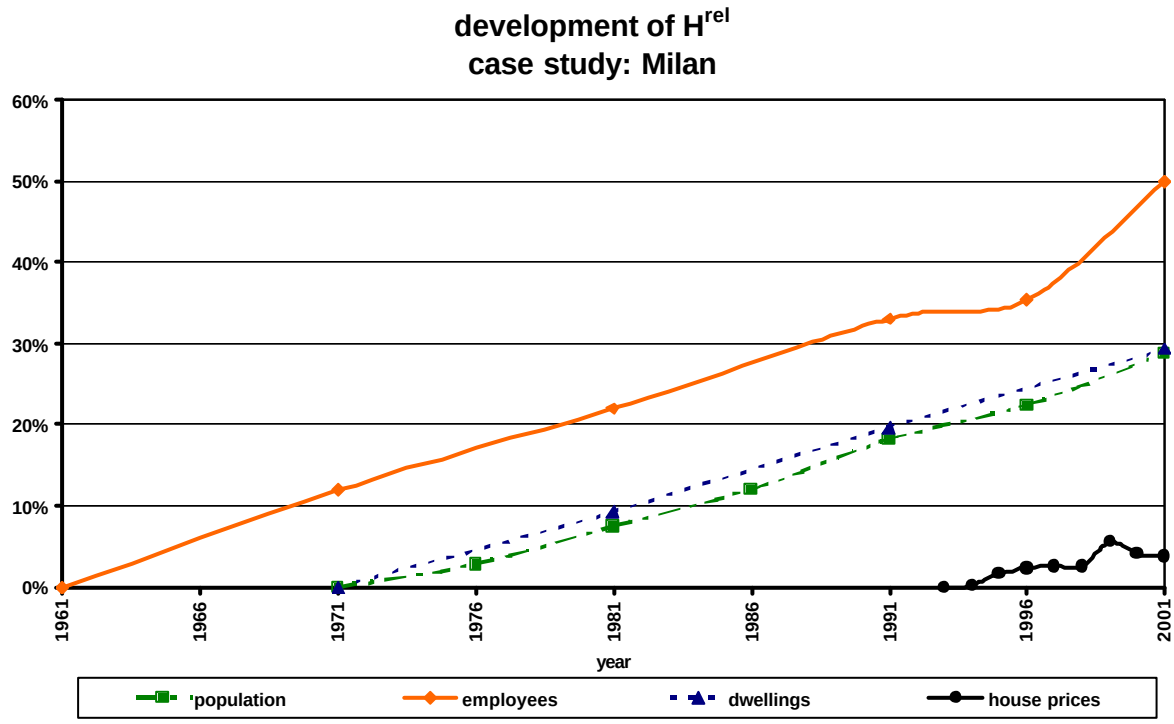

Figure 13: Development of the relative concentration measure $H^{population}(t)$, $H^{employees}(t)$, $H^{dwellings}(t)$ and $H^{land\ price}(t)$

2.4 Development of global and local Moran I

An evident increasing autocorrelation in the location choices of inhabitant per km^2 and in the housing market (dwelling per km^2) can be easily seen in figure 14. The trajectories of the global Moran I for the two indicators show a very similar behaviour, with a medium positive level of spatial autocorrelation.A different trend can, in part, be stated for the employees per km^2 (employment density): despite a general lower value of the Moran I, an increasing autocorrelation

in such indicator can be seen until early '90. After such date the value decrease indicating an almost uncorrelated spatial development.

Considering house prices we can see how the level of the autocorrelation is low, and is lowering over time. Such trajectory of the Moran I depend on the general increase of the land value in the whole study area, that tends to reduce the value's differences between rural and urban housing.

The increase of the spatial autocorrelation during the last decades (population and employment density and dwellings per km^2) indicates, that within the Milan study the economic interactions between the certain municipalities have spread out and slightly increased. The whole area of the urban region has become more homogeneous, since the sprawling effect of the population, employment and dwellings statistically diminish the differences between rather rural and urban municipalities.

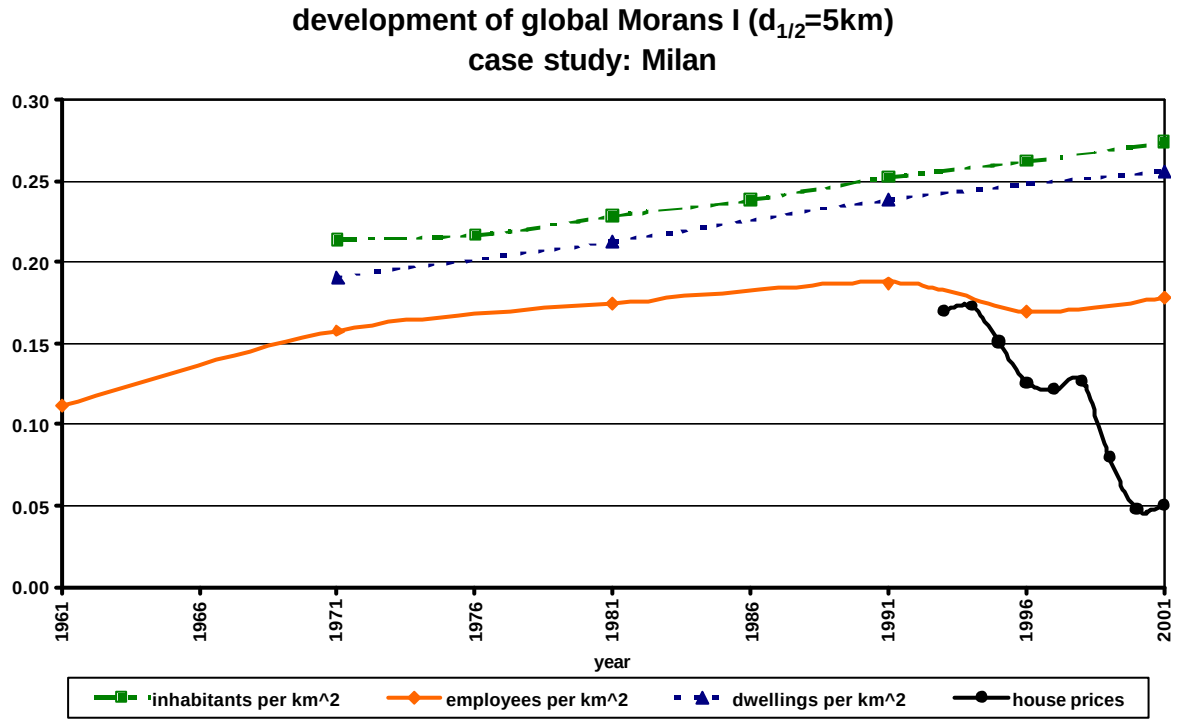

Figure 14: Development of global Moran I of inhabitants per km^2, employees per km^2, dwellings per km^2 and land price

In figures below (figures 15 and 17).it can be observed how the local Moran I indicators for population and employees density are distributed among the study area in the last year available for the analysis. Another set of figures (figures 16 and 18) illustrates the values of the local Moran I considering the differences between the values of such indicators in the earlier and in the later year available. In both cases, for population and employees density, we can see that a high level of autocorrelation is detectable in the central-north part of the study area (Milan and his north surrounding municipalities), the western zones and, at a lower level, in the eastern zones. In the rest of the study area the values of the indicator are more scattered, especially if we consider the employees table. From the difference table we can see how the level of autocorrelation, especially in the western zones, but also in the Milan north surrounding municipalities, was growing in the last decades.

Therefore, an assembly of correlated and uncorrelated municipalities with there neighbours within the Milan study can be identified for the different socio-economic variables under consideration.

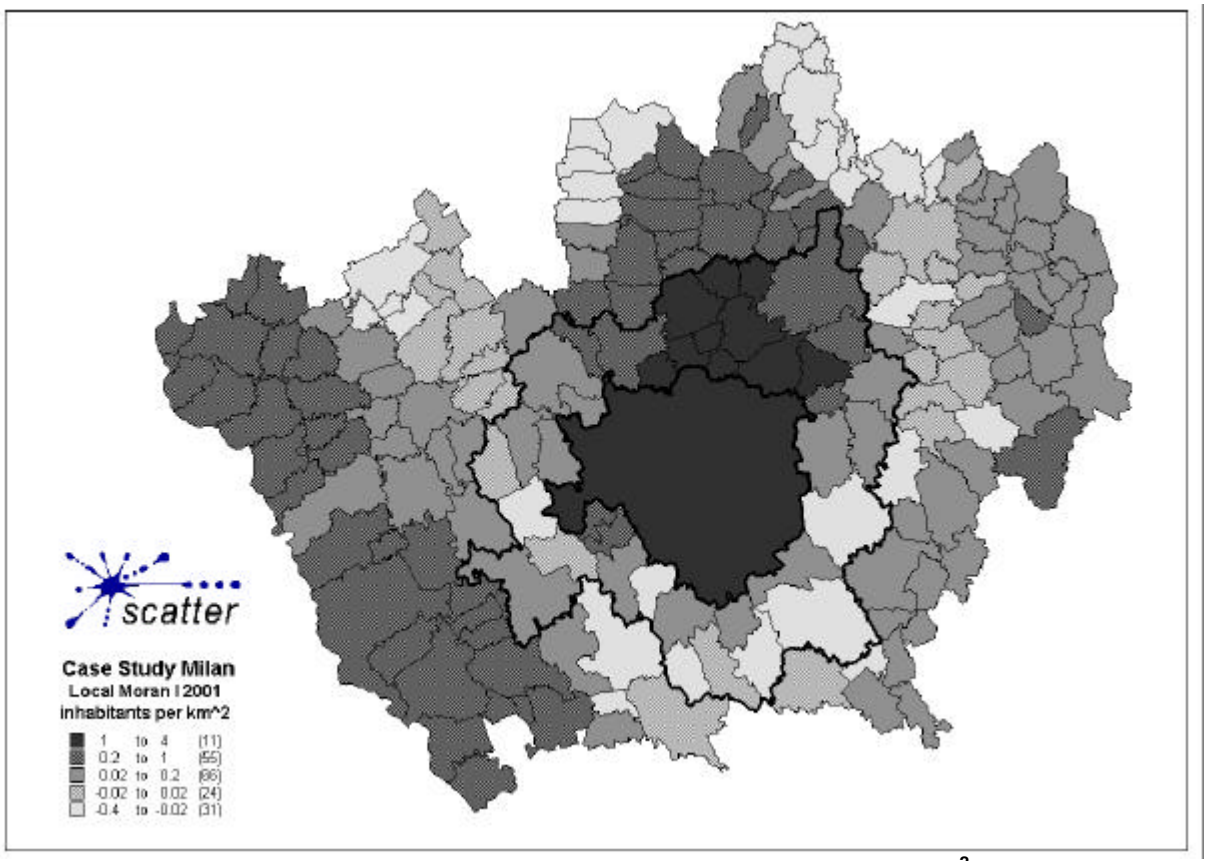

Figure 15: Spatial distribution of Local Moran I for inhabitants per km^2

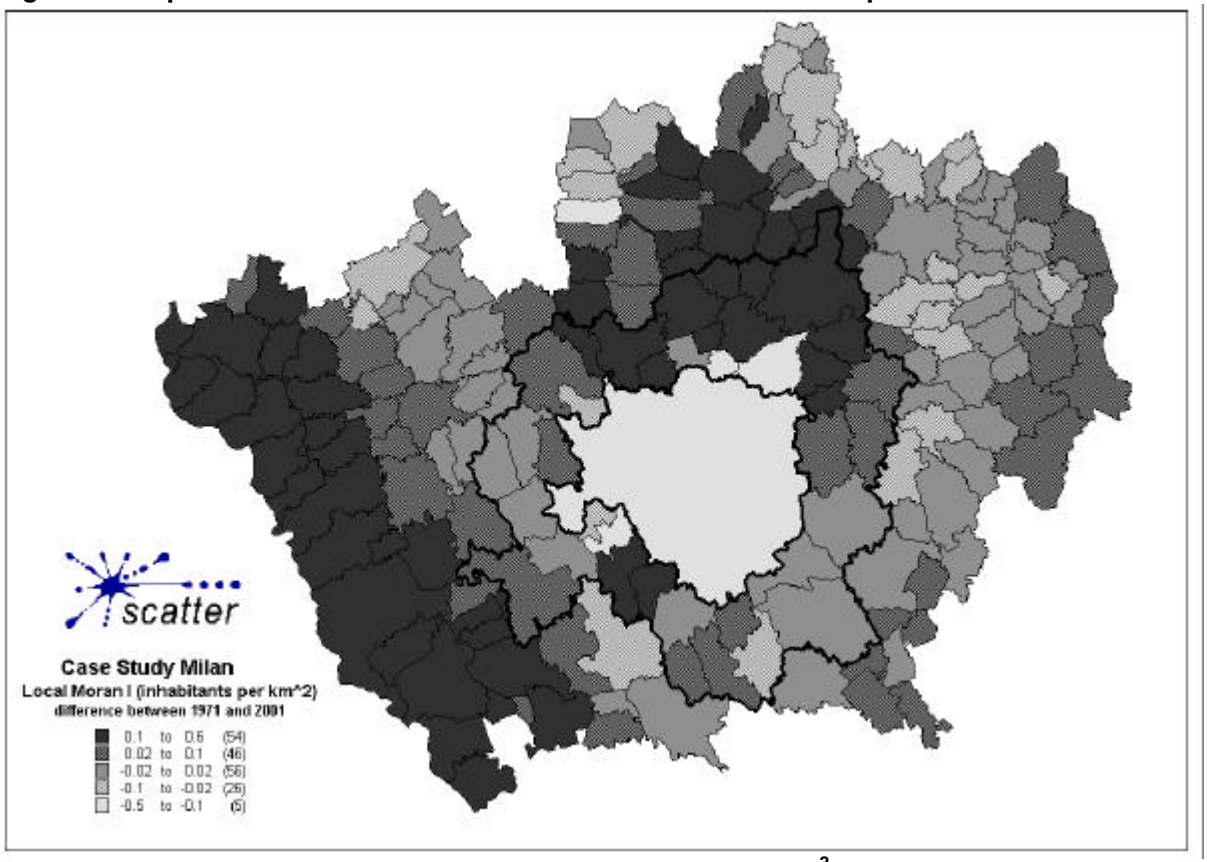

Figure 16: Changes of Local Moran I for inhabitants per km^2

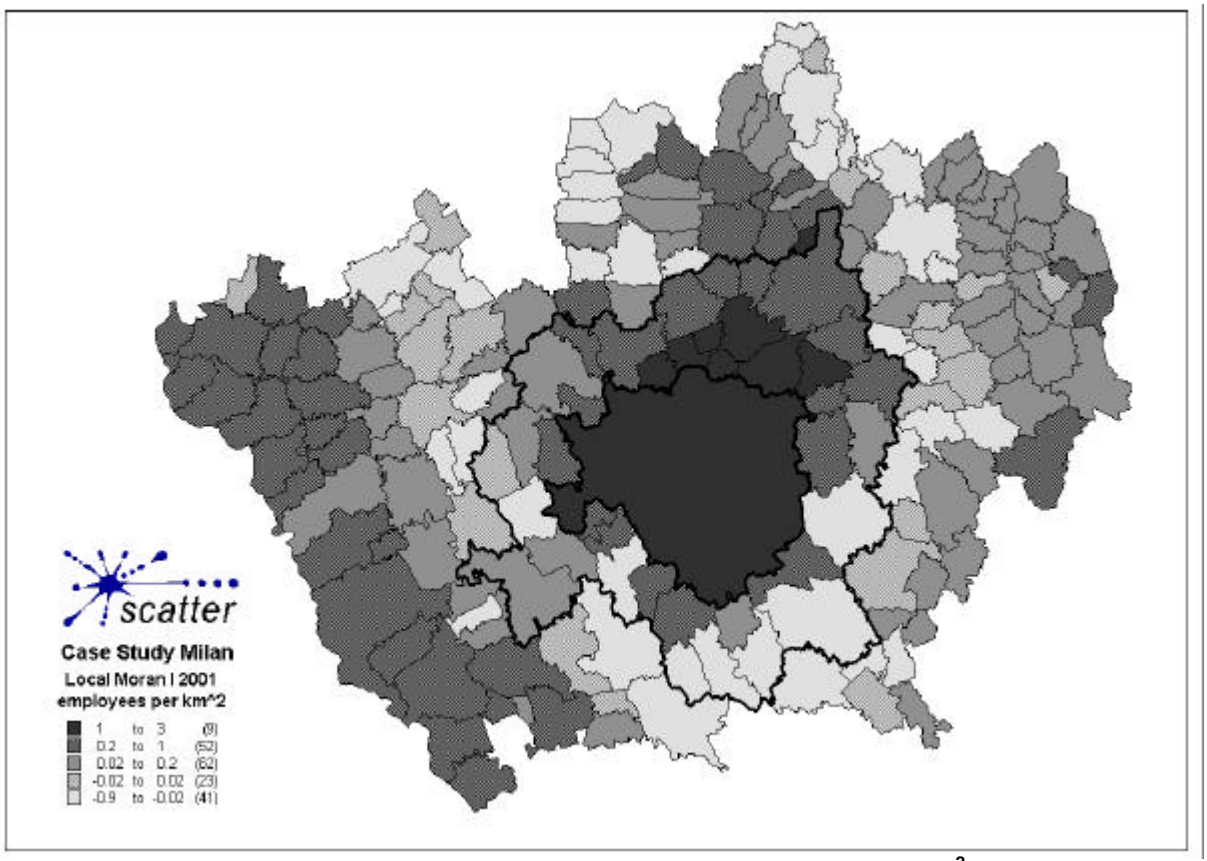

Figure 17: Spatial distribution of Local Moran I for employees per km^2

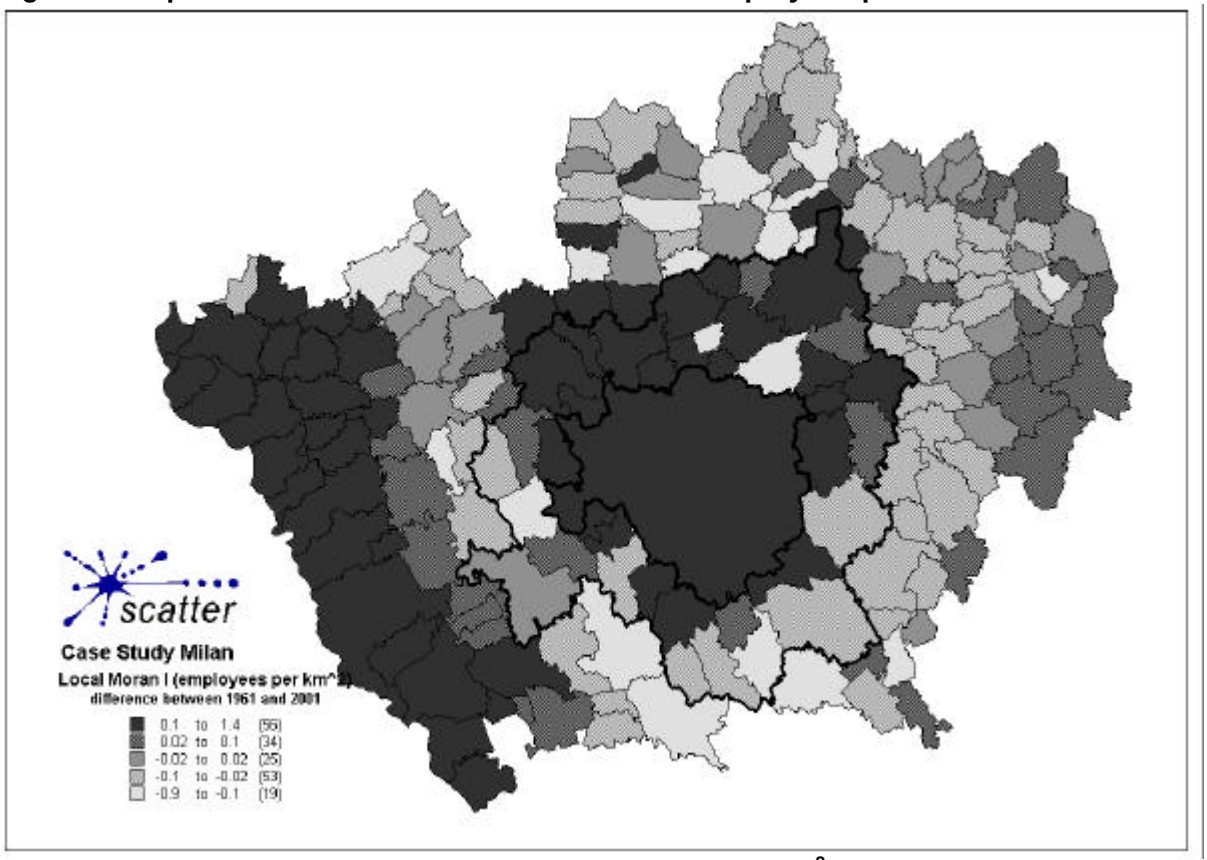

Figure 18: Changes of Local Moran I for employees per km^2

2.5 Summary of the Milan Case Study

All the data analysed in this chapter seem to lead to the same conclusion: urban sprawl occurred in the Milan Province and the entity of such phenomenon is relevant and detectable.

In the above quantitative analysis we saw how all the considered indicators seem to make clear that the Milan study area is becoming more and more homogeneous. In fact, in front of a general decrease of employees and/or population in the central municipality and in its surrounding areas, the hinterland, always have an opposite behaviour that make nearly null the overall phenomenon. An increased homogeneity inside the study area, or better a sort of specialization of wide part of the study area, can be seen by the increasing values of the autocorrelation indicators.

Anyway this interpretation of the phenomenon is influenced by the number of the considered variables in the analysis, and by the zoning scale (municipality). From the interviews reported in the last chapter of the annex, and from other specific literature[9], we can observe how the growing process can generate some differentiation process inside some single municipalities.

Moreover also the indicator purposely implemented for this analysis, the concentration measure H, shows the increasing level of sprawl.

[9] Lanzani, A. et al., Milano, paper

3. PRESENTATION OF THE PLANNING SYSTEM

A brief presentation of the Italian planning system is provided in this chapter.

According to In the Italian ongoing de-centralization process, the national authority has now a marginal role in the definition of the general development strategies, as such a role is demanded to the Regions. This process began in the 1976 (DL 616/76) with the delegation to the Regional Authorities of some institutional powers and was more recently (DL/59/97, known as “legge Bassanini”) completed. National authority still has a strategic role only in the definition of sector plans regarding, for example, transport (national interest network), etc. In a similar way the Regions have to delegate to lower institutional level some of the acquired powers.

It has to be emphasised that in the definition of the planning tools for transport and land-use no coordination is explicitly taken into account between the two sectors. The different tools are then presented in turn, first land-use and then transport.

3.1 Land Use planning system

Figure 19 illustrates the Italian Planning system from the regional to the local level (Regione Lombardia in the Milan case study). The first step is the implementation of the “Piano Regionale di Sviluppo” (*regional development plan*) whose aim is to design the strategic development of the whole area.

At a lower level the Provinces produce the “Piano Territoriale di Coordinamento Provinciale” (*province coordination plan*) with the main aim to collaborate with and to coordinate the single municipalities, with particular attention to the implementation of critical aspects of the single City Master Plans. These aspects are generally those that invest an area wider then the one of the single municipality, and so a common and shared definition of the strategy to act in relation to such problem.

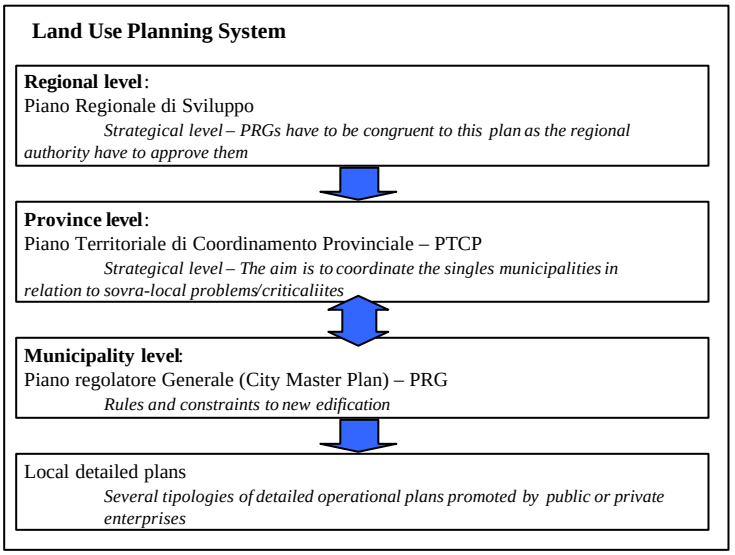

Figure 19: Land Use Planning System in Italy

The planning tool that gives, in practice, most part of the rules and the constraint to land-use is the “Piano Regolatore Generale” (*city master plan*) implemented by the Municipality. This plan defines also the mayor land-use policy at the local level and it has to be coherent with the regional plan as it have to be approved by the Regional Authority. In addition to the PRG there are several typologies of local detailed implementation plans that are used for regulating the construction sector and the formation of the physical townscape and that can be promoted by both public and private enterprises and have to be approved by the municipality Government.

3.2 Transport planning system

In figure 20 a scheme to illustrate the Italian transport planning system is presented. Here the national authority, in spite of what happens for the land-use planning system, has a relevant role in this planning process, as it is the one that gives the sovra-local directives (and the funding) about the main transport and logistic infrastructure investments. The planning instrument is the "Piano Generale dei Trasporti e della Logistica" (*transport and logistic master plan*) and it concerns transport infrastructures and policies of national interest such as motorways, railways etc.

At the lower level we can find the regional government that produces its main transport planning tool, the "Piano Regionale dei Trasporti" (*transport regional plan*), and another tool, concerning the regional environmental aspects that is strongly related with the transport criticalities. The aim of the Piano Regionale dei Trasporti is to provide the transport network favouring the interactions between the different transport modes with a particular attention devoted to the reduction of their environmental impact. Moreover it gives the strategic approach for public transport planning of the whole region and it has also to coordinate the different Provinces in such plans.

For the application of the regional transport plan, the Provinces (and/or the Metropolitan Areas if existing[10]) have to prepare a "Programma triennale dei servizi di TPL" (*Triennial public transport program*). This is made in cooperation with the regional authority (that will co-finance the planned services) and the local authorities with the aim of regulating public transport services supply and defining a minimum standard in such services.

Al local level, Municipalities with more than 30,000 inhabitants prepare the "Piano Urbano del Traffico" (*urban traffic plan*) - with the aim of regulating and optimising the urban road network and the local public transport services supply in the shorter term (2 years) and without relevant infrastructure investment. Moreover Municipalities (or group of municipalities) with more than100,000 inhabitants prepare the "Piano Urbano della Mobilità" (*urban mobility plan*) concerning the same element as the above plan, but at a different (strategical) level, in the medium term (10 Years) and with the possibility to modify the physical transport network.

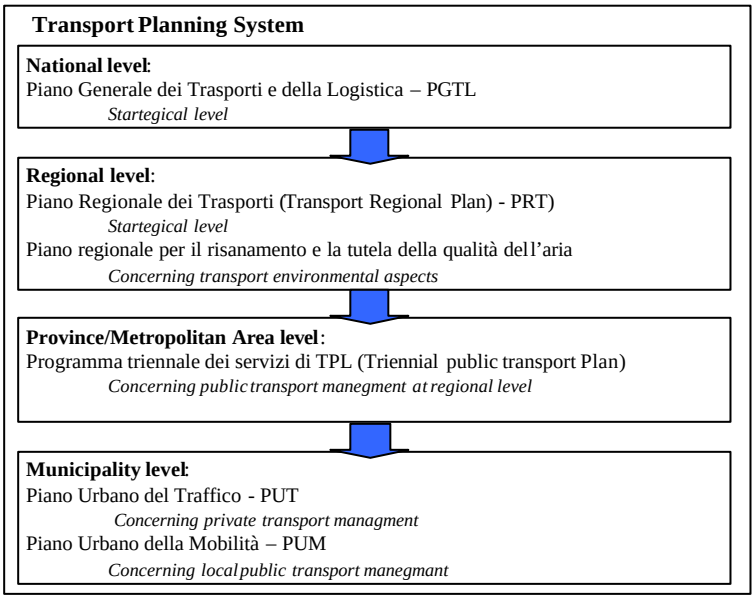

Figure 20: Transport Planning System

[10] In Milan case there is a law instituting the Metropolitan Area, but it has never been formally operating as a regional administrative and planning unit)

4. SYNTHESIS OF THE INTERVIEWS OF EXPERTS AND LOCAL AUTHORITIES (RESULTS OF WP2)

4.1 Introduction

This report is a synthesis of the contents of the interviews that have been carried out to investigate changes occurred in the (Milan) urban area. The purpose of the interviews was to detect and understand the local events and rationale involved in the emergence of urban sprawl, its relevance in the decisional agenda of local authorities and experts, and the overall level of awareness of this particular urban phenomenon.

The synthesis is based on a recursive process of contents (or text) analysis and concept mapping according to which elementary concepts found in the interviews' transcripts and relevant to the synthesis purpose are first selected and then grouped together into higher-level thematic categories. The latter are built during the analytical process on the basis of the map of relationships drawn by the interviewees among the different concepts. This methodology is especially appropriate for the analysis of semi- and un-structured interviews as those used in this project. The contents of each interview are treated as a different commentary of the same subject and during the analysis emerging themes, correspondences and contradictions can be detected. The final report however does not detail the interviewees' individual comments by means of references or quotations but it organizes and delivers their perspectives of the complex network of issues surrounding the concept of urban sprawl.

4.2 Structure of the report

The analysis of the interviews conducted on the Milan case study has lead to the definition of several categories of themes, which have been used to draw up the structure of the report. These can only partly be attributed to the bias given by the interview framework and have been looked at as original ideas of the group of interviewees.

1. The identification of population migration flows as a privileged perspective upon the changes occurred in the locational patterns of the Milan urban region.

2. The main factors, which have determined the changes in the locational choices.

3. The spatial and functional structures as a sum of these locational choices.

4. The characters (and impacts) of the different urban structures.

5. Definitions and typologies of urban sprawl.

6. Urban policies and the management of urban change and urban sprawl.

The issue of the awareness of local authorities has been investigated in different ways:

1. Through the analysis of the interviewees' direct comments on the level of sensitivity and knowledge displayed by local decision makers

2. Through the search for implicit references to the above mentioned sensitivity

3. Through the general level of awareness displayed by the interviewees themselves.

A further remark should be made with regards to the spatial scale of analysis adopted as a framework for the interviews. All the respondents have negatively commented on the aptness of the proposed scale to represent the growing spatial extension of the investigated phenomenon.

However, as commented later in this report, despite the common identification of sprawl as a global problem, the recommended "solutions" are locally based and adopt a "bottom-up" approach and make little or no reference to a large-scale of intervention.

4.3 Migration flows and locational choices in the milan region

During a period of nearly twenty years between the mid 70s and mid 90s, the city of Milan and the immediately surrounding urban centres have faced a continuous loss of population (about 1/3 of the total population), which relocated mainly in the urban centres along the second urban ring. During the same period, and particularly in the last ten years, new tertiary, financial and cultural activities have settled in the core of the city. More recently the loss in the area has been mitigated by the influx of new types of population, which are hardly detected by the census data. These are mainly immigrants from east European and North African countries and "city users", the latter consisting of population which daily or weekly commute to the city centre not only for work and business purposes, but also for leisure.

Several factors have influenced more or less directly the location choices of the different types of population and subsequent migration flows.

1. **Planning regulations and policies** The first policy that imposed a limit to the new edifications within the city administrative boundaries was the Milan Master Plan in 1953. It caused a lack of available areas within Milan and the beginning of the expansion in the surrounding Municipalities. But the sprawl grows mainly from mid '70 to mid '90 also as a consequence of the urban policies implemented in the whole area. More recently (in the last 10 years) regeneration policies have been undertaken by local authorities governing the municipalities surrounding the city of Milan as an attempt to compensate the growing deterioration of peripheral areas of both Milan and the secondary cities of metropolitan region, due to this earlier phase of migration. The side-effects of these regeneration policies have been the creation of new attraction nodes on the metropolitan area and of more local trends of de-urbanisation from the secondary centres towards their peripheral areas due to the increased costs of housing in the central areas.

2. **Households' life-cycle and cultural factors.** The search for residential areas is driven by the attempt to meet lifestyle requirements (living space, general and service accessibility) which on one side change with the households' lifecycle and on the other are influenced by ideological and cultural trends such as those of the garden city, "small is beautiful", the appeal of a better quality of the environment. The result is an ever-changing concept of "quality of life" and a continuous shift in locational trends from de-urbanisation to re-urbanisation. The factors influencing the spread in the locational choices can be summarised as follows:

   - High standards of housing in suburban areas are preferred to a "perceived" lack of efficiency of the city.

   - High dimensional standards are preferred. Housing prices allow to buy more square meters in peripheral areas than in central ones.

   - The real estate market is driven by this growing demand towards the production of mainly residential areas, with a low urban "value".

   - The planning system and the decisional arenas reinforce these trends favouring the spread of residential areas.

   On the other hand we can now notice a tendency to a form of re-urbanisation, led by changing household requirements (due to different life cycles, e.g. when sons grow and left parents houses) and by increasing transport difficulties (due to increasing congestion).

3. **Economic factors.** Increasing land values in central areas are a significant cause of population emigration. Less wealthy households, unable to meet the increasing costs of housing move out of the city towards poor and deprived peripheries which are still within economically affordable distances from the central area and its employment basin. More wealthy, bourgeois households instead can afford to move to a farther distance from the centre where higher housing and environmental standards are to be found.

4. **Progressing decrease in the quality of life in the city of Milan.** Increasing pollution, reduced access to services, lack of open and green spaces. The city becomes, in facts and in its residents perception, a hard place for families to live in. On a different note the city core has been able to increase those factors able to attract types of population like the "city users" whose definition of quality of life rests on the satisfaction of different requirements: high level employment centres, cultural and leisure facilities.

5. **Locational freedom,** granted by the use of private means of transport, mainly cars. Indicators show that the level of land consumption for residential uses grows according to the growing rate of motorisation.

6. **Non-internalisation within households' budgets of the negative externalities generated by the use of car.** The costs of negative externalities such as traffic, congestion, pollution and land and infrastructure consumption are only met by public local authorities; households therefore suffer less living expenses and are therefore driven to chose location whose accessibility is only supported by private transport.

7. **Minor influence of infrastructures and public transport supply.** Areas within the Milan urban region facing the more significant trends of growth are, particularly in the last decade, not strictly related to transport infrastructures and public transport supply.

4.4 Spatial and functional structure of the milan urban region

The sum of these different factors and their shifting relevance during time as produced recursive waves of de-urbanisation and polarisation which have left their sign on the spatial and functional structure of the Milan urban region. This is not characterised by obvious areas of functional specialisation. Even within the urban centre, functions are not easily detectable. However different overlapping systems of functional and spatial characterisation can be recognized.

A patchwork system based on the growth history of the Milan urban region and characterised mainly by the differences between:

- areas marked by intense industrial developments in Milan periphery and in surrounding municipality, whose legacy is a compact urban fabric dotted by large dismissed brownfields presently subject to re-use interventions;

- vacant or slightly urbanised areas mainly of agricultural land-use presently subject to a scattered development on new tertiary developments;

- areas characterised by a compact growth along the main transport infrastructures.

A monocentric system according to which the core of Milan still holds the primacy of "higher" urban functions while residential areas have been mainly decentralised toward the periphery as a result of the expulsion dynamics described above. A change in the structure of the urban core is not currently foreseeable and such structure is confirmed by commuting data which show the capacity of Milan to attract more and more "city users".

A "wave" system mainly of urban quality. Subsequent cycles of population emigration from the central areas of Milan and of the immediately surrounding urban centres, have determined a structure of waves along which are distributed characters such as urban quality (identified by

levels of maintenance, quality of public spaces, types of urban functions), land values, social classes and households' typologies (families rather than singles, wealthy rather than poor, old rather than young households).

A polycentric system consisting of the historical urban centres and a system of decentralised local authorities. These are characterised by high standards of quality of life, high accessibility and higher per-capita supply of public services. They offer an alternative sub-urban way of life to the one offered by the north-American archetype. These centres are often depicted as the most effective response to the negative aspects of sprawl-like growth.

Where historical territorial identities and communities have been preserved, the quality of the urban and settlement environment has been maintained. The peripheral areas of Milan and of the other urban centres have instead been swept by process of poor quality sub-urbanisation, with little or no control or interest by the planning authorities and these identities have gone lost.

4.5 The structure of mobility patterns

The spatial and functional structure of Milan and its urban region determines, on one hand the patterns of mobility and therefore the transport demand, and on the other hand which types of transport policies can effectively be pursued. The latter will be described in details in the section dedicated to the policy measures.

The overlapping of the different spatial and functional systems described so far, creates a structure of several micro-nodes immersed in a territory of dispersed urbanisation characterised by different gradients of environmental and urban quality and by different levels of activity. This structure has generated a quantitative increase of mobility. Moreover, changes occurred in lifestyles and "workstyles" have added to the quantitative increase a qualitative fragmentation of mobility and commuting patterns.

Several types of emerging types of mobility can be detected:

Intra-urban mobility. In the central areas of the historical core of Milan the increase of mobility has been mainly counterbalanced by the supply of public transport, which collects over 70% of the total trips. This has been possible due to the compact nature of the urban fabric where efficiency thresholds can be met. In the urban areas outside the core the public transport system still collects nearly 50% of the total mobility, but this level decrease according to the distance from the urban core.

Radial mobility between Milan and the surrounding areas. Due to the spillover of residential areas in the first and second urban rings, and to the preservation of the Milan urban core not only as the main "high added values" employment centre but also as cultural and leisure centre, the radial mobility has increased dramatically in the last ten years. However the lack of functional specialisation areas within the city and the dispersed nature of the residential settlements hamper a clear identification of the origins and destinations of these commuting patterns.

Random mobility. This definition is used to describe the increased complexity and loss of systematicity of trips and it could be seen as an evolution towards a higher level of randomness of the radial mobility. It affects mainly the external and more scattered areas of the urban region where mobility doesn't consist only of commuting (home-work) patterns but also of fragmented chains of trips involving shopping and leisure activities.

Horizontal mobility. A mobility pattern and a subsequent transport demand is arising from external areas which are building, following a planned scheme or mostly through processes of self-organisation, to new forms of autonomous (from the Milan node) and self-contained functioning. It is mainly found on the east-west piedmont alignment and in the northern areas of the region. The level of infrastructure in this case is particularly weak or still based on radial relationship with Milan.

These patterns can be considered as the trademark of the spatial organisation of the region and it is only when and if they impact on a weak transport infrastructure that they produce negative effects such as congestion.

4.6 Definitions of sprawl

One of the most frequent aspects which go along with the definition of urban sprawl seems to be the absence of a proper level of quality of life and of the living and residential environments. Several references exist with regards to which factors contribute to the composition of the concept of "quality of life": the aesthetic quality and the level of maintenance of the built environment, the supply and standard of the public spaces, the quality and typology of settled functions. The identification of these factors is made possible also thank to a shared and spread sensitivity among experts and local authorities for the issue of "urban quality". Problems emerge due to the increasing number of different representations and concepts of "urban quality" among those looking for a suitable location, which can meet their personal requirements.

In this sense sprawl can be defined as lifestyle, based on the choice to favour individualistic values, to satisfy only those individual and family needs, which can be met by housing.

▪ The sprawling residential suburb

Where this lifestyle produce residential suburbs which despite the high quality of the housing stock lack all the elements usually associated with the "urban" character, and the public spaces and sense of community which are a significant aspect of urban life, urban sprawl becomes the outcome of an increasing loss of identity of the space and of the population. The originally chosen condition of isolation can only apparently and partially be overcome by the freedom of movement granted by the use of private transports. The level of infrastructure remains poor and in time becomes congested with traffic preventing the full exploitation of the dispersed settlements and of its recreational and employment potentials.

▪ The sprawl of deprived peripheries

The peripheral areas of main and secondary centres, left aside by regeneration policies and new planning interventions, grown during the early stages of outwards emigration, have been the main "catchment's basin" for groups of population looking for residential areas at low prices and within affordable travelling distances from the main centre. This type of sprawl is characterised mainly by high densities and deprived social and physical environments.

▪ Non-residential sprawl

It's the sprawl of highly land-consuming and highly accessible activities such as commercial centres and the leisure clusters located on the main transport infrastructures. A jumble of mixed functions that has erased the original historical structure of the region.

4.7 Urban policies and management of urban change

When the issue of urban policies is raised the main reference is to necessary but unfortunately missing policies. There is a common agreement on the lack of a strategic and shared vision for the urban region, of a proper institutional level or form for government of this typology of urban changes. Policies and institutions should be able to rearrange the fragmentation of the social fabric and of the urban space within the proper spatial and temporal scale and to subtract the government of urban changes from the hands of private speculative interventions.

▪ The institutional system

With regards to the city of Milan, an increased level of awareness and sensibility on the problems related with the sprawl is shared. But despite this, policies implemented by the different authorities are often inconsistent or conflicting: e.g. Milan municipality through the redefinition of the administrative boundaries of inner city districts, whose number has been reduced from 20 to 9, has locally implemented the reform of the institutional system. Despite positive outcomes such as the re-organisation of public services, this reform has reduced the identity features of each district and weakened the possibility for local authorities to design effective policies for the regeneration of local individual sites as well of the whole city.

At the regional level, the management of urban sprawl doesn't depend on the identification of a new institutional level with the power to enforce planning regulations and implement planning policies at the proper scale. Scale is perceived less as a political problem than an analytical issue. The suggested solutions all refer to an effective coordination of existing powers, to a multi-governance of a region whose spatial dimensions vary with the different planning issues.

▪ Regeneration policies

Regeneration policies can be divided into interventions for the re-use of brownfields and new developments on vacant areas.

Both are mainly of private initiatives (public initiatives are acted only as a support to prevent the de-functionalization of such areas when the private initiatives are going to fail this goal), but none is integrated within a strategic or long term planning framework. Speculative decisions dominate over strategic ones. Private interventions for the re-use of dismissed areas are often aiming to create a development of mixed "valuable" functions in order to maximise the expected returns on land values. However these goals are not always met, and often in such cases public interventions are needed to give to such areas some elevate function. The relationships between demand and supply set by the housing market often push these interventions towards the development of mainly residential areas.

▪ Transport policies

The possibility to design transport policies and to efficiently implement them varies with the different types of mobility observed. As a general rules policies favouring the shift from the private to the public mean of transport and the reinforcement of relationships among functionally relevant centres are preferred to policies promoting a general relief from congestion.

Radial mobility involves trips from outside the city of Milan towards its centre. The possibility to increase the share of trips using public transport rests on the ability of the adopted policies to move as many users as possible from one mean of transport of the other. In the areas characterised by highly dispersed settlements and low density this requires a breaking in the mode of transport, which is often perceived as problematic. Suggested solutions try to exploit this "breaking points" as an advantage rather than as a loss of time by providing areas where the modal split takes place with a range of mixed services. In this regard road pricing policies are often less effective than park pricing policies if the main goal is to reduce the use of private means of transport.

On a similar note an improvement in the management of "rendez vous" between metropolitan railways, circular roads and underground is highly required.

▪ Sprawl as a global problem with local solutions

Policies which can effectively contain the growth of urban sprawl should aim at restoring of the system of centralities through the reconstruction of local identities and urban communities as well as of functional specialization and structured and co-operations among urban centres. A more

structured and therefore more manageable mobility is one of the expected virtuous effects of such policies.
There is a significant demand for the development of co-operation policies coming form local authorities but due to the lack of enforcing and planning powers of the higher institutional levels such demands remain often unanswered. However some areas have successfully experimented on a bottom-up approach to the design and implementation of sovra-local urban policies. Such innovative approach has revealed itself as an effective way to enforce the polycentric and plural functioning of the urban systems, which can counterbalance the growth of urban sprawl.

4.8 Awareness as a knowledge issue

▪ The scale of analysis

The scale by which problems are looked at, change their perception and definition.

Two different perspectives can be suggested to analyse the Milan area: a local scale, which looks at Milan and its immediate surroundings and allow detecting a diffusive type of growth; a wider, regional or even interregional scale, which identifies Milan as one node in a polycentric system and as part of a compact conurbation extending to the north and to the east. Urban sprawl, which doesn't refer only to diffusive growth, should be observed at the latter scale.

At the same time, the temporal scale of observation should be "handled with care". As reported above there has been a first wave of urban growth, mainly located along transport infrastructure (railways and underground) and a second wave, with higher penetration force and wider extension, characterised by infill processes of areas not necessarily connected to the infrastructure system.

▪ The set of data

The knowledge and data collection system cannot exclusively be based on census information given the census structural inability to reveal phenomena, which have a great influence on the actual demographic and employment structure of Milan. However the interviews have given no suggestion with regards to alternative forms on information gathering.

▪ The planner changing agenda

A major source of information on the growing awareness on urban sprawl and its related problems can be found in the changes effecting planners and decision makers' agendas.

A part from the reported innovations in the definition of bottom-up forms of co-operation between local authorities which prove an awareness towards the changing scale of the problem, a growing attention is devoted to the relationships between transports and new developments or brownfields' regeneration projects.